

Appendixes

Search Strategy

Focused Search 1: November 2006

<u>#3</u>	Search "Weight Gain"[MeSH]	<u>12977</u>
<u>#7</u>	Search "Pregnancy"[MeSH] OR "Postpartum Period"[MeSH]	<u>583182</u>
<u>#9</u>	Search #3 AND #7	<u>1939</u>
<u>#10</u>	Search gestational weight gain	<u>1694</u>
<u>#11</u>	Search #9 OR #10	<u>3130</u>
<u>#12</u>	Search #9 OR #10 Limits: English, Humans	<u>1681</u>
<u>#15</u>	Search ("Outcome Assessment (Health Care)"[MeSH] OR "Pregnancy Outcome"[MeSH]) OR "Outcome and Process Assessment (Health Care)"[MeSH] Limits: English, Humans	<u>287919</u>
<u>#16</u>	Search #12 AND #15 Limits: English, Humans	<u>297</u>
<u>#17</u>	Search "Pregnancy Outcome"[MeSH] Limits: English, Humans	<u>19056</u>
<u>#18</u>	Search #12 AND #17 Limits: English, Humans	<u>255</u>
<u>#19</u>	Search ("Weight Gain/ethnology"[MeSH] OR "Weight Gain/genetics"[MeSH]) Limits: English, Humans	<u>97</u>
<u>#20</u>	Search #12 AND #19 Limits: English, Humans	<u>21</u>
<u>#22</u>	Search "Socioeconomic Factors"[MeSH] Limits: English, Humans	<u>154168</u>
<u>#23</u>	Search #12 AND #22 Limits: English, Humans	<u>183</u>
<u>#27</u>	Search "Body Weight"[MeSH] OR "Body Mass Index"[MeSH] Limits: English, Humans	<u>125469</u>
<u>#28</u>	Search #12 AND #27 Limits: English, Humans	<u>1438</u>
<u>#29</u>	Search #28 AND #15 Limits: English, Humans	<u>257</u>
<u>#31</u>	Search "Obesity"[MeSH] Limits: English, Humans	<u>49340</u>
<u>#32</u>	Search "Obesity"[MeSH] Limits: All Adult: 19+ years, English, Female, Humans	<u>22784</u>
<u>#33</u>	Search #32 AND #12 Limits: All Adult: 19+ years, English, Female, Humans	<u>131</u>
<u>#36</u>	Search #9 OR #10 Limits: English, Publication Date from 1990, Humans	<u>1453</u>
<u>#38</u>	Search "United States"[MeSH] Limits: English, Publication Date from 1990, Humans	<u>364130</u>
<u>#39</u>	Search #38 AND #36 Limits: English, Publication Date from 1990, Humans	<u>135</u>

#42	Search iom	<u>682</u>
#43	Search #42 AND #12	<u>19</u>
#45	Search #43 OR #39 Limits: English, Publication Date from 1990, Humans	<u>150</u>
#47	Search ("Counseling"[MeSH] OR "Directive Counseling"[MeSH]) Limits: English, Publication Date from 1990, Humans	<u>11733</u>
#48	Search #47 AND #12 Limits: English, Publication Date from 1990, Humans	<u>13</u>
#53	Search "Body Weights and Measures/instrumentation"[MeSH] Limits: English, Publication Date from 1990, Humans	<u>13</u>
#54	Search Body Weights and Measures[MeSH]	<u>275772</u>
#55	Search #12 AND #54	<u>1030</u>
#66	Search Anthropometry [mh]	<u>70445</u>
#67	Search #55 AND #66	<u>350</u>

KQ1: OUTCOMES

#3	Search "Weight Gain"[MeSH]	<u>12977</u>
#7	Search "Pregnancy"[MeSH] OR "Postpartum Period"[MeSH]	<u>583182</u>
#9	Search #3 AND #7	<u>1939</u>
#10	Search gestational weight gain	<u>1694</u>
#11	Search #9 OR #10	<u>3130</u>
#12	Search #9 OR #10 Limits: English, Humans	<u>1681</u>
#15	Search ("Outcome Assessment (Health Care)"[MeSH] OR "Pregnancy Outcome"[MeSH]) OR "Outcome and Process Assessment (Health Care)"[MeSH] Limits: English, Humans	<u>287919</u>
#16	Search #12 AND #15 Limits: English, Humans	<u>297</u>
#17	Search "Pregnancy Outcome"[MeSH] Limits: English, Humans	<u>19056</u>
#18	Search #12 AND #17 Limits: English, Humans	<u>255</u>

KQ2: SES

#19	Search ("Weight Gain/ethnology"[MeSH] OR "Weight Gain/genetics"[MeSH]) Limits: English, Humans	<u>97</u>
#20	Search #12 AND #19 Limits: English, Humans	<u>21</u>
#22	Search "Socioeconomic Factors"[MeSH] Limits: English, Humans	<u>154168</u>
#23	Search #12 AND #22 Limits: English, Humans	<u>183</u>

KQ3: IOM Guidelines

<u>#27</u>	Search "Body Weight"[MeSH] OR "Body Mass Index"[MeSH] Limits: English, Humans	<u>125469</u>
<u>#28</u>	Search #12 AND #27 Limits: English, Humans	<u>1438</u>
<u>#29</u>	Search #28 AND #15 Limits: English, Humans	<u>257</u>
<u>#31</u>	Search "Obesity"[MeSH] Limits: English, Humans	<u>49340</u>
<u>#32</u>	Search "Obesity"[MeSH] Limits: All Adult: 19+ years, English, Female, Humans	<u>22784</u>
<u>#33</u>	Search #32 AND #12 Limits: All Adult: 19+ years, English, Female, Humans	<u>131</u>
<u>#36</u>	Search #9 OR #10 Limits: English, Publication Date from 1990, Humans	<u>1453</u>
<u>#38</u>	Search "United States"[MeSH] Limits: English, Publication Date from 1990, Humans	<u>364130</u>
<u>#39</u>	Search #38 AND #36 Limits: English, Publication Date from 1990, Humans	<u>135</u>
<u>#42</u>	Search iom	<u>682</u>
<u>#43</u>	Search #42 AND #12	<u>19</u>
<u>#45</u>	Search #43 OR #39 Limits: English, Publication Date from 1990, Humans	<u>150</u>

KQ4: Recommendations

<u>#47</u>	Search ("Counseling"[MeSH] OR "Directive Counseling"[MeSH]) Limits: English, Publication Date from 1990, Humans	<u>11733</u>
<u>#48</u>	Search #47 AND #12 Limits: English, Publication Date from 1990, Humans	<u>13</u>

KQ5: Tools

<u>#53</u>	Search "Body Weights and Measures/instrumentation"[MeSH] Limits: English, Publication Date from 1990, Humans	<u>13</u>
<u>#54</u>	Search Body Weights and Measures[MeSH]	<u>275772</u>
<u>#55</u>	Search #12 AND #54	<u>1030</u>
<u>#66</u>	Search Anthropometry [mh]	<u>70445</u>
<u>#67</u>	Search #55 AND #66	<u>350</u>

Focused Search 2: February 2007

#2 Search "Weight Gain"[MeSH] = 13220

#5 Search pregnancy [mesh] = 577647

#6 Search #2 AND #5 = 1808

#7 Search gestational weight gain = 1725

#8 Search #6 OR #7 = 3023

#9 Search #6 OR #7 Limits: English, Humans = 1696

#15 Search ("Outcome Assessment (Health Care)"[MeSH] OR "Outcome and Process Assessment (Health Care)"[MeSH] OR "Pregnancy Outcome"[MeSH]) OR "Reproductive History"[MeSH] OR "birth outcomes" OR "infant health outcomes" OR "maternal health outcomes Limits: English, Humans = 332914

#16 Search #9 AND #15 Limits: English, Humans = 474

#19 Search ("Counseling"[MeSH] OR "Directive Counseling"[MeSH]) = 23091

#20 Search #9 AND #19 = 12

#25 Search "Body Weights and Measures"[MeSH] = 279399

#26 Search #9 AND #25 = 1044

#29 Search "Anthropometry"[MeSH] = 71849

#30 Search #26 AND #29 = 359

CINAHL

DE= Weight gain - in pregnancy = 253

63 duplicates

190 new records

COCHRANE = 4 records, already in database

EMBASE = 18 records, 8 new

Total unduplicated database = 913

Focused Search 3: March 2007

Same search as Focused Search 1 using Cochrane, CINAHL

Focused Search 4: June 2007

#1 Search pregnancy	620141
#2 Search height OR weight OR BMI OR "body mass index" OR skinfolds OR circumferences OR BIA OR "body impedance analyzer" OR ultrasound OR DEXA OR UWW OR "underwater weighing" OR "BOD POD" OR CT OR MRI	1369412
#3 Search #1 AND #2	103432
#4 Search #1 AND #2 Limits: Humans, English	66133
#5 Search #1 AND #2 Limits: Publication Date from 1990, Humans, English, All Adult: 19+ years	24044
#6 Search BMI OR "body mass index" OR skinfolds OR circumferences OR BIA OR "body impedance analyzer" OR ultrasound OR DEXA OR UWW OR "underwater weighing" OR "BOD POD" OR CT OR MRI Limits: Publication Date from 1990, Humans, English, All Adult: 19+ years	247723
#7 Search #5 AND #6 Limits: Publication Date from 1990, Humans, English, All Adult: 19+ years	15336
<hr/>	
#4 Search ("Pregnancy/physiology"[Majr]) AND ("Weight Gain"[Mesh])	379
#7 Search ("Adipose Tissue/anatomy and histology"[Mesh])	14707
#8 Search #4 AND #7	14
#9 Search ("Pregnancy/physiology"[Majr]) AND ("Weight Gain"[Mesh]) Limits: Publication Date from 1990, Humans, English, All Adult: 19+ years	148

Focused Search 5: October 2007

#1 Search "Weight Gain"[MeSH] AND pregnancy [mesh]	1889
#2 Search gestational weight gain	1812
#3 Search #1 OR #2	3160
#4 Search #1 OR #2 Limits: added to PubMed in the last 1 year, Humans, English	98
#5 Search ("Outcome Assessment (Health Care)"[MeSH] OR "Outcome and Process Assessment (Health Care)"[MeSH] OR "Pregnancy Outcome"[MeSH]) OR "Reproductive History"[MeSH] OR "birth outcomes" OR "infant health outcomes" OR "maternal health outcomes"	395351
#6 Search #4 AND #5	26
#7 Search ("Counseling"[MeSH] OR "Directive Counseling"[MeSH])	23918
#8 Search #4 AND #7	1
#9 Search "Body Weights and Measures"[MeSH] AND "Anthropometry"[MeSH]	42873
#10 Search #4 AND #9	34
#11 Search ("Pregnancy/physiology"[Majr]) AND ("Weight Gain"[Mesh]) AND ("Adipose Tissue/anatomy and histology"[Mesh])	14
#12 Search ("Pregnancy/physiology"[Majr]) AND ("Weight Gain"[Mesh]) AND ("Adipose Tissue/anatomy and histology"[Mesh]) Limits: added to PubMed in the last 1 year, Humans, English	0

CINAHL

DE= Weight gain - in pregnancy = 36

Duplicates = 18

new records = 18

COCHRANE = 1 records

EMBASE = 5 records

Duplicates = 1

New records = 4

58 new records

Total unduplicated database = 1024

Appendix B. Sample Data Collection Forms

Systematic Review of Maternal Weight Gain

Abstract Review Form

First Author, Year: _____

Endnote: _____

Abstractor Initials: _____

Primary Inclusion/Exclusion Criteria			
1. Original research (Exclude editorials, commentaries, letters to editor, reviews, etc.)	Yes	No	Cannot Determine
2. Study published between January 1990 and February 2007	Yes	No	Cannot Determine
3. Study published in English	Yes	No	Cannot Determine
4. Is this study located in a developed nation? (US, Canada, Western Europe, Japan, New Zealand, Australia)	Yes	No	Cannot Determine
5. Eligible Study type (Include RCTs, cohorts with comparisons, and case-controls with N≥40, case-series with N≥100) a. ___ RCT (N =___) b. ___ Cohorts with comparison (N =___) c. ___ Case-control (N =___) d. ___ Case series (N =___)	Yes	No	Cannot Determine
6. Applies to research topic (if not select one of the following reasons): a. ___ Basic science b. ___ Not "maternal weight gain"	Yes	No	Cannot Determine
7. Entirely or mostly singleton births	Yes	No (100% multi-fetal)	Cannot Determine

Retain for (include meta-analyses and systematic reviews here as appropriate):

___ **BACKGROUND/DISCUSSION**

___ **REVIEW OF REFERENCES**

___ **Other**

COMMENTS:

Reviewing



Reviewing at Level 1

SRS has detected that you may not need to fill this form out. It has already been completed by 2 users and is currently being worked on by 0 other users. It only needs to be reviewed by 2 users therefore your input may be redundant.

Click [here](#) to skip to the next one

Refid: 1, Birenbaum, H. J., M. A. Pane, S. M. Helou and K. P. Starr, Comparison of a restricted transfusion schedule with erythropoietin therapy versus a restricted transfusion schedule alone in very low birth weight premature infants, *South Med J*, 99(10), 2006, p. 1059-62
State: Excluded, Level: 1

Abstract Review

Keywords:

Anemia, Neonatal/blood/ prevention & control

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Decrease Font Size

Abstract:

OBJECTIVE: Erythropoietin (EPO) is commonly used in very low birth weight neonates to minimize blood transfusions during hospitalization. Data are limited comparing the use of EPO along with a restricted transfusion schedule versus a restricted transfusion schedule alone. We compared the effects of a restricted transfusion schedule with EPO versus a restricted transfusion schedule alone during two consecutive 6-month periods. METHODS: In period I, infants born at <30 weeks gestational age (GA) or <1,500 g birth weight (BW) were treated prophylactically for six weeks with EPO 1,000 U/kg/wk in three divided doses and blood transfusions were given using a restricted transfusion schedule. This was called the EPO Group. In period II, a restricted transfusion schedule was utilized, but EPO was not administered. This constituted the No EPO Group. No other changes in clinical practice were introduced in either period. RESULTS: There were 30 neonates in the EPO Group and 20 in the No EPO Group. There were no significant differences in sex, race, mean birth weight (1,074 +/- 283 versus 965 +/- 330 g), mean gestational age (28.9 +/- 2.96 versus 27.8 +/- 2.86 wks), 5 minute Apgar score (7.8 +/- 1.2 versus 7.6 +/- 1.1), or mean hematocrit (48.2% +/- 6.05 versus 48.6% +/- 6.31) at admission. There were no significant differences in the total number of transfusions between the two periods. In the EPO Group, 8/30 patients received 27 transfusions. Six transfusions violated guidelines based on hematocrit level. EPO was discontinued in three infants secondary to treatment-related neutropenia. There were two deaths unassociated with EPO treatment. Excluding deaths, 6 patients received 16 transfusions. In the No EPO Group, 8/20 patients received 13 transfusions. Two transfusions violated guidelines based on hematocrit. There were three deaths and one patient transfer. Excluding these four patients, 6 infants received 11 transfusions ($P < 0.05$). Among survivors, there were no significant differences in mean total length of stay (49.3 +/- 22.7 versus 53.2 +/- 26.4 d), mean discharge weight (2,144 +/- 405 versus 2,358 +/- 458 g), or average weight gain/d (20.7 +/- 5.44 versus 22.6 +/- 6.81 g), between the two groups respectively, nor were there significant differences when all babies were included in the analysis. There was a significant difference in mean hematocrit at discharge, respectively, (38.3% +/- 6.84

Submit Data

1. Original research (no review articles, editorials, letters to the editor or commentaries)?

- ☒ Yes
☐ No
☐ Cannot determine

[Clear Selection](#)

2. Study published after January 1, 1990?

- ☒ Yes
☐ No
☐ Cannot determine


[Clear Selection](#)

3. Study published in English?

- ☐ Yes
☐ No
☒ Cannot determine


[Clear Selection](#)

4. Study conducted in a developed nation? (for example- US, Canada, western Europe, Japan, New Zealand, Australia)

- ☐ Yes
☐ No- if not then where? 
☒ Cannot determine

[Clear Selection](#)

5. Study design is one of the following:

- ☐ RCT
☒ Cohort studies N => 40
☐ Case control with N => 40
☐ Case series N => 100
☐ Cross sectional N => 100
☐ None of the above- so exclude
☐ None of the above- but include (please provide explanation) 
☐ Cannot determine

[Clear Selection](#)

6. Entirely or mostly singleton births?

- ☐ Yes
- ☐ No (100% multi-fetal)
- ☒ Cannot determine

[Clear Selection](#)

7. Applies to research topic of maternal weight gain or the measurement body fat?

- ☐ Yes
- ☒ No- not maternal weight gain or the measurement of body fat
- ☐ No - "basic science"
- ☐ No - other (please elucidate)
- ☐ Cannot determine

[Clear Selection](#)

8. Article should be marked and saved for background but not abstracted (This question is optional).

- ☐ Yes
- ☒ No
- ☐ Cannot determine

[Clear Selection](#)

9. Population

- ☐ 100% healthy populations or mix of healthy populations and "nonhealthy" populations
- ☐ 100% populations with health conditions (ie. drug abuse or diabetes) Please define -

[Clear Selection](#)

Form took 0.2807617 seconds to render
Form Creation Date: Not available
Form Last Modified: Not available

Reviewing



Reviewing at Level 2

Refid: 1611, Jain, N. J., C. E. Denk, L. K. Kruse and V. Dandolu, Maternal obesity: can pregnancy weight gain modify risk of selected adverse pregnancy outcomes?, *Am J Perinatol*, 24(5), 2007, p. 291-8

State: Ok, Level: 2 

Full-Text Review

[Save to finish later](#)
[Submit Data](#)

1. Article is concerned with topics relevant to maternal weight gain or the measurement of body fat?

- ☐ Yes
- ☐ No- so exclude

[Clear Selection](#)

2. Should the article be excluded for any of the following general reasons?

- ☐ Article should be excluded because (pick at least one of the following options)
- ☐ n < 40 for comparisons including cohort studies
- ☐ n < 100 for case-series
- ☐ Not published in english
- ☐ Wrong publication type (e.g. letter, commentary or editorial)
- ☐ Wrong design - please explain
- ☐ Includes only a population w/ a pre-existing condition - please list condition
- ☐ 100% multi-fetal
- ☐ Published before 1990
- ☐ Study not conducted in a developed nation? (Please provide country name)
- ☐ Study reported as an abstract only
- ☐ Not related to key questions
- ☐ Other reason- please explain briefly
- ☐ None of the above- should be included!

3. Regardless of inclusion/exclusion status, article should be retained for background.

- ☐ Yes
- ☐ No

[Clear Selection](#)

4. Which of the following key questions are addressed by the article

- ☐ KQ1 What is the evidence that either total weight gain or rate of weight gain during pregnancy is associated with: (1) birth outcomes, (2) infant health outcomes, and (3) maternal health outcomes?
- ☐ KQ2 What are the confounders and effect modifiers in examining the association between maternal weight gain (overall and patterns) and birth outcomes?
- ☐ KQ3 What is the evidence that weight gain above or below thresholds defined in the 1990 Institute of Medicine BMI Guidelines or weight loss in pregnancy contribute to ante-partum or post-partum complications, or longer-term maternal and fetal complications?
- ☐ KQ4 What are the harms or benefits of offering the same weight gain recommendations to all pregnant women, irrespective of age and body weight considerations (e.g., pregravid weight, actual body weight at a particular time point, or optimal body weight)?
- ☐ KQ5 What are the anthropometric tools for determining adiposity and their appropriateness for the pregnancy state?
- ☐ None of the above so exclude!

5. If study addresses KQ 1-4 it must include pre-pregnancy weight or BMI measures.

- ☐ Pre-pregnancy weight or BMI is not in article so exclude
- ☐ Include!

[Clear Selection](#)

6.
If article addresses KQ 3 it must includes the IOM guidelines.

- ☐ No IOM guidelines so exclude
- ☐ Include!

[Clear Selection](#)

Save to finish later

Submit Data

Form took 0.2026367 seconds to render
Form Creation Date: Not available
Form Last Modified: Not available


Reviewing



Reviewing at Level 3

Reviewer Comments ([Add a Comment](#))

Refid: 127, Joseph, K. S., D. C. Young, L. Dodds, C. M. O'Connell, V. M. Allen, S. Chandra and A. C. Allen, Changes in maternal characteristics and obstetric practice and recent increases in primary cesarean delivery, *Obstet Gynecol*, 102(4), 2003, p. 791-800

State: Ok, Level: Abstraction form, KQ5 

Abstraction

Save to finish later

Submit Data

1. First author et. al, year

[Enlarge](#) [Shrink](#)

2. Country and setting


If more than a couple of countries are included just call it multinational.

Settings include primary care, hospitals, university clinics, doctors offices, nursing home, multicenter etc.

[Enlarge](#) [Shrink](#)

3. Source of funding to conduct study:

☐ Pharmaceutical company or other commercial source- please list name. 

☐ Government or non-profit organization- please list name. 

☐ Not reported

4. Research objective (Please be brief and concise):

[Enlarge](#) [Shrink](#)

5. Which of the following key questions are addressed by the article

☐ KQ1 What is the evidence that either total weight gain or rate of weight gain during pregnancy is associated with: (1) birth outcomes, (2) infant health o

☐ KQ2 What are the confounders and effect modifiers in examining the association between maternal weight gain (overall and patterns) and birth outcom

☐ KQ3 What is the evidence that weight gain above or below thresholds defined in the 1990 Institute of Medicine BMI Guidelines or weight loss in pregn maternal and fetal complications?

☐ KQ4 What are the harms or benefits of offering the same weight gain recommendations to all pregnant women, irrespective of age and body weight co or optimal body weight)?

☐ KQ5 What are the anthropometric tools for determining adiposity and their appropriateness for the pregnancy state?


☐ None of the above so exclude!

6. Article reports on an observational study, check the applicable box -

☐ Case series



☐ Cohort

☐ Case-control

- ☐ Cross-sectional
- ☐ Other observational 
- ☐ No, not an observational study


[Clear Selection](#)

7. Observational study is-

- ☐ Prospective
- ☐ Retrospective
- ☐ Combination, please explain 
- ☐ Other, please explain! 

[Clear Selection](#)

8. Article reports on a RCT or meta-analysis, check appropriate box.

- ☐ RCT
- ☐ Meta-analysis
- ☐ Other controlled study design, please explain 
- ☐ No, it is not a controlled trial

[Clear Selection](#)


9. Overall study n =

[Enlarge](#) [Shrink](#)


10. Duration of study?

[Enlarge](#) [Shrink](#)

11. How was pregravid weight collected?

- ☐ Self-reported
- ☐ Measured by study investigators
- ☐ Routine pre-natal care
- ☐ Other- please explain! 
- ☐ Not reported

12. How was pregravid height collected?


- ☐ Self-reported
- ☐ Measured by study investigators
- ☐ Routine pre-natal care
- ☐ Other- please explain! 
- ☐ Not reported

13. Was BMI imputed?

- ☐ Yes
- ☐ No

[Clear Selection](#)

14. How was BMI categorized?


- ☐ Continuous
- ☐ IOM guidelines
- ☐ WHO International Taskforce
- ☐ Other- please define 
- ☐ Not reported

15. Are any other anthropometric measures collected?


- ☐ Yes
- ☐ No

[Clear Selection](#)



16. How were weight gain measurements categorized?

- ☐ Continuous
- ☐ Quartiles
- ☐ According to IOM
- ☐ Other - please define 

17. How were weight gain measurements collected?

- ☐ Self-reported
- ☐ Collected by study investigators
- ☐ Routine pre-natal care or maternity records
- ☐ Other - define or explain 

18. How was total weight gain ascertained?

- ☐ Self-reported
- ☐ Based on last clinically measured weight prior to delivery 
- ☐ Other- please explain! 
- ☐ Not reported
















19. Inclusion criteria

[Enlarge](#) [Shrink](#)

20. Exclusion criteria

[Enlarge](#) [Shrink](#)

Baseline Characteristics

	Group 1	Group 2	Group 3	G
21. Groups - if only one group please put in first column	<input type="text"/> 	<input type="text"/> 	<input type="text"/> 	<input type="text"/>
22. # in group (n):	<input type="text"/> 	<input type="text"/> 	<input type="text"/> 	<input type="text"/>
23. Mean age (years):	<input type="text"/> 	<input type="text"/> 	<input type="text"/> 	<input type="text"/>
24. Weight at baseline (lbs or kgs)	<input type="text"/> 	<input type="text"/> 	<input type="text"/> 	<input type="text"/>
25. BMI at baseline	<input type="text"/> 	<input type="text"/> 	<input type="text"/> 	<input type="text"/>

26. Parity (mean):	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
27. Race (% white):	<input type="text"/>		<input type="text"/>	
28. Race (% black):	<input type="text"/>		<input type="text"/>	
29. Race (% hispanic):	<input type="text"/>		<input type="text"/>	
30. Race (% Asian and/or Pacific region origins):	<input type="text"/>		<input type="text"/>	
31. Race (% other):	<input type="text"/>		<input type="text"/>	
32. Smoking (%):	<input type="text"/>		<input type="text"/>	
33. Gestational diabetes mellitus (%):	<input type="text"/>		<input type="text"/>	
34. Hypertension (%):	<input type="text"/>		<input type="text"/>	
35. Additional characteristics:	<input type="text"/>		<input type="text"/>	
36. Additional characteristics:	<input type="text"/>		<input type="text"/>	
37. Additional characteristics:	<input type="text"/>		<input type="text"/>	

Outcomes

38. How was post-partum weight collected?

☐ Self-reported☐ Measured by study investigators☐ Routine care☐ Other- please explain!☐ Not reported

39. What type of statistical analysis was used? Check all that apply.

☐ Bivariate☐ Multivariate☐ Risk ratios☐ Odds ratios☐ ANOVA☐ Other- please explain

40. If relevant, define comparison or reference group.

[Enlarge](#) [Shrink](#)**Outcomes- primarily bivariate**

	Group 1	Group 2	Group 3	G
41. Groups - if only one group please put in first column. With intervention include p-values for example, ($P < 0.05$).	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
42. # in group (n):	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
43. Birthweight (lbs or kgs):	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
44. Maternal weight gain:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
45. Gestational diabetes (%):	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

46. Caeserian delivery (%):

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47. Use of episiotomy:

						
--	---	--	---	--	---	--

48. Instrumental delivery (%):

						
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49. Additional maternal outcomes of interest- please be brief!

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[Enlarge](#) [Shrink](#)

50. Additional infant outcomes of interest- please be brief!

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[Enlarge](#) [Shrink](#)

51. Maternal confounders accounted for in analysis:

- ☐ Age
- ☐ Race
- ☐ Parity
- ☐ Pre-gravid BMI
- ☐ GDM
- ☐ Pregnancy induced hypertension
- ☐ Pre-eclampsia
- ☐ Eclampsia
- ☐ C-section
- ☐ Post-partum weight retntion
- ☐ Lactation/ Breast feeding (Which one?)
- ☐ Obesity (How defined or categorized?)
- ☐ Type 1 Diabetes or pre-existing Type 2 Diabetes
- ☐ CVD
- ☐ Cancer
- ☐ Others- please list
- ☐ Smoking
- ☐ Pre-existing hypertension

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52. Infant and child confounders accounted for in analysis:

- ☐ Pre-term birth
- ☐ Gestational age
- ☐ Birth weight
- ☐ SGA
- ☐ LGA
- ☐ Birth length
- ☐ Child weight/height
- ☐ Childhood obesity

☐ Childhood diabetes (Type 1)

☐ Child with CVD

☐ Child's blood pressure

☐ Others- please list

53. More outcomes- mostly multivariate!

[Enlarge](#) [Shrink](#)

	Category or confounder	Group 1	Group 2	Group 3	G
54. Groups - if only one group please put in second column following confounder. If result is an odds ratio (95% CI) should be included.	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
55. # in group (n):	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
56. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
57. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
58. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
59. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
60. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
61. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
62. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
63. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
64. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
65. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
66. Confounder:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Additional outcomes

	Characteristic	Group 1	Group 2	Group 3	G
67. Outcomes - if only one outcome please put in second column following characteristic column. If result is an odds ratio (95% CI)	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

should be included.

68. # in group (n):	<input type="checkbox"/>	<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
69. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
70. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
71. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
72. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
73. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
74. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
75. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
76. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
77. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
78. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>
79. Characteristic:		<input type="text"/>		<input type="text"/>		<input type="text"/>		<input type="text"/>

80. Is study generalizable?

- ☐ Yes - why?
- ☐ No- why not?
- ☐ Can't tell...

[Clear Selection](#)

Quality Review

81. Randomization adequate?

- ☐ Yes
- ☐ No
- ☐ Not randomized
- ☐ Method not reported

[Clear Selection](#)

82. Allocation concealment adequate?

- ☐ Yes
- ☐ No
- ☐ Not randomized
- ☐ Method not reported

[Clear Selection](#)

83. Groups similar at baseline?

- ☐ Yes
- ☐ No

[Clear Selection](#)84. **Outcome assessors masked?**

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported

[Clear Selection](#)85. **Care provider masked?**

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported


[Clear Selection](#)86. **Patient masked?**

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported

[Clear Selection](#)87. **What was lost to follow-up (%)?**[Enlarge](#) [Shrink](#)88. **How many dropped out (%)?**[Enlarge](#) [Shrink](#)89. **Was the statistical analysis based on intention-to-treat (ITT)?**

- ☐ Yes
- ☐ No
- ☐ Cannot tell

[Clear Selection](#)90. **Were there any post-randomization exclusions?**

- ☐ Yes (how many?) 
- ☐ No
- ☐ Cannot tell

[Clear Selection](#)91. **Quality rating for efficacy/effectiveness**

- ☐ Good
- ☐ Fair
- ☐ Poor

Why?

92. Were both groups selected from the same source population?

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported

[Clear Selection](#)

93. Did both groups have the same risk of having the outcome of interest at baseline?

- ☐ Yes
- ☐ No
- ☐ Not reported

[Clear Selection](#)

94. Were subjects in both groups recruited over the same time period?

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported

[Clear Selection](#)

95. Was there any obvious selection bias?

- ☐ Yes
- ☐ No
- ☐ Not reported

[Clear Selection](#)

96. Were ascertainment methods adequate and equally applied to both groups?

- ☐ Yes
- ☐ No
- ☐ Not reported

[Clear Selection](#)

97. Was an attempt made to blind the outcome assessors?

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported

[Clear Selection](#)

98. Was the time of follow-up equal in both groups?

- ☐ Yes
- ☐ No
- ☐ Not reported

[Clear Selection](#)

99. What was lost to follow-up (%)?

[Enlarge](#) [Shrink](#)

100. How many dropped out (%)?

[Enlarge](#) [Shrink](#)

101. Did the statistical analysis consider potential confounders or adjust for different lengths of follow-up?

- ☐ Yes
- ☐ No
- ☐ Yes, but method not described
- ☐ Not reported

[Clear Selection](#)

102. Was the length of follow-up adequate to assess the outcome of interest?

- ☐ Yes
- ☐ No
- ☐ Not reported

[Clear Selection](#)



103. Quality rating for observational studies

- ☐ Good
- ☐ Fair
- ☐ Poor

Why?

104. Is the principle focus of this article maternal weight gain and associated outcomes

- ☐ Yes 
- ☐ No then limit abstraction to MWG and associated outcomes and the confounders and effect modifiers 

105. Time frame?

[Enlarge](#) [Shrink](#)[Save to finish later](#)[Submit Data](#)

Form took 1.953125 seconds to render
Form Creation Date: Not available
Form Last Modified: Aug 20 2007 10:20AM

Evidence Table Template

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year:	Design:	Pregravid weight:	Race, %:
Country and setting:	Total Study N:	Pregravid BMI:	White
Enrollment period:	Group Description:	Age (mean, yrs):	Black
Funding:	Group N:	Parity:	Hispanic
Study Objective:	Inclusion criteria:		Asian/Pacific Islander
Time frame:	Exclusion criteria:		Other
Duration of the study:	•		Smoking, %:
			Diabetes mellitus, %:
			Hypertension, %:
			Additional characteristics:

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N):	Birth weight:	Outcomes Description:	Background:
Total weight gain:	Gestational diabetes, %:	Groups:	Sample selection:
Categorized:	Cesarean delivery, %:	Results:	Definition of maternal weight gain:
Collected from:	Instrumental delivery, %:	Maternal confounders and effect modifiers accounted for in analysis:	Definition of outcomes:
Ascertained by:	Episiotomy, %:	Infant and child confounders and effect modifiers accounted for in analysis:	Source of information on exposure, outcomes, and confounders:
•	Other maternal outcomes:		Followup:
	Other infant outcomes:		Analysis comparability:
			Analysis of outcomes:
			Interpretation:
			Sum of Good/Fair/Poor:
			Final Quality Score:

Quality Rating Form

(Items in yellow highlight not likely to be relevant for observational studies)

1. Background/Context

1.1. Provision of Background Information:

Is the study presented in the context of prior research and/or clinical practice?

Yes	
No	
Partially/Somewhat	
NA	

1.2. Problem/question clearly stated:

Is the hypothesis/aim/objective of the study clearly described?¹⁻³

Yes	
No	
Partially/Somewhat	
NA	

2. Sample Definition and Selection

2.1. Retrospective/prospective:

Is the study design prospective, retrospective, or mixed? *Higher score for prospective*

Retrospective	
Prospective	
Mixed	

2.2. Inclusion/exclusion criteria:

- a. Are the inclusion/exclusion criteria explicitly stated? [May want to ask individually about unique criteria that are critically important.]

Yes	
No	
Partially/Somewhat	

- b. Were inclusion/exclusion criteria applied uniformly to all groups?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

- c. If prospective or mixed, were the pathways by which participants entered the study (recruitment strategy) clearly described?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

- d. Are the characteristics of the participants included in the study clearly described? [In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case-control studies, a case-definition and the source for controls should be given.]⁴

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

- 2.3. c. Was there a power analysis or some other basis noted for determining the adequacy of study group sizes?⁵

Yes	
No	
NA (birth certificate or birth registry)	

- 2.4. Selected to be representative (External validity measure)

- a. Are the individuals selected to participate in the study likely to be representative of the target population? [selected from the relevant population, representative of whom results would be generalized]^{6,7}

Very likely	
Somewhat likely	
Not likely	
Cannot determine	
NA	

3. Interventions/exposure

- 3.1. Clear specification

- a. Is weight gain or rate of weight gain clearly defined?

Low (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

- b. Does the description of the intervention/exposure adequately describe (list separately): setting, duration, frequency, intensity.

Low (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

- c. Is the test reference standard (diagnostic test) clearly specified?

Low (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

- d. Is there a clearly specified intervention protocol?

Low (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

3.2. Concurrent/concomitant treatment

- a. Is usual clinical care clearly described?

Low (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

3.4 Was pregravid weight checked for biological plausibility?

Yes	
No	
Not applicable (from first prenatal visit, or measured)	

3.5 Details on data cleaning (on outliers)?

No information (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

4. Outcomes

4.1 Clear specification

- a. Are the primary outcomes clearly described?⁹ [this can be asked for all outcomes together or each primary outcome can be listed separately]

Low (unclear, many details missing)	
Medium (pretty clear, most details provided)	
Very clear (all essential details provided)	

- c. Are study questions relevant to the key questions of the SER? This should be part of an applicability rating, not study quality. Should it be deleted?

Yes	
Partially	
No	

5. Creation of treatment groups

5.3. How allocation occurred

- a. Is assignment made to study groups randomly?⁵ *Yes/No*

Yes	
No	

- b. Is an explicit case/comparison definition provided?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

- c. Are the criteria for assignment to study groups clearly described?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

- d. Is the selection of the non-exposed cohort appropriate?¹⁴ *Drawn from the same community as the exposed cohort/Drawn from a different source or no description of the derivation of the non- exposed cohort*

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

5.4. Any attempt to balance

a. Any attempt to balance the allocation between the groups? /

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

5.7. Contamination

a. Has the possibility of participants having received an unintended intervention that may influence results been reported and ruled out?¹⁴

Yes	
No	

d. Was there variation from the protocol in relation to: duration, intensity, frequency, and/or setting sufficiently large to compromise the findings?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

e. Is the level of adherence adequate?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

f. Is the evaluation of adherence adequate?

Yes	
No	
Partially/Somewhat	
Cannot determine	
NA	

6. Blinding

6.1. Blind or double blind administration

- a. Is there blinding of study subjects? (Blinding may not be possible with some interventions.)

Yes, all arms	
Yes, some arms	
No	
NA	

- b. Are those administering the intervention blinded to the study subject's exposure status? Blinding may not be possible with some interventions.

Yes	
No	
NA	

6.2. Blind outcomes assessment

- a. Are the outcome assessors blinded to the intervention or exposure status of participants?^{6,7}

Yes	
No	
NA	

7. Soundness of information

7.1. Source of information re interventions/exposure

- a. How was maternal weight gain or rate of weight gain obtained?

All self report (poor)	
Combination of self report and measured by observer (fair)	
All measured by observer, using pregravid weight or weight in first trimester and weight at last measurement before or at delivery (good)	

7.2. Source of information re outcomes

Are the sources establishing the validity and reliability of outcome measures described or referenced?^{15,16} [may want to list important measures separately]

Good	
------	--

Fair	
Poor	

8. Follow-up

8.1 Equality of length of follow-up for participants

In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?⁴ [Where follow-up was the same for all study patients the answer is yes. If different lengths of follow-up were adjusted by, for example, survival analysis, the answer is yes. Studies where differences in follow-up are ignored should be answered no.]

Yes	
No	
Cannot determine	
NA (cross-sectional)	

8.2. Length of followup adequate

b. Is the length of followup sufficient to support the conclusions of the study?

Yes	
No	
NA (cross-sectional)	

8.3. Completeness of followup

Are the reasons why study subjects were lost to follow-up adequately reported?

Good	
Fair	
Poor	
NA (cross-sectional or retrospective)	

9. Analysis comparability

9.1 Assessment of baseline comparability by design

b. Are the cohorts comparable through the design of the study? If not, does the analysis control for differences?

Yes	
No	
Cannot determine	
NA	

- c. For categorical variables, is the choice of control/non-exposure groups reasonable? *Yes/No*

Yes	
No	
Partial/somewhat	
NA	

9.2. Identification of prognostic factors

- a. Does the study adequately identify confounding and modifying variables?

Gestational age at the time of weight measurement

Gestational age at delivery

Pregravid BMI

Smoking

Preexisting health condition (eating disorders, ??)

Pregnancy complications (PIH, GDM)

Parity

Age of mother

Race

SES or education (diet, physical, activity, access to medical care, proxy for other things)

Weight retention confounders (diet, energy expenditure/exercise/return to work, breastfeeding, maternal illness, pregnancy)

[list measures]

All	
Some	
None	

- b. Are the principal confounders in each group of subjects to be compared clearly described?⁴ [A list of principal confounders is provided.]

Yes	
No	
Somewhat	

7.4. Source of information re confounders

Are the sources establishing the validity and reliability of confounders described or referenced?^{15,16} [may want to list important measures separately]

Good (objective)	
Fair (self-report)	
Poor (not described)	

9.3. Adjustment for confounding

Is there adequate adjustment in the analysis for confounding variables? *Yes, No, Unable to determine*

Yes	
No	
Partially/somewhat	
Unable to determine	
NA	

10. Analysis outcome

10.1. Intention-to-treat analysis

- a. **Is intention-to-treat (ITT) analysis reported?¹⁷**

Yes	
No	

- b. Are all enrolled subjects (patients and comparison groups) accounted for in follow-up?¹⁸

Yes	
No	
Cannot determine	
NA	

- c. Are all enrolled subjects accounted for in the follow-up through assessment of the impact of dropout rates, sensitivity analysis, or other intention-to-treat adjustment methods?

Yes	
No	
Cannot determine	
NA	

- d. Are subject withdrawals, lost to follow-up, and missing data adequately accounted for in the analysis? *Inadequate/Adequate/Excellent/Unable to determine*

Good	
Fair	
Poor/No	
NA	

Actual loss-to-followup or Missing data:

Missing data:

10.2. Appropriate statistical methods

- a. Is the statistical approach for analyzing the data reported in sufficient detail so that reported results may be replicated?¹⁹

Yes	
No	
Partially/somewhat	
Unable to determine	
NA	

- b. Are the statistical methods used to assess the main outcome appropriate to the data?^{20,21} *Yes/No/Unable to determine*

Yes	
No	
Partially/Somewhat	

- i. Multivariate analysis

Yes	
No	

- ii. For cohort studies only, if the outcome has a greater than 10 percent prevalence, is the risk ratio and relative risk calculated directly (not using logistic regression)?

Yes	
No	
For some outcomes	
NA	

11. Interpretation

11.1. Appropriately based on results

- a. Are results interpreted appropriately based on study design and statistical analysis (trends noted, precision of confidence intervals noted, statistical results are clearly differentiated)?

Yes	
No	
Partially/somewhat	

- b. Are conclusions supported by results with possible bias and limitations taken into consideration?²²

0 (poor, not defined)	1	2	3	4	5 (excellent, clearly defined)

11.3. Application/implications

Are the results generally applicable or limited to one particular healthcare delivery setting?⁵

General	
Limited	

11.4. Clinical importance and statistical significance

- a. Are the statistical findings presented in a manner that is clinically useful?

Yes	
No	
Somewhat	

Are the statistical findings clinically useful?

Yes	
No	
Somewhat	

11.5. Interpretation in context

Are study conclusions presented in the context of prior research?

Yes	
No	
Somewhat	

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Appendix C. Evidence Tables

Glossary

adj	adjusted	MWG	maternal weight gain
AGA	appropriate for gestational age	N	number
AOR	adjusted odds ratio?	NA	not applicable
bf	body fat	NICU	neonatal intensive care unit
BF	breast feeding	NIH	National Institutes of Health
bp	blood pressure	NIMU	neonatal intensive medical unit
BMI	body mass index	NR	not reported
CI	Confidence interval	NVSD	normal spontaneous vaginal delivery
CPD	cardiopulmonary disease	OGTT	oral glucose tolerance test
CPS	Collaborative Perinatal Study	p	P-value
ECW	extra cellular water	PE	pulmonary embolism
g	gram	pg	pregnancy?
ga	gestational age	PIH	pregnancy induced hypertension
GDM	gestational diabetes	PNC	prenatal care
gest	gestational	PPWR	postpartum weight reduction
GWG	gestational weigh gain	Prepg	prepregnancy
HDL	high density lipoprotein	PTB	preterm birth
HDP	hypertensive disorders of pregnancy	RR	relative risk
hg	hemoglobin	SD	standard deviation
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification	SE	standard error
IGT	impaired glucose tolerance	SGA	small for gestational age
IGUR	intrauterine growth retardation	TBW	total body water
IOM	Institute of Medicine	TSF	triceps skinfold
IUGR	intrauterine growth restriction	UCSF	University of California at San Francisco
IVF	in vitro fertilization	US	United States
kg	kilogram	VBAC	vaginal birth after cesarean
kg/wk	kilogram per week	VLBW	very low birth weight
lb	pound	WHO	World Health Organization
LBW	low birth weight	WHR	waist to hip ratio
LGA	large for gestational age	WIC	Women's, Infant, and Children program
MCH	maternal and child health		

Evidence Table 1. Gestational weight gain and discomforts of pregnancy

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Atwal et al., 2006 Country and setting: United Kingdom, hospital Enrollment period: 4-month period (1 March 2000 to 30 June 2000 inclusive) Funding: NR Study Objective: To observe prevalence of striae gravidarum in primiparae and identify independent associated risk factors Time frame: 4-month period (1 March 2000 to 30 June 2000 inclusive) Duration of the study: Duration of pregnancy	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 309 Group Description: NR Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Primiparae who delivered after 28 weeks of gestational age and had no previous pregnancies lasting more than 12 weeks Exclusion criteria: <ul style="list-style-type: none"> Multiple births Non-white women 	Pregravid weight: <ul style="list-style-type: none"> Booking weight Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> No Categorized: NR Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Striae gravidum (%)	Background: Good
Total weight gain: G1: Odds ratio 1.08 (95% CI 1.02-1.14) <i>P</i> = 0.0121	Gestational diabetes, %: NR	Groups: G1: MWG < 15 kg G2: MWG > 15 kg	Sample selection: Poor
Cesarean delivery, %: NR	Cesarean delivery, %: NR	Results: G1: 47 G2: 60	Definition of maternal weight gain: Poor
Instrumental delivery, %: NR	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: NR	Definition of outcomes: Fair
Episiotomy, %: NR	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Source of information on exposure, outcomes, and confounders: Poor
Other maternal outcomes: <ul style="list-style-type: none"> Women with largest weight gain had greatest incidence of striae 	Other maternal outcomes: <ul style="list-style-type: none"> Women with largest weight gain had greatest incidence of striae 		Followup: Fair
Other infant outcomes: NR	Other infant outcomes: NR		Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Poor
			Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor
			Final Quality Score: Poor

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Madlon-Kay DJ, 1993 Country and setting: USA, hospital Enrollment Period: NR Funding: Grant from American Academy of Family Physicians and Ramsey Foundation Study Objective: To study factors associated with formation of striae gravidarum and measures used by women to prevent them Time frame: NR Duration of the study: From gestational weeks 34 to 36 until birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 48 Group Description: G1: All G2: Abdominal Striae Present G3: Abdominal Striae Absent Group N: G1: 48 G2: 22 G3: 26 Inclusion criteria: <ul style="list-style-type: none"> Nulliparous women at 34-36 weeks' gestational age who planned to give birth at either of 2 study hospitals Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> NR G2: 61.7kg G3: 58.5kg Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: 26.7 G2: 25 P < 0.05 G3: 28 P < 0.05 Parity: NR	Race, %: White G1: 98% G2: NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 17.6kg $P < 0.05$ G2: 14kg $P < 0.05$ Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Not stated Ascertained by: <ul style="list-style-type: none"> Hospital charts 	Birth weight: G1: NR G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Abdominal striae (kg) Groups: G1: Abdominal Striae Present G2: Abdominal Striae Absent Results: Pregnancy weight gain in abdominal striae groups (kg) G1: 14.9 G2: 13.0 $P < 0.05$ Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 3 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Marrero et al., 1992 Country and setting: UK, teaching hospital Enrollment Period: NR Funding: NR Study Objective: To study prevalence and severity of reflux symptoms in pregnancy Time frame: NR Duration of the study: 91 were in first trimester, 274 in second and 228 in third	Design: <ul style="list-style-type: none"> • Cross-sectional • Retrospective Total Study N: 607 Group Description: G1: Total G2: NR Group N: G1: 607 G2: NR Inclusion criteria: <ul style="list-style-type: none"> • Consecutive patients in antenatal clinic Exclusion criteria: <ul style="list-style-type: none"> • incomplete survey responses 	Pregravid weight: <ul style="list-style-type: none"> • Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> • No Categorized: <ul style="list-style-type: none"> • Continuous Age (mean, yrs): G1: 29.5 G2: NR Parity: % primigravid G1: 37.2 G2: NR	Race, %: White G1: 65% G2: NR Black G1: 14% G2: NR Hispanic NR Asian/Pacific Islander G1: 16% G2: NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Says record but not clearly stated Ascertained by: <ul style="list-style-type: none"> Weight gain in this paper was up until time of questionnaire NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: BMI before pregnancy and weight gain in pregnancy were not found to be risk factors for pregnancy heartburn Other infant outcomes: NR	Outcomes Description: Heartburn Groups: NA, continuous weight gain measure Results: Weight gain in pregnancy not risk factor for heartburn in pregnancy Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rodriguez et al., 2001</p> <p>Country and setting: Sweden, prenatal health care centers</p> <p>Enrollment Period: NR</p> <p>Funding: Swedish Council of Planning and Coordination of Research and Knut and Alice Wallenberg Foundation</p> <p>Study Objective: To document prevalence and frequency of 27 pregnancy symptoms and to systematically investigate, cross sectionally and prospectively, effect of psychosocial factors on prevalence and frequency of these symptoms, while controlling for biomedical</p> <p>Time frame: NR</p> <p>Duration of the study: initiation of prenatal care to delivery</p> <p>Quality: Fair</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 476 nulliparous Scandinavian women</p> <p>Group Description:</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Nulliparous Scandinavian origin Solicited by midwives from 5 prenatal health care centers (91% of women agreed to participate and provided information on at least one measure) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care recorded at first prenatal care visit <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Underweight BMI < 20; normal weight BMI 20-24.99; overweight BMI > 25 <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: weight at delivery minus prepreg weight 	Birth weight: G1: 3.457 (0.633) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Pregnancy symptoms: urogenital, gastrointestinal, musculoskeletal, miscellaneous pregnancy symptoms Other infant outcomes: NR	Outcomes Description: Pearson correlation coefficient (r) for prevalence of 27 pregnancy symptoms for continuous weight gain measure Pearson correlation coefficient (r) for frequency of 27 pregnancy symptoms for continuous weight gain measure Groups: G1: Week 10 G2: Week 12 G3: Week 20 G4: Week 28 G5: Week 32 G6: Week 36 Results Prevalence G1: 0.05 G2: 0.03 G3: 0.13 ($P < 0.05$) G4: 0.16 ($P < 0.01$) G5: 0.18 ($P < 0.01$) G6: 0.19 ($P < 0.001$) Frequency G1: 0.09 G2: 0.04 G3: 0.11 ($P < 0.05$) G4: 0.16 ($P < 0.01$) G5: 0.19 ($P < 0.01$) G6: 0.24 ($P < 0.001$) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 7 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Tulman et al., 1998</p> <p>Country and setting: USA, obstetric and nurse-midwifery practices</p> <p>Enrollment Period: NR</p> <p>Funding: NR</p> <p>Study Objective: To examine relationship of prepregnancy weight and pregnancy weight gain to functional status, physical symptoms, and physical energy</p> <p>Time frame: NR</p> <p>Duration of the study: Recruited from practices and had home visits during pregnancy-thus during pregnancy through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 222</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 222 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Englishspeaking, married, pregnant women at low risk who were 18 years of age and older. Participants could have no underlying medical problems (e.g., diabetes, chronic renal or cardiac disease) or preexisting factors in their obstetric histories that would classify them as high risk at time of recruitment during first trimester of pregnancy (e.g., previous premature birth, history of incompetent cervix) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Mmultiple gestations, if they delivered before 36 weeks, missing information on weight at first trimester interview or third trimester interview 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 22.82 (SD 3.49) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelinesno obese category - just > 26 <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 1. Gestational weight gain and discomforts of pregnancy (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 222 G2: NR Total weight gain: G1: 13.93 kg (SD 4.63) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Percentage weight gain during pregnancy Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference in pounds between prepregnancy weight and weight at time of data collection Percentage weight gain during pregnancy was calculated as weight gain in pounds divided by prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> There was a statistically significant difference in functional status between women whose total weight gain for pregnancy was more than recommended amount based on prepregnancy BMI ($n = 62$) and those who gained within recommended range ($n = 160$), $t(220) = 2.47$, $P = .014$. Women who gained an excessive amount of weight had a lower third trimester level of functional status ($M = 2.30$) than those who did not ($M = 2.43$). There were no differences in number of physical symptoms or level of physical energy for women who gained an excessive amount of weight and those who did not Other infant outcomes: <ul style="list-style-type: none"> None 	Outcomes Description: Inventory of Functional Status – Antepartum Period, 1-3 point scale (mean, SD) Groups: G1: Excess weight gain G2: Weight gain within recommended range Results: G1: 2.3 G2: 2.43 $P < 0.014$ Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 2. Gestational weight gain and hyperemesis

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Dodds et al., 2006</p> <p>Country and setting: Canada, perinatal database</p> <p>Enrollment Period: 1988-2002</p> <p>Funding: NR</p> <p>Study Objective: To evaluate maternal and neonatal outcomes among women with hyperemesis during pregnancy</p> <p>Time frame: 1988-2002</p> <p>Duration of the study: Prenatal to neonatal</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 156,091</p> <p>Group Description: G1: Antepartum admission for hyperemesis G2: No antepartum admission for hyperemesis</p> <p>Group N: G1: 1,270 G2: 154,821</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton 20 weeks or more gestation ≥ 500g at birth Hyperemetic pregnancies defined as those with 1 or more antepartum admissions for hyperemesis first of which occurred before 24 completed weeks gestation <p>Exclusion criteria: NA</p>	<p>Pregravid weight:</p> <ul style="list-style-type: none"> From records in database not mentioned whether it was self reported or not <p>G1: < 60kg: 45.4% 60-69: 25.3% 70-79: 13.9% ≥ 80: 15.3%</p> <p>G2: < 60kg: 42.8% 60-69: 27.6% 70-79: 15.1% ≥ 80: 14.5%</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): G1: < 20 years: 12.1% 20-29: 64.8% 30-34: 17.8% 35-49: 5.4% G2: < 20 years: 8.0% 20-29: 56.7% 30-34: 25.5% 35-49: 9.8%</p> <p>Parity: G1: % nulliparous: 48.7 G2: 44.3</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 21.4 G2: 30.2</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 2. Gestational weight gain and hyperemesis (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> < 7kg and ≥ 7kf Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not specifically stated by authors 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Antepartum admission for hyperemesis (Kg) Groups: G1: No antepartum admission for hyperemesis G2: Antepartum admission for hyperemesis Results Adjusted RR for pregnancy weight gain < 7kg G1: 1.0 (ref) G2: 2.1 (1.8-2.5) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Maternal prepregnancy weight Time period Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 2. Gestational weight gain and hyperemesis (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Dodds et al., 2006
(continued)

Evidence Table 2. Gestational weight gain and hyperemesis (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
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Evidence Table 3. Maternal weight gain and abnormal glucose metabolism

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Bianco et al., 1998 Country and setting: Mount Sinai Medical Center, New York City Enrollment period: Funding: NR Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women Time frame: NR Duration of the study: 1988 to 1995	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 613 morbidly obese 11,313 nonobese Group Description: G1: Obese G2: Controls Group N: G1: 613 G2: 11,313 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years Exclusion criteria: <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$) Pregravid BMI: <ul style="list-style-type: none"> NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$) Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)	Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$) Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$) Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$) Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes: Incidence of gestational diabetes Groups Reported only for BMI > 35: G1: weight loss or no gain G2: 1-15 lb gain G3: 16-25 lb gain G4: 26-35 lb gain Results G1: 15.7% G2: 15.0% G3: 14.4% G4: 13.4% G5: 12.5% ($P = \text{NS}$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Race Parity Clinic service Substance abuse And preexisting medical conditions Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Brennand et al., 2005 Country and setting: Canada, medical records Enrollment Period: Prenatal to birth Funding: cree board of health and social services of James Bay (Quebec) Study Objective: To determine effect of pregravid weight and pregnancy weight gain on pregnancy outcomes in Cree women Time frame: Prenatal to birth Duration of the study: 7 year period: January 1994 to December 2000	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 603 Group Description: G1: Normal: BMI 18.5 - 24.9 G2: Overweight: BMI 25-29.9 G3: Obese: BMI ≥ 30 G4: Total Group N: G1: 139 G2: 168 G3: 296 G4: 603 Inclusion criteria: <ul style="list-style-type: none"> Used only Cree women First birth observed per woman during study time period Must have first weight recorded within first 14 weeks gestation and final weight recorded within 4 weeks of birth Exclusion criteria: <ul style="list-style-type: none"> Women with secondary pregnancy in dataset (n = 792) Women with first weight record > 14 weeks gestation (n = 314) Women with final weight record > 4 weeks from birth (n = 202) Women with both first weight record > 14 weeks and final weight record > 4 weeks (n = 70) Women missing data on first or final weight (n = 3) 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care Medical records Measured within 14 weeks of gestation G1: 59.7 (5.0) G2: 73.0 (4.3) G3: 93.6 (12.3) G4: 80.0 (16.9) Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> Yes Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 20.8 (5.2) G2: 23.8 (5.4) G3: 25.5 (5.5) G4: 24.0 (5.7) Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: G1: 4.3 G2: 14.9 G3: 27.4 G4: 18.6 Hypertension, %: G1: 1.4 G2: 1.8 G3: 4.8 G4: 3.2 Additional characteristics: % low weight gain: G1: 20.1 G2: 10.1 G3: 28.0 G4: 21.2 % acceptable weight gain: G1: 28.8 G2: 32.1 G3: 33.4 G4: 32.0 % excessive weight gain: G1: 51.1 G2: 57.7 G3: 38.5 G4: 46.6

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 139 G2: 168 G3: 296 Total weight gain: Categorized: <ul style="list-style-type: none"> 1999 Canadian guidelines Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: within 4 weeks of birth 	Birth weight: NR Gestational diabetes, %: G1: 4.3 G2: 14.9 G3: 27.4 G4: 18.6 Cesarean delivery, %: G1: 10.8 G2: 11.3 G3: 24.1 ($p < 0.001$) Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Definition of low, adequate, and excessive weight gains: For normal weight women - adequate weight gain is 11.5 to 16 kg For overweight women, adequate weight gain is 7 to 11.5 kg For obese women, adequate weight gain is 7 to 11.5 kg Weight gain below specified range is "low" and weight gain above specified range is "excessive" Other infant outcomes: > 4000g, > 4500g	Outcomes: Incidence of gestational diabetes and impaired glucose tolerance Groups: G1: "Low weight gain" G2: "Acceptable weight gain" G3: "Excessive weight gain" All categories per Canadian Guidelines Results: Incidence of GDM G1: 38.6% G2: 27.3% G3: 19.3% ($P = 0.011$) Incidence IGT: G1: 12.0% G2: 15.2% G3: 7.9% ($P = 0.249$) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Brennand et al., 2005 (continued)	<ul style="list-style-type: none"> • Pregnancies with factors that may have influenced maternal weight gain such as 1 parent being non-Cree (n = 13), preterm deliveries (n = 91), twin pregnancies (n = 6), missing gestational age (n = 9) • Women with unknown glycemic status (n = 30), type 2 DM (n = 8), glycemic abnormalities before pregnancy not followed for diagnosis (n = 70) • Women classified as underweight (n = 5) 		

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
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Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Edwards et al., 1996 Country and setting: USA, hospital Enrollment Period: 1997-1993 Funding: NR Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change Time frame: 1997-1993 Duration of the study: 1997-1993	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,443 Group Description: G1: Obese G2: Normal Weight G3: total sample Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births Exclusion criteria: <ul style="list-style-type: none"> Missing data Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 G2: 61 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) Age (mean, yrs): G1: 27.1 G2: 25.4 Parity: NR	Race, %: White G1: NR G2: NR G3: 69.0 (Total sample) Black G1: NR G2: NR G3: 21.0 (Total sample) Hispanic G1: NR G2: NR G3: 7.0 (Total sample) Asian/Pacific Islander NR Other G1: NR G2: NR G3: 4.0 (Total sample) Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes: Incidence of gestational diabetes Groups Pre gravid wt 19.8-26.0 BMI: G1: < 11.5 kg gain G2: 11.6-16 kg gain G3: > 16 kg gain Pre gravid wt > 29 kg G4: lost/gained nothing G5: 0.5-6.5 kg gain G6: 7-11.5 kg gain G7: 12-16 kg gain G8: >16 kg gain Results Incidence gestational diabetes: G1: 2.3% G2: 3.3% G3: 2.9% ($P = .759$) G4: 13.3% G5: 24.3% G6: 11.9% G7: 16.7% G8: 17.3% ($P = .554$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Parity Race Prenatal smoking Prenatal alcohol use Prenatal illicit drug use Pregravid health Weight and adequacy of prenatal care Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Hackmon et al, 2007 Country and setting: United States, Hospital Enrollment period: 2003 Funding: NR Study Objective: Aim was to determine whether maternal age, prepregnancy and mid-trimester body mass index (BMI), or excessive mid-pregnancy weight gain predict abnormal glucose challenge test (GCT) results Time frame: 2003 Duration of the study: Entry into prenatal care through 24 to 28 weeks of pregnancy	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 75 Group Description: G1: Study population Group N: G1: 75 Inclusion criteria: <ul style="list-style-type: none"> Consecutive, inner city, singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Known gestational diabetes 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care NR Pregravid BMI: G1: 27.4 • Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 31 (range: 19-43) Parity: G1: 0.9	Race, %: White G1: 22 Black G1: 31 Hispanic G1: 39 Asian/Pacific Islander G1: 5 Other G1: 3 Smoking, %: NR Diabetes mellitus, %: G1: Abnl GCT: 29.3% Hypertension, %: NR Additional characteristics: NR

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes : Gestational diabetes	Background: Good
Total weight gain: • NR	Gestational diabetes, %: G1: Abnl GCT: 29.3%	Groups NR	Sample selection: Poor
Categorized: • Continuous	Cesarean delivery, %: NR	Results There was no difference in maternal weight gain during early pregnancy between patients with abnormal versus normal GCT values (mean+/-SD of 4.13+/-3.2 and 4.16+/-1.67, respectively).	Definition of maternal weight gain: Fair
Collected from: • Routine pre-natal care or maternity records	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: • Gravidity • Parity • Ethnicity • BMI	Definition of outcomes: Good
Ascertained by: • NR	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes • No difference in maternal weight gain during early pregnancy between patients with abnormal versus normal GCT values (mean+SD of 4.13+/-3.2 and 4.16+/-1.67, respectively)		Followup: Fair
	Other infant outcomes NR		Analysis comparability: Poor
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor
			Final Quality Score: Fair

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kabiru and Raynor, 2004 Country and setting: USA, hospital Enrollment Period: 1999 to 2002 Funding: NR Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes Time frame: 1999 to 2002 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,131 Group Description: G1: No change in BMI between first prenatal visit and delivery G2: 1 category increase in BMI between first prenatal visit and delivery G3: > 1 category increase in BMI between first prenatal visit and delivery Group N: G1: 2,556 G2: 2,252 G3: 323 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	Pregravid weight: <ul style="list-style-type: none"> Measured at first prenatal visit Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 Age (mean, yrs): G1: 24.7 (6.1) G2: 24.4 (5.7) G3: 25.2 (5.9) $P < 0.001$ Parity: G1: Gravidity (mean): 1.9 (1.9) G2: 1.5 (1.7) G3: 1.2 (1.7) $P < 0.001$	Race, %: White G1: 1.9 G2: 2.6 G3: 2.8 Black G1: 84.1 G2: 82.8 G3: 88.2 Hispanic G1: 13.9 G2: 14.6 G3: 9.0 Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean weight gain: G1: 8.6 pounds (8.4) G2: 22.2 pounds (10.2) G3: 55.3 pounds (23.8) Additional characteristics: NR

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) $P < 0.001$ G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) $P = 0.015$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.2 G2: 12.6 G3: 21.0 $P < 0.001$ G4: 13.0 G5: 14.3 G6: 19.3 $P = 0.256$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes description Incidence of gestational diabetes Groups: BMI < 25 first assessment: G1: no change BMI category G2: increase 1 category G3: increase > 1 category BMI ≥ 25 first assessment G4: no change BMI category G5: increase 1 category G6: increase > 1 category Results: G1: 0.5% G2: 1.5% G3: 3.7% ($P = .005$) G4: 1.0% G5: 3.3% G6: 1.9% ($P = .005$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pregravid BMI Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NR 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kieffer et al., 2006</p> <p>Country and setting: United States, community health center</p> <p>Enrollment period: Jan 1999 to Feb 2001</p> <p>Funding: Study supported by National Institutes of Diabetes and Digestive and Kidney Diseases (grant R18DK 062344); Biostatistics and Measurement Cores of Michigan Diabetes Research and Training Center(grant NIH5P60 DK20572); General Clinic Center, National Institutes of Health (grant M01 RR00042); Maternal and Child Health Bureau (grant R40 MC00115-03); and Detroit Community Academic Urban Research Center</p> <p>Study Objective: Study assessed combined influence of maternal weight and other anthropometric and metabolic characteristics on birthweights of Latino infants</p> <p>Time frame: Jan 1999 to Feb 2001</p> <p>Duration of the study: From entry into prenatal care up til delivery. Ave ga at entry was 17 weeks.</p>	<p>Design:</p> <ul style="list-style-type: none"> • Cohort • Prospective <p>Total Study N: 1,041</p> <p>Group Description: G1: Total</p> <p>Group N: G1: 1,041</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> • Latino women entering prenatal care during study period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> • Multiple gestation • Late entry into prenatal care • Previous participation in study • Miscarriage • Stillbirth • Missing records 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> • When unknown or missing-used weight obtained within first 10 weeks of pregnancy <p>G1: 63.4 ±12.9</p> <p>Pregravid BMI: G1: 25.9 ±5.0</p> <p>Imputed:</p> <ul style="list-style-type: none"> • Yes <p>Categorized:</p> <ul style="list-style-type: none"> • IOM guidelines <p>Age (mean, yrs): G1: 25.2 ±5.1</p> <p>Parity: Multiparous, no. (%) G1: 0 429 (41.2) 1- 574 (55.1) ≥4 38 (3.7)</p>	<p>Race, %: Hispanic G1: 100%</p> <p>Smoking, %: G1: 9% before 2% during</p> <p>Diabetes mellitus, %: G1: 6.8</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: Total 933 Total weight gain: G1: Adjusted R2: 0.30 kg [PE 8.2, SE 2.2, P < 0.01] Categorized: <ul style="list-style-type: none"> Continuous according to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: G1: 6.8 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Women with GDM had significantly lower average weight gain than those without GDM; weight gain not significantly related to glucose category Maternal waist, hip, and upper-arm circumference and upper-arm fat area associated with increasingly abnormal glucose categories among women with and without GDM Significant linear increase in birthweight with increasing glucose level maintained after further adjustment for maternal age, parity, BMI, weight gain, hypertensive disorders, and family history of diabetes Other infant outcomes: NR	Outcomes Description: GDM Groups: NA, weight gain as continuous variable (study aim to determine relationship of anthropometric and metabolic variables on infant outcomes) Results Women with GDM had significantly lower average weight gain than those without GDM but weight gain was not significantly related to glucose category Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Pregravid BMI Weight gain Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 2 Fair, 0 Poor Final Quality Score: Good

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kieffer et al., 2001</p> <p>Country and setting: USA, city health system</p> <p>Enrollment Period: Latinas: August 1996 - December 1998 African Americans: January 1995 to February 1998</p> <p>Funding: Grants from Health Resources and Services Administration, Maternal and Child Health Bureau, and African American health Initiative of Blue Cross Blue Shield of Michigan Foundation</p> <p>Study Objective: To estimate prevalence of GDM, obesity, and excessive weight gain during pregnancy among Latinas and African American women and to explore risk factors associated with GDM and its implications</p> <p>Time frame: Latinas: August 1996 to December 1998 African Americans: January 1995 to February 1998</p> <p>Duration of the study: during prenatal care</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: Latinas: 661 African American: 673</p> <p>Group Description: G1: Latina G2: African American</p> <p>Group N: G1: 661 G2: 673</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> African American and Latina women Received at least 4 prenatal care visits Delivery of single infant within large Detroit health system <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Documented diabetes prior to prenatal care Information on infants other than first pregnancy within study period 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported if not self-reported, used weight measured within 10 weeks of gestation <p>Pregravid BMI: Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines: < 19.8, 19.8-26.0, > 26.0-29.0, > 29.0-35.0, > 35.0 <p>Age (mean, yrs): G1: NR</p> <ul style="list-style-type: none"> < 20: 18.2% 20-29: 62.6% ≥ 30: 19.1% <p>G2: NR</p> <ul style="list-style-type: none"> < 20: 22.1% 20-29: 49.1% ≥ 30: 28.8% <p>Parity: % primiparous: G1: 39.7 G2: 43.6</p>	<p>Race, %: White NR Black G1: NR G2: 100 Hispanic G1: 100 G2: NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 3.8 G2: 10.7</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Married: G1: 60.3% G2: 31.5%</p> <p>Additional characteristics: NR</p>

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 661 G2: 673 Total weight gain: G1: 29.1 (14.6) G2: 32.6 (12.1) P < 0.004 vs. Latinas Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: GDM Groups: NR Results Multiple logistic regression analyses revealed statistically significant risk factors for GDM included weight gain during the first 28 wks gestation Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Family history diabetes Parity BMI Weight gain first 28 weeks Ethnicity Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Murakami et al., 2004 Country and setting: Japan, hospital Enrollment Period: 2001 Funding: NR Study Objective: To estimate risk of perinatal morbidity of mother and infant with respect to maternal prepregnancy BMI and weight gain in Japanese women Time frame: 2001 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 633 Group Description: G1: Total cohort G2: NR Group N: G1: 633 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Live, singletons delivered between 24 to 42 weeks gestation Exclusion criteria:	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 20.9 (2.8) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 29.1 (4.5) G2: NR Parity: G1: 0.6 (0.7) G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 8.5 G2: NR Diabetes mellitus, %: G1: 2.1 G2: NR Hypertension, %: NR Additional characteristics: G1: Preeclampsia - mild: 5.4%; severe: 4.1% G2: NR Additional characteristics: NR

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 633 G2: NR Total weight gain: G1: 10.5 (3.4) G2: NR Categorized: <ul style="list-style-type: none"> < 8.5kg, 8.5-12.5, > 12.5 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: last measurement was taken at hospitalization prior to delivery 	Birth weight: G1: 3,052.6 (483.8) G2: NR Gestational diabetes, %: G1: 2.1 G2: NR Cesarean delivery, %: G1: 10.3 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AORs (95% CI) of gestational diabetes Groups G1: < 8.5 kg gain G2: 8.5-12.5 kg gain G3: >12.5 kg gain Results G1: 5.14 (0.97-27.20) G2: Reference G3: 3.91 (0.61-24.73) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Parity Smoking Weight gain Pregravid BMI Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Saldana et al., 2006</p> <p>Country and setting: United States, hospital</p> <p>Enrollment period: August 1, 1995 through May 31, 2000</p> <p>Funding: Supported in part by National Institute of General Medical Sciences (Grant R25GM55336), National Institute of Child Health and Development (Grant 28684), and North Carolina Clinical Nutrition Research (Grant DK56350)</p> <p>Study Objective: Objective of study to examine weight and its relationship to glucose intolerance during pregnancy</p> <p>Time frame: August 1, 1995 through May 31, 2000</p> <p>Duration of the study: Entry into prenatal care through end of second trimester</p> <p>Quality: Good</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 952</p> <p>Group Description: G1: Normal Glucose Tolerance G2: Impaired Glucose Tolerance G3: GDM</p> <p>Group N: G1: 809 G2: 48 G3: 95</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy More than 16 years of age English speaking Access to phone Planned to continue care at 1 of study sites <p>Exclusion criteria:</p> <ul style="list-style-type: none"> From non-white or non-black racial group Having a second pregnancy in cohort Pre-existing diabetes No glucose screening data High screen without an oral glucose tolerance test 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 25 (0.24) G2: 28 (1.1) G3: 30 (0.82)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26 (0.22) G2: 29 (0.91) G3: 28 (0.59)</p> <p>Parity: G1: 0.9 (0.04) G2: 1.1 (0.16) G3: 0.9 (0.10)</p>	<p>Race, %: White G1: 58% G2: 73% G3: 69%</p> <p>Black G1: 42% G2: 27% G3: 31%</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: G1: 25% G2: 26% G3: 25%</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Weight gain ratio (observed/recommended [compared with IOM range]) G1: 1.43 (0.04) G2: 1.48 (0.21) G3: 1.88 (0.15)</p> <p>Additional characteristics: NR</p>

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Impaired Glucose Tolerance GDM	Background: Good
Total weight gain: G1: 9.1 (0.19) G2: 8.1 (0.90) G3: 9.4 (0.62)	Gestational diabetes, %: NR	Groups: Weight gain ratio (observed/recommended)	Sample selection: Good
Categorized: <ul style="list-style-type: none"> 2 weight gain variables were created. Weight gain was calculated by subtracting prepregnancy weight from weight at end of second trimester (G2 weeks). Weight gain ratio calculated as ratio of observed weight gain to recommended 	Cesarean delivery, %: NR	Results OR for weight gain ratio on Impaired Glucose Tolerance (95% CI) 0.9 (0.7, 1.1)	Definition of maternal weight gain: Good
	Instrumental delivery, %: NR	OR for weight gain ratio on GDM (95% CI) 1.2 (0.9, 1.4)	Definition of outcomes: Good
	Episiotomy, %: NR	Maternal confounders and effect modifiers accounted for in analysis: Race Maternal age Gestational age of weight measurement	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Followup: Good
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Other infant outcomes:		Analysis comparability: Good
Ascertained by: <ul style="list-style-type: none"> NR 			Analysis of outcomes: Fair
			Interpretation: Good
			Sum of Good/Fair/Poor: 7 Good, 2 Fair, 0 Poor
			Final Quality Score: Good

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Seghieri et al., 2005 Country and setting: Italy, outpatient clinic Enrollment Period: January, 1997 to December 2003 Funding: NR Study Objective: To study effect of parity on impairment of insulin sensitivity during pregnancy and on risk of GDM Time frame: January, 1997 to December 2003 Duration of the study: Caucasian pregnant women who received a 3 hour OGTT at 24 to 28 weeks gestation; also 75 women whose glucose levels were tested in 2 consecutive pregnancies	Design: <ul style="list-style-type: none"> Cross-sectional Retrospective Total Study N: 1880 Group Description: G1: Parity = 0 G2: Parity = 1 G3: Parity = 2 G4: Parity = 3 G5: Parity > 3 Group N: G1: 944 G2: 604 G3: 232 G4: 77 G5: 23 Inclusion criteria: <ul style="list-style-type: none"> Women who tested glucose intolerant by glucose challenge or who had an elevated 1 hour glucose or had other risk factors for GDM (hx glucose intolerance, macrosomic infants, diabetes of first degree relative) Exclusion criteria: <ul style="list-style-type: none"> No criteria are mentioned by authors 	Pregravid weight: <ul style="list-style-type: none"> Not explained in Methods section Pregravid BMI: G1: 22.5 (3.4) G2: 23.4 (4.1) G3: 23.7 (4.1) G4: 24.1 (5.3) G5: 24.4 (6.1) (<i>P</i> Duncan's test after anova = 0.0001, 0 vs.3, > 3) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.2 (4.3) G2: 31.4 (4.5) G3: 31.9 (4.5) G4: 33.8 (4.3) G5: 35.2 (4.2) (<i>P</i> Duncan's test after anova = 0.0001, 0 vs. 1,2,3, > 3) Parity: NR	Race, %: White G1: 100 G2: 100 G3: 100 G4: 100 G5: 100 Group 6 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Weight increase (kg) G1: 7.4 (3.6) G2: 7.2 (3.7) G3: 6.8 (4.0) G4: 6.9 (3.5) G5: 8.7 (8.6) (<i>P</i> Duncan's test after anova = 0.0119, 0, 1,2,3 vs. > 3) Additional characteristics: G1: 2-hr AUC glucose (area under the curve of glucose 0-120 min): 0.82 (0.17) G2: 0.85 (0.18) G3: 0.86 (0.18) G4: 0.86 (0.19) G5: 0.97 (0.17) (<i>P</i> Duncan's test after anova = 0.0001, 0, 1,2,3 vs. > 3) Additional characteristics: G1: ISI OGTT (mg/dl per min): 6 (3.3) G2: 5.8 (2.8) G3: 5.6 (2.2) G4: 5.6 (2.2) G5: 4 (2.5) (<i>P</i> Duncan's test after anova = 0.0002, 0, 1,2,3 vs. > 3)

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1764 G2: 124 Total weight gain: G1: 7.3 (3.9) G2: 7.2 (5.3) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by researchers - appears that weight gain was computed at time of testing which was at 24-28 weeks rather than total weight gain 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Weight gain as predictor of GDM OR (95% CI) Groups NA, weight gain continuous variable Results 1.024 (0.974-1.077) (<i>P</i> = NS) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Age Pregestational BMI Weight gain Family history diabetes Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 3 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Thorsdottir et al., 2002 Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland Enrollment Period: Funding: NR Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight Time frame: NR Duration of the study: 1998	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 614 Group Description: G1: No complication G2: Complications in pregnancy or delivery G3: Complications in pregnancy G4: Complications in delivery Group N: G1: 452 G2: 162 G3: 56 G4: 106 Inclusion criteria: <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 63.1 (6.2) G2: 62.0 (5.6) $P = 0.059$ G3: 61.7 (4.8) $P = 0.174$ G4: 62.2 (6.1) $P = 0.274$ Pregravid BMI: G1: 22.2 G2: 22.4 (1.6) $P = 0.270$ G3: 22.4 (1.5) $P = 0.338$ G4: 22.3 $P = 0.584$ Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29 G2: 29 $P = 0.857$ G3: 29 $P = 0.404$ G4: 29 $P = 0.398$ Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Proportional weight gain, %: G1: 26.0 G2: 28.0 $P = 0.018$ G3: 30.0 $P = 0.005$ G4: 27.0 $P = 0.546$ Additional characteristics: NR

Evidence Table 3. Maternal weight gain and abnormal glucose metabolism (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) $P = 0.080$ G3: 18.4 (5.1) $P = 0.013$ G4: 16.9 (5.1) $P = 0.887$ Categorized: <ul style="list-style-type: none"> According to IOM < 11.5, 11.-16.0, \geq 16.1, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3789 (469) G2: 3749 (565) $P = 0.389$ G3: 3643 (526) $P = 0.032$ G4: 3806 (578) $P = 0.529$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Incidence of gestational diabetes Groups: G1: <11.5 kg gain G2: 11.5-16.0 kg gain G3: 16.1-20.0 kg gain G4: >20 kg gain Results: G1: 2.9% G2: 0 G3: 0 G4: 0 ($P = .015$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Height Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race,%: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension,%: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Incidence of pregnancy induced hypertension Groups Reported only for BMI > 35: G1: weight loss or no gain G2: 1-15 lb gain G3: 16-25 lb gain G4: 26-35 lb gain G5: > 35 lb gain ($P = NS$) Results G1: 11.8% G2: 13.7% G3: 13.7% G4: 12.4% G5: 21.3% Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Race Parity Clinic service Substance abuse Preexisting medical conditions Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Brennand et al., 2005</p> <p>Country and setting: Canada, medical records</p> <p>Enrollment Period: Prenatal to birth</p> <p>Funding: cree board of health and social services of James Bay (Quebec)</p> <p>Study Objective: To determine effect of pregravid weight and pregnancy weight gain on pregnancy outcomes in Cree women</p> <p>Time frame: Prenatal to birth</p> <p>Duration of the study: 7 year period: January 1994 to December 2000</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 603</p> <p>Group Description:</p> <p>G1: Normal: BMI 18.5 - 24.9</p> <p>G2: Overweight: BMI 25-29.9</p> <p>G3: Obese: BMI ≥ 30</p> <p>G4: Total</p> <p>Group N:</p> <p>G1: 139</p> <p>G2: 168</p> <p>G3: 296</p> <p>G4: 603</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Used only Cree women First birth observed per woman during study time period Must have first weight recorded within first 14 weeks gestation and final weight recorded within 4 weeks of birth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with secondary pregnancy in dataset (n = 792) Women with first weight record > 14 weeks gestation (n = 314) Women with final weight record > 4 weeks from birth (n = 202) Women with both first weight record > 14 weeks and final weight record > 4 weeks (n = 70) Women missing data on first or final weight (n = 3) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care Medical records Measured within 14 weeks of gestation <p>G1: 59.7 (5.0)</p> <p>G2: 73.0 (4.3)</p> <p>G3: 93.6 (12.3)</p> <p>G4: 80.0 (16.9)</p> <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs):</p> <p>G1: 20.8 (5.2)</p> <p>G2: 23.8 (5.4)</p> <p>G3: 25.5 (5.5)</p> <p>G4: 24.0 (5.7)</p> <p>Parity: NR</p>	<p>Race,%:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%:</p> <p>G1: 4.3</p> <p>G2: 14.9</p> <p>G3: 27.4</p> <p>G4: 18.6</p> <p>Hypertension,%:</p> <p>G1: 1.4</p> <p>G2: 1.8</p> <p>G3: 4.8</p> <p>G4: 3.2</p> <p>Additional characteristics:</p> <p>% low weight gain:</p> <p>G1: 20.1</p> <p>G2: 10.1</p> <p>G3: 28.0</p> <p>G4: 21.2</p> <p>% acceptable weight gain:</p> <p>G1: 28.8</p> <p>G2: 32.1</p> <p>G3: 33.4</p> <p>G4: 32.0</p> <p>% excessive weight gain:</p> <p>G1: 51.1</p> <p>G2: 57.7</p> <p>G3: 38.5</p> <p>G4: 46.6</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 139 G2: 168 G3: 296 Total weight gain: Categorized: <ul style="list-style-type: none"> 1999 Canadian guidelines Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: within 4 weeks of birth 	Birth weight: NR Gestational diabetes, %: G1: 4.3 G2: 14.9 G3: 27.4 G4: 18.6 Cesarean delivery, %: G1: 10.8 G2: 11.3 G3: 24.1 (p < 0.001) Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Definition of low, adequate, and excessive weight gains: For normal weight women - adequate weight gain is 11.5 to 16 kg For overweight women, adequate weight gain is 7 to 11.5 kg For obese women, adequate weight gain is 7 to 11.5 kg Weight gain below specified range is "low" and weight gain above specified range is "excessive" Other infant outcomes: > 4000g, > 4500g	Outcomes Description: hypertensive disorders, PIH, preeclampsia Groups G1: "Low weight gain" G2: "Acceptable weight gain" G3: "Excessive weight gain" All categories per Canadian Guidelines Results HTN Disorders G1: 7.3% G2: 12.5% G3: 19.3% (P = 0.051) PIH: G1: 3.7% G2: 6.3% G3: 4.4% (P = 0.698) Preeclampsia G1: 3.7% G2: 6.3% G3: 14.9% (P = 0.013) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Brennand et al., 2005 (continued)	<ul style="list-style-type: none"> • Pregnancies with factors that may have influenced maternal weight gain such as 1 parent being non-Cree (n = 13), preterm deliveries (n = 91), twin pregnancies (n = 6), missing gestational age (n = 9) • Women with unknown glycemic status (n = 30), type 2 DM (n = 8), glycemic abnormalities before pregnancy not followed for diagnosis (n = 70) • Women classified as underweight (n = 5) 		

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
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Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
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Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Cedergren, 2006</p> <p>Country and setting: Sweden, Medical Birth Registry</p> <p>Enrollment Period: January 1, 1994 - December 31, 2002</p> <p>Funding: Ostergotland County Council</p> <p>Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes</p> <p>Time frame: January 1, 1994 to December 31, 2002</p> <p>Duration of the study: First visit to maternity health care center to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 245,526</p> <p>Group Description: BMI</p> <p>G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35</p> <p>Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 <p>Age (mean, yrs):</p> <p>G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1%</p> <p>G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9%</p> <p>G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5%</p> <p>G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4%</p> <p>G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%</p>	<p>Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR</p> <p>Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: <ul style="list-style-type: none"> < 8kg, 8-16, > 16 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Preeclampsia Groups G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI>35 Results Preeclampsia by BMI for weight gain < 8 kg (reference gain 8-16 kg) OR (95% CI): G1: 0.90 (0.55-1.48) G2: 0.73 (0.61-0.89) G3: 0.64 (0.54-0.76) G4: 0.52 (0.42-0.62) G5: 0.63 (0.51-0.79) Preeclampsia by BMI for weight gain >16 kg (reference weight gain 8-16kg) OR (95% CI): G1: 2.23 (1.83-2.71) G2: 2.31 (2.15-2.49) G3: 1.88 (1.72-2.06) G4: 1.65 (1.43-1.92) G5: 1.50 (1.17-1.92) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Smoking in early pregnancy Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Year of birth 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: DeVader et al., 2007</p> <p>Country and setting: United States, birth certificate data</p> <p>Enrollment period: 1999 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI</p> <p>Time frame: 1999 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 94,696</p> <p>Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs</p> <p>Group N: G1: 16,852 G2: 37,292 G3: 40,552</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8 –26.0 kg/m²) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized: NR</p> <p>Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4%</p> <p>Parity: NR</p>	<p>Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7</p> <p>Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Preeclampsia	Background: Good
Total weight gain: NR	Gestational diabetes, %: NR	Groups G1: Weight gain < 25 lbs G2: Weight gain 25-35 lbs G3: Gained > 35 lbs	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results AOR (95% CI) G1: 0.56 (0.49-0.64) G2: 1 G3: 1.88 (1.74-2.04)	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Race/ethnicity Education Medicaid status Tobacco and alcohol use Maternal height Adequacy of prenatal care 	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Child's sex Child's birth year 	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 		Followup: Fair
	Other infant outcomes: <ul style="list-style-type: none"> NR 		Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor
			Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Edwards et al., 1996 Country and setting: USA, hospital Enrollment Period: 1997-1993 Funding: NR Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change Time frame: 1997-1993 Duration of the study: 1997-1993	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,443 Group Description: G1: Obese G2: Normal Weight G3: total sample Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births Exclusion criteria: <ul style="list-style-type: none"> Missing data Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 G2: 61 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) Age (mean, yrs): G1: 27.1 G2: 25.4 Parity: NR	Race, %: White G1: NR G2: NR G3: 69.0 (Total sample) Black G1: NR G2: NR G3: 21.0 (Total sample) Hispanic G1: NR G2: NR G3: 7.0 (Total sample) Asian/Pacific Islander NR Other G1: NR G2: NR G3: 4.0 (Total sample) Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes,%: NR Cesarean delivery,%: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery,%: Episiotomy,%: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Preeclampsia, gestational hypertension Groups Pregravid wt 19.8-26.0 BMI: G1: < 11.5 kg gain G2: 11.6-16 kg gain G3: > 16 kg gain Pregravid wt > 29 kg G4: lost/gained nothing G5: 0.5-6.5 kg gain G6: 7-11.5 kg gain G7: 12-16 kg gain Results Preeclampsia: G1: 2.8% G2: 2.9% G3: 6.6% ($P = .048$) G4: 10.7% G5: 7.7% G6: 8.3% G7: 7.9% G8: 16.5% ($P = .076$) Gestational HTN: G1: 2.3% G2: 3.8% G3: 3.3% ($P = .607$) G4: 9.3% G5: 8.3% G6: 11.3% G7: 10.3% G8: 9.0% ($P = .832$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Parity Race Prenatal smoking Prenatal alcohol use Prenatal illicit drug use Pregravid health Weight and adequacy of prenatal care Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Jensen et al., 2005 Country and setting: Denmark, university hospitals Enrollment Period: Gestation through birth Funding: Many different funds Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women Time frame: Gestation through birth Duration of the study: NR	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 481 Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg Group N: G1: 93 G2: 134 G3: 132 G4: 122 Inclusion criteria: <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included Exclusion criteria: <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n-153) 	Pregravid weight: <ul style="list-style-type: none"> Records Patient report of pregravid BMI Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8) Parity: NR	Race, %: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0. 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Gestational hypertension Groups G1: < 5kg gain G2: 5.0-9.9 kg gain G3: 10.0-14.9 kg gain G4: ≥ 15.0 kg gain Results OR (95% CI) G1: 1 G2: 2.1 (0.8-5.7) G3: 3.6 (1.3-9.8) G4: 4.8 (1.7-13.1) (P = 0.001) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Results of 2 hour OGTT Age Pregnant BMI Parity Smoking Ethnicity and site of prenatal care Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kabiru and Raynor, 2004 Country and setting: USA, hospital Enrollment Period: 1999 to 2002 Funding: NR Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes Time frame: 1999 to 2002 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,131 Group Description: G1: No change in BMI between first prenatal visit and delivery G2: 1 category increase in BMI between first prenatal visit and delivery G3: > 1 category increase in BMI between first prenatal visit and delivery Group N: G1: 2,556 G2: 2,252 G3: 323 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	Pregravid weight: <ul style="list-style-type: none"> Measured at first prenatal visit Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 Age (mean, yrs): G1: 24.7 (6.1) G2: 24.4 (5.7) G3: 25.2 (5.9) $P < 0.001$ Parity: G1: Gravidity (mean): 1.9 (1.9) G2: 1.5 (1.7) G3: 1.2 (1.7) $P < 0.001$	Race, %: White G1: 1.9 G2: 2.6 G3: 2.8 Black G1: 84.1 G2: 82.8 G3: 88.2 Hispanic G1: 13.9 G2: 14.6 G3: 9.0 Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean weight gain: G1: 8.6 pounds (8.4) G2: 22.2 pounds (10.2) G3: 55.3 pounds (23.8) Additional characteristics: NR

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) $P < 0.001$ G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) $P = 0.015$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.2 G2: 12.6 G3: 21.0 $P < 0.001$ G4: 13.0 G5: 14.3 G6: 19.3 $P = 0.256$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Incidence preeclampsia Groups BMI < 25 first assessment: G1: no change BMI category G2: increase 1 category G3: increase > 1 category BMI ≥ 25 first assessment G4: no change BMI category G5: increase 1 category G6: increase >1 category Results G1: 1.9% G2: 3.2% G3: 1.6% ($P = .203$) G4: 2.8% G5: 3.7% ($P = .002$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid weight Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kiel et al., 2007</p> <p>Country and setting: United States, birth registry</p> <p>Enrollment period: 1990 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women</p> <p>Time frame: 1990 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 120,170</p> <p>Group Description:</p> <p>G1: Obese Class I (BMI 30–34.9) (n = 70,536)</p> <p>G2: Obese Class II (BMI 35–39.9) (n = 30,609)</p> <p>G3: Obese Class III (BMI 40 and More) (n = 19,025)</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NR 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NIH guidelines <p>Age (mean, yrs):</p> <p>G1: <26: 46% 26–35: 47% Older than 35: 8%</p> <p>G2: <26: 44% 26–35: 48% Older than 35: 8%</p> <p>G3: <26: 40% 26–35: 52% Older than 35: 9%</p> <p>Parity: Nulliparous:</p> <p>G1: 34% G2: 33% G3: 32%</p>	<p>Race, %: White G1: 78 G2: 77 G3: 73</p> <p>Black G1: 22 G2: 23 G3: 27</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: 22</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% ($P < 0.05$) G2: SGA: 7% LGA: 16% ($P < 0.05$) G3: SGA: 6% LGA: 18% ($P < 0.05$)	Outcomes Description: Preeclampsia	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41	Groups Analysis done by each class of obesity and weight changes in gestation: <ul style="list-style-type: none"> • Weight loss ≥ 10 lbs • Weight loss 2-9 lbs • No weight change • Gain 2-9 lbs • Gain 10-14 lbs • Gain 15-25 lbs • Gain 26-35 lbs • Gain > 35 lbs. 	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, • and greater than 35 lb gain 	Instrumental delivery, %: NR Episiotomy, %: NR	Results Data all presented in graph form: Using a gain of 15-25 pounds as reference for each obesity class, OR of preeclampsia lower with less weight gain and higher with more weight gain.	Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Education • Poverty (defined as participation in one or more subsidized programs) • Tobacco use • Parity • Chronic hypertension 	Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair
Ascertained by: NR		Infant and child confounders and effect modifiers accounted for in analysis: NR	

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 of 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>	

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Murakami et al., 2004 Country and setting: Japan, hospital Enrollment Period: 2001 Funding: NR Study Objective: To estimate risk of perinatal morbidity of mother and infant with respect to maternal prepregnancy BMI and weight gain in Japanese women Time frame: 2001 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 633 Group Description: G1: Total cohort G2: NR Group N: G1: 633 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Live, singletons delivered between 24 to 42 weeks gestation Exclusion criteria: NR	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 20.9 (2.8) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 29.1 (4.5) G2: NR Parity: G1: 0.6 (0.7) G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 8.5 G2: NR Diabetes mellitus, %: G1: 2.1 G2: NR Hypertension, %: NR Additional characteristics: G1: Preeclampsia - mild: 5.4%; severe: 4.1% G2: NR Additional characteristics: NR

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 633 G2: NR Total weight gain: G1: 10.5 (3.4) G2: NR Categorized: <ul style="list-style-type: none"> < 8.5kg, 8.5-12.5, > 12.5 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: last measurement was taken at hospitalization prior to delivery 	Birth weight: G1: 3,052.6 (483.8) G2: NR Gestational diabetes, %: G1: 2.1 G2: NR Cesarean delivery, %: G1: 10.3 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Preeclampsia Groups G1: < 8.5 kg gain G2: 8.5-12.5 kg gain G3: >12.5 kg gain Results Estimated OR (95% CI) G1: 0.74 (0.37-1.48) G2: 1 G3: 0.57 (0.24-1.32) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Parity Smoking Weight gain Gestational weeks Pregravid BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ogunyemi et al., 1999</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1990 to 1995</p> <p>Funding: NR</p> <p>Study Objective: To test IOM guidelines in a predominantly rural black population</p> <p>Time frame: 1990 to 1995</p> <p>Duration of the study: 582 women who delivered and then their medical record was abstracted</p>	<p>Design:</p> <ul style="list-style-type: none"> Other observational: 582 women consecutive women who delivered Retrospective <p>Total Study N: 582</p> <p>Group Description: G1: Underweight G2: Normal G3: Overweight G4: Obese </p> <p>Group N: G1: 78 G2: 223 G3: 78 G4: 203 </p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Single child > 37 weeks gestation Black Registration for prenatal care within first trimester of pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Difference between recalled pregravid weight and measured first trimester weight was $\geq 10\%$ 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 20.3 G2: 22.1 G3: 23.7 G4: 25.4 ($P < 0.01$) </p> <p>Parity: G1: # nulliparous: 53 G2: 54 G3: 42 G4: 26 ($P < 0.01$) </p>	<p>Race,%: White NR Black G1: 100 G2: 100 G3: 100 G4: 100 Hispanic NR Asian/Pacific Islander NR Other NR </p> <p>Smoking,%: NR </p> <p>Diabetes mellitus,%: G1: n = 0 G2: n = 4 G3: n = 3 G4: n = 8 ($P = 0.02$) </p> <p>Hypertension,%: G1: n = 1 G2: n = 2 G3: n = 4 G4: n = 14 ($P < 0.01$) </p> <p>Additional characteristics: NR </p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 196 G2: 181 G3: 205 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: weight at last prenatal visit 	Birth weight: G1: 3,029 G2: 3,210 G3: 3,283 ($P < 0.01$) Gestational diabetes, %: G1: n = 0 G2: n = 4 G3: n = 3 G4: n = 8 ($P = 0.02$) Cesarean delivery, %: G1: n = 20 G2: n = 10 G3: n = 17 ($P = 0.02$) Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> Asthma Preeclampsia Vomiting C-section Other infant outcomes: <ul style="list-style-type: none"> Low birth weight Fetal distress NICU 	Outcomes Description: Incidence preeclampsia Groups G1: "low weight gain" G2: "normal weight gain" G3: "high weight gain" Results G1: 10% G2: 7% G3: 19% ($P = <.01$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pregravid BMI Tobacco use Hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Poor Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Thorsdottir et al., 2002</p> <p>Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight</p> <p>Time frame: NR</p> <p>Duration of the study: 1998</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 614</p> <p>Group Description:</p> <p>G1: No complication</p> <p>G2: Complications in pregnancy or delivery</p> <p>G3: Complications in pregnancy</p> <p>G4: Complications in delivery</p> <p>Group N:</p> <p>G1: 452</p> <p>G2: 162</p> <p>G3: 56</p> <p>G4: 106</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.1 (6.2)</p> <p>G2: 62.0 (5.6) $P = 0.059$</p> <p>G3: 61.7 (4.8) $P = 0.174$</p> <p>G4: 62.2 (6.1) $P = 0.274$</p> <p>Pregravid BMI:</p> <p>G1: 22.2</p> <p>G2: 22.4 (1.6) $P = 0.270$</p> <p>G3: 22.4 (1.5) $P = 0.338$</p> <p>G4: 22.3 $P = 0.584$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs):</p> <p>G1: 29</p> <p>G2: 29 $P = 0.857$</p> <p>G3: 29 $P = 0.404$</p> <p>G4: 29 $P = 0.398$</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Proportional weight gain, %:</p> <p>G1: 26.0</p> <p>G2: 28.0 $P = 0.018$</p> <p>G3: 30.0 $P = 0.005$</p> <p>G4: 27.0 $P = 0.546$</p> <p>Additional characteristics: NR</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) $P = 0.080$ G3: 18.4 (5.1) $P = 0.013$ G4: 16.9 (5.1) $P = 0.887$ Categorized: <ul style="list-style-type: none"> According to IOM < 11.5, 11.-16.0, ≥ 16.1, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3789 (469) G2: 3749 (565) $P = 0.389$ G3: 3643 (526) $P = 0.032$ G4: 3806 (578) $P = 0.529$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Gestational hypertension, preeclampsia Groups G1: <11.5 kg gain G2: 11.5-16.0 kg gain G3: 16.1-20.0 kg gain G4: >20 kg gain Results % gestational htn G1: 1.5% G2: 4.6% G3: 5.1% G4: 9.2% ($P = 0.026$) % preeclampsia G1: 1.4% G2: 2.3% G3: 5.4% G4: 4.4% ($P = 0.262$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Height Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Wataba et al., 2006</p> <p>Country and setting: Japan, academic medical center</p> <p>Enrollment Period: 1981 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To analyze association of pregnancy complications with prepregnant body mass index and weight gain during pregnancy in Japanese women</p> <p>Time frame: 1981 to 1999</p> <p>Duration of the study: Entry into PNC up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base and look at medical records retrospectively Retrospective <p>Total Study N: 21,718</p> <p>Group Description: G1: Nulliparous G2: Parous women</p> <p>Group N: G1: 10,413 G2: 11,305</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy delivering term baby at Osaka Med Center and Research Institute for Maternal and Child Health in 1981-1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> None reported 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> In data base don't know if self reported <p>Pregravid BMI: G1: 20.5 (2.6) G2: 21.1 (3.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in 2 kg/m² point intervals from prepregnancy weight; categorical into low, medium, high BMI groups (< 18, 18-23.9, > 24) <p>Age (mean, yrs): G1: 27.8 (4.1) G2: 30.45 (3.9)</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 4. Gestational weight gain and hypertensive disorders (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 10413 G2: 11305</p> <p>Total weight gain: G1: kg/wk: 0.25 (SD 0.09) G2: kg/wk: 0.24 (0.09) $P < 0.01$</p> <p>Categorized:</p> <ul style="list-style-type: none"> • Categorical in kg/wk using prepregnancy weight and weight at delivery divided by gestational age of infant at birth <p>Collected from:</p> <ul style="list-style-type: none"> • Rate of weight gain determined by: total weight gain divided by weeks ga <p>Ascertained by:</p> <ul style="list-style-type: none"> • Based on last clinically measured weight prior to delivery: and subtracting prepregnancy weight 	<p>Birth weight: G1: SGA: 5.4% LGA 5.2% G2: SGA 6.5% LGA 5.2%</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: • NR</p> <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Preeclampsia</p> <p>Groups Separate analyses done for low, medium and high pregravid weight groups by following intervals of kg/week gain:</p> <ul style="list-style-type: none"> • <0.15 • 0.15-.20 • 0.20-.25 • 0.25-.30 • 0.30-.35 • 0.35-40 • >0.40 <p>Results No clear trends for preeclampsia or severe preeclampsia by pregravid weight status and kg/week weight gains. AOR generally crossed 1.0 or had wide confidence intervals</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Baseline BMI • Parity <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor</p> <p>Final Quality Score: Poor</p>

Evidence Table 5. Gestational weight gain and gallstones

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ko, 2006</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1987-2001</p> <p>Funding: NR</p> <p>Study Objective: Aim was to define incidence and risk factors for postpartum hospitalization as a result of gallstone-related disease</p> <p>Time frame: 1987 to 2001</p> <p>Duration of the study: Entry into prenatal care through the postpartum period</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 26,680</p> <p>Group Description: G1: Cases G2: Controls</p> <p>Group N: G1: 6,670 G2: 20,010</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Diagnosis of biliary tract-related diseases either at delivery hospitalization or on hospitalizations within 1 year postpartum Women with acute pancreatitis with associated diagnosis of cholelithiasis, choledocholithiasis, or cholangitis. Cases were defined as any woman with a biliary tract diagnosis at delivery hospitalization, or with a primary discharge diagnosis related to the biliary tract for a postpartum hospitalization Four controls who were not hospitalized for biliary tract disease within 1 yr postpartum were randomly selected for each case and matched for year of delivery <p>Exclusion criteria:</p> <ul style="list-style-type: none"> See above 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: < 25 32.8%, 25-29.9 26.8%, > 30 40.4% G2: BMI < 25 62.8%, 25-29.9 22.1%, > 30 15.1%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce < 25, 25-29.9, > 30 <p>Age (mean, yrs): G1: 26.0 ± 5.9 G2: 27.2 ± 6.0 P < 0.001</p> <p>Parity: G1: Median 1 (0–13) G2: Median 1 (0–14)</p>	<p>Race, %: White G1: 71.3 G2: 83.5 Black G1: 3.6 G2: 3.9 Hispanic G1: 17.5 G2: 11.2 Asian/Pacific Islander G1: 2.6 G2: 6.4 Other G1: 17.8 G2: 12.8</p> <p>Smoking, %: G1: 17.4 G2: 15.0</p> <p>Diabetes mellitus, %: G1: 5.0 G2: 3.0</p> <p>Hypertension, %: Pregnancy: G1: 1.6% G2: 0.8%</p> <p>Additional characteristics: NR</p>

Evidence Table 5. Gestational weight gain and gallstones (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 6670 G2: 20010 Total weight gain: G1: 12.6 ± 7.1 G2: 14.4 ± 6.0 <i>P</i> < 0.001 Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> birth certificate data 	Birth weight: G1: 3,442 ± 767 G2: 3,443 ± 718 Gestational diabetes, %: G1: 5.0 G2: 3.0 Cesarean delivery, %: G1: 25.1 G2: 21.3 Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> “Risk of hospitalization was inversely associated with weight gain during pregnancy, even after adjustment for prepregnancy body mass index.” Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> Hospitalization for gallstones at delivery or within the first year postpartum Groups: G1: Cases G2: Controls Results: OR for pregnancy weight gain, per kg G1: 0.98 (0.97- 0.99) <i>P</i> < 0.001 G2: NR Outcomes Set 2: NR Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Pre-gravid BMI GDM Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Poor Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 5. Gestational weight gain and gallstones (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Lindseth and Bird-Baker, 2004 Country and setting: USA, hospitals and clinics Enrollment Period: NR Funding: NIH, NICHD Study Objective: To examine relationships of demographics, anthropometrics, prenatal physical activity, serum cholesterol, and nutrient intakes to symptomatic cholelithiasis occurrence Time frame: NR Duration of the study: 14 weeks gestation to 1 month post-partum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 128 Group Description: G1: total cohort G2: NR Group N: G1: 128 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Within first 12 weeks of pregnancy Consented to participation 18 to 40 years of age Could understand, read, and speak English Exclusion criteria: NR	Pregravid weight: <ul style="list-style-type: none"> Measured by study investigators Routine pre-natal care Pregravid BMI: G1: 26.5 (6.08) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 1990 National Academy of Sciences Standards Age (mean, yrs): G1: 26.0 (4.78) G2: NR Parity: Gravida: G1: 2.7 (1.65) G2: NR	Race, %: White G1: 76% G2: NR Black NR Hispanic NR Asian/Pacific Islander NR Other G1: 24% (Native American) G2: NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 5. Gestational weight gain and gallstones (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not specifically stated 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: cholelithiasis in 16 women (12.5%) Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Cholelithiasis during pregnancy or upto 12 weeks postpartum Groups: NA, weight gain continuous variable G1: 128 G2: NR Results: Prenatal weight gain Partial correlation = 0.33; B = 0.13; not statistically significant Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Prenatal physical activity Dietary fat Dietary iron supplement History of gallbladder disease Serum cholesterol Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 6. Gestational weight gain and premature rupture of membranes

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Gosselink et al., 1992</p> <p>Country and setting: USA, university clinics</p> <p>Enrollment Period: September 1985-August 1987 (University of Iowa Hospitals) September 1987-April 1990 (University of Chicago)</p> <p>Funding: US Public Health Services, National Institute of Child Health and Human Development</p> <p>Study Objective: To test hypothesis that maternal prepregnancy body weight, weight gain during gestation, and prepregnancy and pregnancy diet and supplement status relate to PROM and preterm delivery</p> <p>Time frame: September 1985 to August 1987 (University of Iowa Hospitals) September 1987 to April 1990 (University of Chicago)</p> <p>Duration of the study: Interviewed within 72 hours of delivery to obtain retrospective data</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: Total n = 1,176</p> <ul style="list-style-type: none"> n = 184, preterm delivery (≤ 36 weeks) and PROM n = 220, preterm delivery without PROM n = 184, fullterm delivery with PROM n = 588, Controls <p>Group Description: G1: All cases G2: All controls</p> <p>Group N: G1: 588 G2: 588</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 15-45 years Singleton delivery Consented to interview while still in hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Mothers with chronic conditions likely to adversely affect the course of pregnancy such as cystic fibrosis, emphysema, chronic heart failure, or poorly controlled diabetes mellitus Women receiving chemotherapy or radiation treatments Mothers with limited mental capacity 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: ≤ 20: 26.5% 20-29: 65.0% ≥ 30: 8.5% G2: ≤ 20: 19.4% 20-29: 68.6% ≥ 30: 12.0%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Underweight: < 20 Normal weight: 20-29 (referent) Obese: > 30 <p>Age (mean, yrs): NR</p> <p>Parity: G1: % nulliparous: 44.4 G2: % nulliparous: 44.4</p>	<p>Race, %: White G1: 36.6 G2: 36.6 Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 6. Gestational weight gain and premature rupture of membranes (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 588 G2: 588 Total weight gain: G1: < 21 lbs: 36.7% 21-30 lbs: 34.0% 31-40 lbs: 14.1% > 40 lbs: 15.1% G2: < 21 lbs: 19.6% 21-30 lbs: 28.9% 31-40 lbs: 24.1% > 40 lbs: 27.4% Categorized: <ul style="list-style-type: none"> • < 21lbs • 21-30 • 31-40 • > 40lbs Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity recordsnot stated Ascertained by: <ul style="list-style-type: none"> • Not specifically stated 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes descriptions: AOR for premature rupture of membrane (95% CI) Groups: G1: GWG: 21-30 lbs G2 GWG: 31-40 lbs G3 GWG: > 40 lbs G4 GWG: < 21 lbs or lost weight Results: Preterm, PROM moms and matched controls G1: 1.00 G2: 0.24 (0.09-0.61) G3: 0.19 (0.07-0.57) G4 2.70 (1.14-6.36) Full term, PROM moms and matched controls G1 1.00 G2: 0.56 (0.33-0.94) G3 0.83 (0.48-1.46) G4 0.83 (0.44-1.57) Preterm without PROM moms and matched controls G1: 1.00 G2: 0.42 (0.21-0.84) G3: 0.37 (0.17-0.80) G4 1.34 (0.78-2.32) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Pre-gravid BMI • Fe supplementation • Urinary tract infection • Chorioamnionitis • Chlamydia • History of previous PROM • Adequacy of pregnancy diet • USDA suggested dairy intake • Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 6. Gestational weight gain and premature rupture of membranes (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nohr et al., 2007</p> <p>Country and setting: Denmark, primary care</p> <p>Enrollment period: 1996 to 2002</p> <p>Funding: Ellen Aagaard Nohr is supported by a grant (No.2002B020) from Health Insurance Foundation. Danish National Research Foundation established Danish Epidemiology Science Centre, which initiated and created Danish National Birth Cohort. Cohort is also result of major grant from this Foundation. Additional support for Danish National Birth Cohort obtained from Pharmacy Foundation, Egmont Foundation, March of Dimes Birth Defects Foundation and Augustinus Foundation</p> <p>Study Objective: Aim of present study to assess impact of obesity and gestational weight gain on risk of subtypes of preterm birth</p> <p>Time frame: 1996 to 2002</p> <p>Duration of the study: Entry into prenatal care - delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 0</p> <p>Group Description: G1: Total</p> <p>Group N: G1: 62,167</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with singleton pregnancies who provided an interview at approximately 16 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data on weight gain in pregnancy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs): G1: < 25: 7,757 (12.5%) 25 to 29: 26,152 (42.1%) 30 to 34: 21,181 (34.1%) 35+: 7,077 (11.4%)</p> <p>Parity: G1: 47% primiparous</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 84.1% nonsmoker</p> <p>Diabetes mellitus,%: G1: 1.2%</p> <p>Hypertension,%: G1: 1.6%</p> <p>Additional characteristics: NR</p>

Evidence Table 6. Gestational weight gain and premature rupture of membranes (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 62 167 G2: 2751 G3: 41 991 G4: 12 270 G5: 5155 Total weight gain: G1: Weekly weight gain (g) 8722;275g: (15.3%) 276–675g: (68.3%) 676g+ (16.4%) Categorized: <ul style="list-style-type: none"> Weekly weight gain categorised into 3 groups (low, medium, high) using cutpoints at 275 and 675 g, which were similar to those used in other studies Collected from: <ul style="list-style-type: none"> Does not specify-women self-reported weight gain status Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: G1: 1.2% Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Before 34 weeks of gestation, risk of induced preterm delivery potentiated among obese women with high weight gain, and after 34 weeks, risk was potentiated at extremes, namely among underweight women with a low weight gain and obese women with a high weight gain Other infant outcomes: NR	Outcomes Description: Adjusted hazard of spontaneous preterm birth with preterm premature rupture of membrane (PPROM) Groups: weekly weight gain G1: <275 g G2: 276-675 g G2: >675 g Results: Spontaneous preterm birth with PPRM G4: 1.5 [1.2, 1.7] G4: 1.0 Reference G4: 1.2 [1.0, 1.5] Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Height Alcohol use Socio-occupational status Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 7. Gestational weight gain and preterm labor

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Lang et al., 1996</p> <p>Country and setting: USA, hospital</p> <p>Enrollment period: August 1977-March 1980</p> <p>Funding: NR</p> <p>Study Objective: To estimate effects of 23 factors on prevalence of premature labor and fetal growth retardation across birthweight spectrum</p> <p>Time frame: August 1977 to March 1980</p> <p>Duration of the study: Pregnancy through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 11,505</p> <p>Group Description: G1: Prevalence of preterm labor G2: Prevalence of SGA</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton Livebirths Had data on birthweight, gestational age, and sex Infants with gestational age from 22 to 45 weeks Birthweights no more than 50% higher than 90th percentile for sex and gestational age <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with menstrual abnormalities for whom gestational dating was problematic Stillbirths Incomplete data Preterm delivery Women with preexisting diabetes mellitus, hypertension, epilepsy, asthma 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Not stated by authors <p>G1: NR</p> <ul style="list-style-type: none"> < 100 pounds: 11.2 100-125: 5.9 126-160: 5.1 161-180: 7.3 > 180: 4.4 <p>G2: NR</p> <ul style="list-style-type: none"> < 100 pounds: 24.9 100-125: 12.6 126-160: 7.7 161-180: 6.5 > 180: 5.9 <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): G1:</p> <ul style="list-style-type: none"> < 15: 14.8 16-19: 11.2 20-24: 8.2 25-34: 4.6 ≥ 35: 5.5 <p>G2:</p> <ul style="list-style-type: none"> < 15: 25.0 16-19: 17.6 20-24: 14.3 25-34: 9.4 ≥ 35: 7.2 <p>Parity: G1: 6.4 G2: 12.3</p>	<p>Race,%: White G1: 5.3 G2: 9.1</p> <p>Black G1: 9.6 G2: 17.7</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: 5.0 G2: 14.0</p> <p>Smoking,%: % smoked throughout pregnancy: G1: 8.3 G2: 17.9</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 7. Gestational weight gain and premature labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Weekly rate of weight gain Collected from: <ul style="list-style-type: none"> Not stated by authors Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> AOR for preterm labor (95% CI) Groups G1: Weekly weight gain \leq 0.40 G2: Weekly weight gain > 0.40-0.65 G3: Weekly weight gain > 0.65-0.90 G4: Weekly weight gain > 0.90 G5: Weekly weight gain missing Results G1: 3.1 (2.3-4.2) G2: 1.6 (1.3-2.0) G3: 1.0 (ref) G4: 1.3 (1.0-1.6) G5: 2.4 (1.1-5.0) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Maternal height Prepregnancy weight Maternal education Health insurance Planned pregnancy Previous induced abortion Previous spontaneous abortion Previous still birth Maternal morbidity Caffeine intake Marijuana Infant and child confounders and effect modifiers accounted for in analysis: Infant sex	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Good Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 3 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 8. Maternal weight gain and post-term pregnancy

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Cedergren, 2006</p> <p>Country and setting: Sweden, Medical Birth Registry</p> <p>Enrollment Period: January 1, 1994 - December 31, 2002</p> <p>Funding: Ostergotland County Council</p> <p>Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes</p> <p>Time frame: January 1, 1994 to December 31, 2002</p> <p>Duration of the study: First visit to maternity health care center to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 245,526</p> <p>Group Description: BMI</p> <p>G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35</p> <p>Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 <p>Age (mean, yrs):</p> <p>G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1%</p> <p>G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9%</p> <p>G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5%</p> <p>G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4%</p> <p>G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%</p>	<p>Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR</p> <p>Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 8. Maternal weight gain and post-term pregnancy (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: <ul style="list-style-type: none"> < 8kg, 8-16, > 16 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Post-term pregnancy (>41 weeks) Groups G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI>35 Results Post-term pregnancy by BMI for weight gain < 8 kg (reference gain 8-16 kg) OR (95% CI): G1: 0.66 (0.27-1.63) G2: 0.86 (0.64-1.16) G3: 1.08 (0.87-1.42) G4: 1.23 (0.84-1.79) G5: 1.25 (0.66-2.37) Post-term pregnancy by BMI for weight gain >16 kg (reference weight gain 8-16kg) OR (95% CI): G1: 0.88 (0.56-1.39) G2: 0.87 (0.74-1.03) G3: 0.82 (0.66-1.03) G4: 0.78 (0.50-1.21) G5: 1.11 (0.51-2.41) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Smoking in early pregnancy Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Year of birth 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 9. Gestational weight gain and induction of labor

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: DeVader et al., 2007</p> <p>Country and setting: United States, birth certificate data</p> <p>Enrollment period: 1999 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI</p> <p>Time frame: 1999 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 94,696</p> <p>Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs</p> <p>Group N: G1: 16,852 G2: 37,292 G3: 40,552</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8 –26.0 kg/m²) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay <p>Pregravid BMI: NR</p> <ul style="list-style-type: none"> Imputed: No Categorized: <p>Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4%</p> <p>Parity: NR</p>	<p>Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7</p> <p>Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: AOR for failed induction of labor	Background: Good
Total weight gain: NR	Gestational diabetes, %: NR	Groups G1: < 30 lbs G2: 30-35lbs G3: > 35 lbs	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results G1: 0.68 (95% CI, 0.59–0.78) G2: 1.0 G3: 1.51 (95% CI, 1.39–1.64)	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR		Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR		Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 	Maternal confounders and effect modifiers accounted for in analysis: Maternal age, maternal race or ethnicity, maternal education, Medicaid status, tobacco use, alcohol use, maternal height, prior pregnancy, adequacy of prenatal care Infant and child confounders and effect modifiers accounted for in analysis: Child's gender, birth year	Followup: Fair
			Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor
			Final Quality Score: Fair
	Other infant outcomes: <ul style="list-style-type: none"> NR 		

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ekblad and Grenman, 1992</p> <p>Country and setting: Finland, hospital</p> <p>Enrollment Period: July 1, 1985 - December 31, 1985 (6 months)</p> <p>Funding: NR</p> <p>Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome</p> <p>Time frame: July 1, 1985 to December 31, 1985 (6 months)</p> <p>Duration of the study: Prepregnancy to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery <p>Total Study N: Total n = 357</p> <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls <p>Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6</p> <p>Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Not stated 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records - not stated if self reported <p>G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5)</p> <p>Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0)</p> <ul style="list-style-type: none"> Imputed: No Categorized: Continuous $\geq 20\%$ over or under normal weight for height <p>Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4)</p> <p>Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Grading
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) $P < 0.05$ compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) $P < 0.0005$ compared to controls G4: 23.2 (22.8) $P < 0.0005$ compared to controls G5: 13.2 (3.4) Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3712 g (614) $P < 0.05$ compared to controls G2: 3293 (362) $P < 0.05$ compared to controls G3: 3284 (880) G4: 3803 (538) $P < 0.005$ compared to controls G5: 3538 (535) Gestational diabetes,%: NR Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Induction of labor (%) Groups G1: weight gain ≤ 5kg G2: weight gain ≥ 20kg G3: reference (normal prepregnancy weight and normal weight gain [undefined]) Results G1: 23 % G2: 43 % G3: 24 % $P < 0.05$ for G2 vs. G3 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Graves et al., 2006</p> <p>Country and setting: USA, midwifery practices</p> <p>Enrollment Period: January 1, 1998-December 31, 2000</p> <p>Funding: NR</p> <p>Study Objective: To identify association between prepregnancy BMI, weight gain in pregnancy, and newborn birth weight on route of delivery and induction of labor in patients receiving nurse-midwifery care</p> <p>Time frame: January 1, 1998-December 31, 2000</p> <p>Duration of the study: PRN care up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> • Cohort • Retrospective <p>Total Study N: 1,500</p> <p>Group Description: G1: Total cohort</p> <p>Group N: G1: 1,500</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> • Non-diabetic • Entered labor after 34 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> • Planned cesarean delivery (n = 8) • Unknown parity (in analyses in which parity was an important consideration, n = 40) • Hypertension • Diabetes 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> • Actual prepregnant weight or early first trimester weight documented in medical records <p>Pregravid BMI: G1: < 19.8: 9.4% 19.8-26.0: 52.1% 26.1-29.0: 20.6% > 29: 17.4%</p> <p>Imputed:</p> <ul style="list-style-type: none"> • No <p>Categorized:</p> <ul style="list-style-type: none"> • IOM guidelines <p>Age (mean, yrs): G1: ≤ 19 years: 32.2% 20-34: 62.4% ≥ 35: 4.9%</p> <p>Parity: G1: % nulliparous: 42.3</p>	<p>Race,%: White G1: 26.9 Black G1: 18.7 Hispanic G1: 52.1 Asian/Pacific Islander NR Other G1: 2.2</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1500 G2: NR Total weight gain: G1: < 15 pounds: 12.7% 15-25: 25.2% 26-35: 29.3% 36-45: 16.3% > 45: 10.1% Categorized: <ul style="list-style-type: none"> ≤ 15 pounds 16-24, 25-35, 36-45, > 45 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: < 2500g: 3.5% 2500-3999: 84.6% 4000-4449: 9.1% ≥ 4500: 1.4% Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.8 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: OR induction of labor Groups G1: ≤ 45 pounds G2: > 45 pounds Results G2: 1.5 (95% CI, 1.0-2.4) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal BMI Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Jensen et al., 2005 Country and setting: Denmark, university hospitals Enrollment Period: Gestation through birth Funding: Many different funds Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women Time frame: Gestation through birth Duration of the study: NR	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 481 Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg Group N: G1: 93 G2: 134 G3: 132 G4: 122 Inclusion criteria: <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included Exclusion criteria: <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n-153) 	Pregravid weight: <ul style="list-style-type: none"> Records Patient report of pregravid BMI Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8) Parity: NR	Race, %: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0, 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: OR for induction of labor Groups G1: GWG < 5.0 kg G2: GWG 5.0-9.9 kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0 kg Results G1: 1.0 G2: 2.7 (95% CI, 1.3-5.7) G3: 2.8 (95% CI, 1.3-5.9) G4: 3.7 (95% CI, 1.7-8.0) <i>P</i> for trend=0.002 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pre-gravid BMI 2 hour OGTT result Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kabiru and Raynor, 2004 Country and setting: USA, hospital Enrollment Period: 1999 to 2002 Funding: NR Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes Time frame: 1999 to 2002 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,131 Group Description: G1: No change in BMI between first prenatal visit and delivery G2: 1 category increase in BMI between first prenatal visit and delivery G3: > 1 category increase in BMI between first prenatal visit and delivery Group N: G1: 2,556 G2: 2,252 G3: 323 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	Pregravid weight: <ul style="list-style-type: none"> Measured at first prenatal visit Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 Age (mean, yrs): G1: 24.7 (6.1) G2: 24.4 (5.7) G3: 25.2 (5.9) $P < 0.001$ Parity: G1: Gravidity (mean): 1.9 (1.9) G2: 1.5 (1.7) G3: 1.2 (1.7) $P < 0.001$	Race, %: White G1: 1.9 G2: 2.6 G3: 2.8 Black G1: 84.1 G2: 82.8 G3: 88.2 Hispanic G1: 13.9 G2: 14.6 G3: 9.0 Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean weight gain: G1: 8.6 pounds (8.4) G2: 22.2 pounds (10.2) G3: 55.3 pounds (23.8) Additional characteristics: NR

Evidence Table 9. Gestational weight gain and induction of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) $P < 0.001$ G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) $P = 0.015$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.2 G2: 12.6 G3: 21.0 $P < 0.001$ G4: 13.0 G5: 14.3 G6: 19.3 $P = 0.256$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percent failed induction of labor Groups G1: normal BMI, no change in BMI between first prenatal visit and delivery G2: normal BMI, 1 category increase in BMI between first prenatal visit and delivery G3: normal BMI, > 1 category increase in BMI between first prenatal visit and G4: overweight BMI, no change in BMI between first prenatal visit and delivery G5: overweight BMI, 1 category increase in BMI between first prenatal visit and delivery G6: overweight BMI, > 1 category increase in BMI between first prenatal visit and delivery Results G1: 4.7 G2: 9.2 G3: 15.9 $P < 0.001$ for difference in normal BMI groups G4: 7.9 G5: 10.3 G6: 14.6 $P < 0.001$ for difference in normal BMI groups Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 10. Maternal weight gain and length of labor

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ekblad and Grenman, 1992</p> <p>Country and setting: Finland, hospital</p> <p>Enrollment Period: July 1, 1985 - December 31, 1985 (6 months)</p> <p>Funding: NR</p> <p>Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome</p> <p>Time frame: July 1, 1985 to December 31, 1985 (6 months)</p> <p>Duration of the study: Prepregnancy to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery <p>Total Study N: Total n = 357</p> <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls <p>Group Description:</p> <p>G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6</p> <p>Group N:</p> <p>G1: 77 G2: 28 G3: 30 G4: 56 G5: 166</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Not stated 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records - not stated if self reported <p>G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5)</p> <p>Pregravid BMI:</p> <p>G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height <p>Age (mean, yrs):</p> <p>G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4)</p> <p>Parity:</p> <p>G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 10. Maternal weight gain and length of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166</p> <p>Total weight gain: G1: 11.8 (6.2) $P < 0.05$ compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) $P < 0.0005$ compared to controls G4: 23.2 (22.8) $P < 0.0005$ compared to controls G5: 13.2 (3.4)</p> <p>Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg </p> <p>Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records </p> <p>Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery </p>	<p>Birth weight: G1: 3712 g (614) $P < 0.05$ compared to controls G2: 3293 (362) $P < 0.05$ compared to controls G3: 3284 (880) G4: 3803 (538) $P < 0.005$ compared to controls G5: 3538 (535)</p> <p>Gestational diabetes,%: NR</p> <p>Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22%</p> <p>Instrumental delivery,%: NR</p> <p>Episiotomy,%: NR</p> <p>Other maternal outcomes: NA</p> <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Labor patterns by stage in minutes (SD)</p> <p>Groups G1: weight gain ≤ 5 kg G2: weight gain ≥ 20 kg G3: reference (normal prepregnancy weight and normal weight gain [undefined])</p> <p>Results I stage G1: 333 (208) G2: 374 (208) G3: 346 (188)</p> <p>II stage G1: 15 (18) $P < 0.05$ compared to reference category G2: 27 (25) G3: 21 (18)</p> <p>III stage G1: 13 (13) G2: 13 (11) G3: 12 (12)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NA</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NA</p>	<p>Background: Fair</p> <p>Sample selection: Poor</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Poor</p> <p>Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor</p> <p>Final Quality Score: Poor</p>

Evidence Table 10. Maternal weight gain and length of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Johnson et al., 1992</p> <p>Country and setting: USA, prenatal clinics</p> <p>Enrollment Period: January 1, 1987- December 31, 1989</p> <p>Funding: NR</p> <p>Study Objective: To determine influences of increased maternal prepregnancy weight and increased gestational weight gain on pregnancy outcome</p> <p>Time frame: January 1, 1987 to December 31, 1989</p> <p>Duration of the study: Initiation of prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 3,191</p> <p>Group Description: G1: BMI < 19.8 G2: 19.8-26.0 G3: 27-29 G4: > 29 G5: All </p> <p>Group N: G1: 755 G2: 1,621 G3: 329 G4: 486 G5: 3191 </p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Delivery at or beyond 38 weeks of gestation Singletons Received prenatal care and delivered in Shands Hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Fetal abnormalities Oligohydramnios Polyhydramnios Medical or surgical complications (GI disorders, sickle cell hemoglobinopathy, hepatitis, hematologic disorders, malignant disease, renal disease, neurologic disease, pulmonary disease, psychiatric disorders, tuberculosis) Incomplete risk variable data or outcome variable information 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> National Academy of Sciences <p>Age (mean, yrs): G1: NR </p> <ul style="list-style-type: none"> < 20 years: 36.6% 20-26 years: 44.8% > 26 years: 18.7% <p>G2: NR</p> <ul style="list-style-type: none"> < 20 years: 30.8% 20-26 years: 46.5% > 26 years: 22.6% <p>G3:</p> <ul style="list-style-type: none"> < 20 years: 25.8% 20-26 years: 48.9% > 26 years: 25.2% <p>G4:</p> <ul style="list-style-type: none"> < 20 years: 16.5% 20-26 years: 53.9% > 26 years: 29.6% <p>G5:</p> <ul style="list-style-type: none"> < 20 years: 29.5% 20-26 years: 47.5 % > 26 years: 23.0% <p>Parity: G1: % first: 49.3 G2: 43.1 G3: 37.4 G4: 31.1 G5: 42.1 </p>	<p>Race,%: White G1: 64.5 G2: 60.0 G3: 49.8 G4: 51.9 G5: 58.7 </p> <p>Black G1: 33.6 G2: 37.9 G3: 48.9 G4: 47.5 G5: 39.5 </p> <p>Hispanic NR </p> <p>Asian/Pacific Islander NR </p> <p>Other G1: 1.9 G2: 2.1 G3: 1.2 G4: 0.6 G5: 1.7 </p> <p>Smoking,%: NR </p> <p>Diabetes mellitus,%: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 </p> <p>Hypertension,%: G1: 3.4 G2: 4.6 G3: 5.8 G4: 10.7 G5: 5.4 </p> <p>Additional characteristics: G1: % married: 42.6 G2: 46.1 G3: 40.4 G4: 49.4 G5: 45.2 </p> <p>Additional characteristics: NR </p>

Evidence Table 10. Maternal weight gain and length of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 755 G2: 1621 G3: 329 G4: 486 G5: 3191 Total weight gain: G1: <ul style="list-style-type: none"> < 16kg: 7.8% 16-25kg: 18.5% 26-35kg: 35.1% > 35kg: 38.5% G2: <ul style="list-style-type: none"> < 16kg: 11.7% 16-25kg: 18.0% 26-35kg: 28.8% > 35kg: 41.5% G3: <ul style="list-style-type: none"> < 16kg: 19.8% 16-25kg: 19.1% 26-35kg: 28.3% > 35kg: 32.8% G4: <ul style="list-style-type: none"> < 16kg: 32.3% 16-25kg: 22.0%; Categorized: <ul style="list-style-type: none"> Quartiles National Academy of Sciences (below, within, or above recommended range) Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at last prenatal visit (mean 6.1 days prior to delivery) 	Birth weight: G1: <ul style="list-style-type: none"> < 2500g: 4.8% 2500-4000g: 89.1% > 4000g: 6.1% G2: <ul style="list-style-type: none"> < 2500g: 2.0% 2500-4000g: 85.2% > 4000g: 12.8% G3: <ul style="list-style-type: none"> < 2500g: 1.5% 2500-4000g: 83.0% > 4000g: 15.5% G4: <ul style="list-style-type: none"> < 2500g: 0.2% 2500-4000g: 82.5% > 4000g: 17.3% Gestational diabetes, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Cesarean delivery, %: G1: NR G2: NR G3: NR G4: NR G5: 11.9 Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Frequency of macrosomia = 12.2% Frequency of cesarean = 11.9% Frequency of LBW = 2.9% 	Outcomes Description: Odds of labor abnormalities Groups G1: total weight gain < 16 pounds G2: total weight gain 16-25 pounds G3: total weight gain 26-35 pounds G4: total weight gain > 35 pounds Results Elevated odds of labor abnormalities only in the group gaining > 35 pounds compared with women gaining < 16 pounds; not significant when adjusted for confounders Trend analysis showed risk of labor abnormalities with increased weight gain, a difference in 10 lb. corresponds to OR: 2 ($P < 0.0001$) after adjusting for BMI, patient care (private vs. nonprivate), parity, infant sex, hypertension, and macrosomia Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Prepregnancy weight quartile Height (tertile) BMI category Race/ethnicity Marital status Private physician Parity Maternal age Hypertension Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Infant sex Birth weight 	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 9 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 10. Maternal weight gain and length of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Johnson et al., 1992
(continued)

Evidence Table 10. Maternal weight gain and length of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
	<ul style="list-style-type: none"> Frequency of postdate pregnancy = 9.8% Frequency of labor abnormalities (40% were unscheduled cesareans) = 7.8% Frequency of oxytocin induction = 13.7% Frequency of oxytocin augmentation = 16.1% Frequency of meconium staining = 21.5% <p>Other infant outcomes: NA</p>	

Evidence Table 10. Maternal weight gain and length of labor (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Purfield and Morin, 1994</p> <p>Country and setting: Tertiary care medical center, Pennsylvania</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To determine whether a group of normal weight women with a low risk pregnancy who increased prepregnancy weight by more than 25% experienced a longer second stage of labor or higher proportion of operative deliveries than a group of normal weight women</p> <p>Time frame:</p> <p>Duration of the study: August 1991 to June 1992</p>	<p>Design:</p> <ul style="list-style-type: none"> Other observational : convenience sample Retrospective <p>Total Study N: 104</p> <p>Group Description: G1: prepregnant weight increased by 25% or less G2: prepregnant weight increased by more than 25%</p> <p>Group N: G1: 52 G2: 52</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Low risk primiparous pregnancy Normal prepregnant weight for height 18 to 40 years of age No medical or obstetric risk factors 37 to 42 weeks gestation Epidural anesthesia Delivery of singleton infant weighing between 5lb 8oz and 8lb 13oz <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Management of delivery influenced by any fetal or maternal risk factor such as fetal distress, malpresentation, cephalopelvic disproportion, or maternal infection 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 135.69 (15.43) G2: 129.81 (14.83)</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Normal weight was defined as a weight within 90-120% of standard weight for height based on Metropolitan Life Insurance Company Table of 1983 NR <p>Age (mean, yrs): G1: 25.75 (4.83) G2: 25.83 (4.81)</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 10. Maternal weight gain and length of labor (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 52 G2: 52</p> <p>Total weight gain: G1: % of weight gain (greater than prepregnant weight): 20.60 (3.52) G2: % of weight gain (greater than prepregnant weight): 33.21 (5.45) $t = -14.02$ $P = 0.001$</p> <p>Categorized:</p> <ul style="list-style-type: none"> > 25% of prepregnant weight and \leq 25% of prepregnant weight <p>Collected from:</p> <ul style="list-style-type: none"> Routine prenatal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at admission to hospital for birth 	<p>Birth weight: G1: 3266 (351.54) G2: 3384 (327.47) $t = -2.33$ $P = 0.02$</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NA</p> <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Length of second stage labor</p> <p>Groups G1: prepregnant weight increased by 25% or less G2: prepregnant weight increased by more than 25%</p> <p>Results Normal weight primigravidas with a low risk pregnancy who gained an excessive amount of weight had a longer mean length of second stage labor than women who gained less weight</p> <p>Length of second stage in minutes by weight groups (SD) G1: 72.42 (46.69) G2: 93.28 (52.87) $t = -2.05$ $P = 0.02$</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NA</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NA</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 11. Gestational weight gain and mode of delivery

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) (<i>P</i> < 0.05) Gestational diabetes, %: G1: 14.2% G2: 4.3% (<i>P</i> < 0.01) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Percentage of cesarean deliveries Groups G1: 0 or weight loss G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: > 35 lbs Results G1: 25.8% G2: 26.8% G3: 28.8% G4: 35.0% G5: 33.8% <i>P</i> = NS Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Brennand et al., 2005</p> <p>Country and setting: Canada, medical records</p> <p>Enrollment Period: Prenatal to birth</p> <p>Funding: cree board of health and social services of James Bay (Quebec)</p> <p>Study Objective: To determine effect of pregravid weight and pregnancy weight gain on pregnancy outcomes in Cree women</p> <p>Time frame: Prenatal to birth</p> <p>Duration of the study: 7 year period: January 1994 to December 2000</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 603</p> <p>Group Description:</p> <p>G1: Normal: BMI 18.5 - 24.9</p> <p>G2: Overweight: BMI 25-29.9</p> <p>G3: Obese: BMI ≥ 30</p> <p>G4: Total</p> <p>Group N:</p> <p>G1: 139</p> <p>G2: 168</p> <p>G3: 296</p> <p>G4: 603</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Used only Cree women First birth observed per woman during study time period Must have first weight recorded within first 14 weeks gestation and final weight recorded within 4 weeks of birth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with secondary pregnancy in dataset (n = 792) Women with first weight record > 14 weeks gestation (n = 314) Women with final weight record > 4 weeks from birth (n = 202) Women with both first weight record > 14 weeks and final weight record > 4 weeks (n = 70) Women missing data on first or final weight (n = 3) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care Medical records Measured within 14 weeks of gestation <p>G1: 59.7 (5.0)</p> <p>G2: 73.0 (4.3)</p> <p>G3: 93.6 (12.3)</p> <p>G4: 80.0 (16.9)</p> <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs):</p> <p>G1: 20.8 (5.2)</p> <p>G2: 23.8 (5.4)</p> <p>G3: 25.5 (5.5)</p> <p>G4: 24.0 (5.7)</p> <p>Parity: NR</p>	<p>Race,%:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%:</p> <p>G1: 4.3</p> <p>G2: 14.9</p> <p>G3: 27.4</p> <p>G4: 18.6</p> <p>Hypertension,%:</p> <p>G1: 1.4</p> <p>G2: 1.8</p> <p>G3: 4.8</p> <p>G4: 3.2</p> <p>Additional characteristics:</p> <p>% low weight gain:</p> <p>G1: 20.1</p> <p>G2: 10.1</p> <p>G3: 28.0</p> <p>G4: 21.2</p> <p>% acceptable weight gain:</p> <p>G1: 28.8</p> <p>G2: 32.1</p> <p>G3: 33.4</p> <p>G4: 32.0</p> <p>% excessive weight gain:</p> <p>G1: 51.1</p> <p>G2: 57.7</p> <p>G3: 38.5</p> <p>G4: 46.6</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 139 G2: 168 G3: 296 Total weight gain: Categorized: <ul style="list-style-type: none"> 1999 Canadian guidelines Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: within 4 weeks of birth 	Birth weight: NR Gestational diabetes, %: G1: 4.3 G2: 14.9 G3: 27.4 G4: 18.6 Cesarean delivery, %: G1: 10.8 G2: 11.3 G3: 24.1 (p < 0.001) Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Definition of low, adequate, and excessive weight gains: For normal weight women - adequate weight gain is 11.5 to 16 kg For overweight women, adequate weight gain is 7 to 11.5 kg For obese women, adequate weight gain is 7 to 11.5 kg Weight gain below specified range is "low" and weight gain above specified range is "excessive" Other infant outcomes: > 4000g, > 4500g	Outcomes Description: Percentage of cesarean sections Groups Primigravid women (maternal weight gain outcomes by BMI presented only for obese women) G1: Obese - low weight gain (< 7 kg) G2: Obese - acceptable weight gain (7-11.5 kg) G3: Obese - excessive weight gain (> 11.5 kg) G4: Total Results G1: 25.3 G2: 23.5 G3: 23.7 χ^2 P=0.952 G4: 24 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Brennand et al., 2005 (continued)	<ul style="list-style-type: none"> • Pregnancies with factors that may have influenced maternal weight gain such as 1 parent being non-Cree (n = 13), preterm deliveries (n = 91), twin pregnancies (n = 6), missing gestational age (n = 9) • Women with unknown glycemic status (n = 30), type 2 DM (n = 8), glycemic abnormalities before pregnancy not followed for diagnosis (n = 70) • Women classified as underweight (n = 5) 		

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
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Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cedergren, 2006 Country and setting: Sweden, Medical Birth Registry Enrollment Period: January 1, 1994 - December 31, 2002 Funding: Ostergotland County Council Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes Time frame: January 1, 1994 to December 31, 2002 Duration of the study: First visit to maternity health care center to delivery	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 245,526 Group Description: BMI G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35 Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Inclusion criteria: <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 Age (mean, yrs): G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1% G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9% G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5% G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4% G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%	Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: <ul style="list-style-type: none"> < 8kg, 8-16, > 16 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AOR for weight gain for weight gain groups by cesarean of instrumental deliveries (95% CI) Groups Weight gain< 8 kg, 8-16 kg, and > 16 kg for each BMI class below G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI ≥ 35 AOR for weight gain< 8 kg for Cesarean section compared with weight gain 8-16 kg G1: 1.07 (0.89-1.29) G2: 0.98 (0.92-1.05) G3: 0.88 (0.82-0.95) G4: 0.81 (0.73-0.90) G5: 0.75 (0.66-0.87) AOR for weight gain< 8 kg for instrumental delivery compared with weight gain 8-16 kg G1: 0.89 (0.71-1.11) G2: 0.88 (0.80-0.96) G3: 0.85 (0.76-0.95) G4: 0.75 (0.63-0.88) G5: 0.83 (0.65-1.03) AOR for weight gain> 16 kg for instrumental delivery compared with weight gain 8-16 kg G1: 1.28 (1.15-1.43) G2: 1.19 (1.14-1.25) G3: 1.14 (1.06-1.23) G4: 1.09 (0.93-1.27) G5: 1.04 (0.77-1.40) AOR for weight gain> 16 kg for Cesarean section compared with weight gain 8-16 kg G1: 1.29 (1.17-1.43) G2: 1.24 (1.19-1.29) G3: 1.23 (1.17-1.30) G4: 1.22 (1.10-1.35) G5: 1.27 (1.05-1.52) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, smoking in early pregnancy, and year of birth Infant and child confounders and effect modifiers accounted for in analysis: Year of birth	Background: Fair Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Chen et al., 2004</p> <p>Country and setting: USA, private practice</p> <p>Enrollment Period: Feb 1993-June 2001</p> <p>Funding: NR</p> <p>Study Objective: To develop an easily usable integrated formula for predicting probability of cephalopelvic disproportion/failure to progress (CPD) and cesarean delivery (CS) as function of demographic factors in middle-class private practice</p> <p>Time frame: Feb 1993-June 2001</p> <p>Duration of the study: Entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 3,355</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 3,355 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All primiparous, singleton births between February 1993 and June 13, 2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> insufficient data for analysis with respect to all 5 demographic factors 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported Weight taken at first prenatal visit if presented before 20 weeks; if after 20 weeks, self-reported <p>Pregravid BMI: G1: BMI < 20 16.3% 20-25 48% 25-30 21% 30-40 12.8% > 40 2% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous/categorical by 5 point increments (< 25, 20-25, etc.) <p>Age (mean, yrs): G1: < 20: 8.9 20-24: 25.8% 25-29: 36.7% 30-34: 20.2% > 35 8.4% G2: NR</p> <p>Parity:</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 852 G2: 1,383 G3: 1,120 Total weight gain: Categorized: <ul style="list-style-type: none"> Categorical, < 25, 25-35, > 35 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: subtracted from weight at first prenatal visit 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: G1: 20.9 G2: 19.3 G3: 25.4 Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: Progression of adjusted OR of Cephalopelvic Disproportion (CPD): Every 5 lbs more weight gain during pregnancy = 1.057 (1.005-1.110) progression in OR. Progression of adjusted OR of Cesarean Delivery: Every 5 lb more weight gain during pregnancy = 1.094 (1.074 - 1.115) progression in OR Other infant outcomes: NR	Outcomes Description: Progression of AOR of cesarean delivery weight gain (for every 5 lbs) Groups Gestational weight gain in lbs Results 1.094 (1.074 - 1.115) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal height Body mass index (BMI) Maternal height Maternal age Pregnancy weight gain Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age at delivery Fetal birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: DeVader et al., 2007 Country and setting: United States, birth certificate data Enrollment period: 1999 to 2001 Funding: NR Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI Time frame: 1999 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 94,696 Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs Group N: G1: 16,852 G2: 37,292 G3: 40,552 Inclusion criteria: <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8 –26.0 kg/m²) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 Exclusion criteria: <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> No Categorized: NR Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4% Parity: NR	Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7 Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Adjusted odds ratio of mode of delivery by weight groups	Background: Good
Total weight gain: NR	Gestational diabetes, %: NR	Groups G1: < 30 lbs G2: 30-35lbs G3: > 35 lbs	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results AOR for cesarean (95% CI): G1: 0.82 (0.78–0.87) G2: 1.0 G3: 1.35 (1.29–1.40)	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Results AOR for cesarean (95% CI): G1: 0.82 (0.78–0.87) G2: 1.0 G3: 1.35 (1.29–1.40)	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Results AOR for cesarean (95% CI): G1: 0.82 (0.78–0.87) G2: 1.0 G3: 1.35 (1.29–1.40)	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 	AOR for instrumental (95% CI): G1: 0.97 (0.90–1.04) G2: 1.0 G3: 1.03 (0.97–1.08)	Followup: Fair
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Maternal race or ethnicity Maternal education Medicaid status Tobacco use Alcohol use Maternal height, Prior pregnancy Adequacy of prenatal care 	Analysis comparability: Fair
		Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Child's gender Birth year 	Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor
			Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Ekblad and Grenman, 1992 Country and setting: Finland, hospital Enrollment Period: July 1, 1985 - December 31, 1985 (6 months) Funding: NR Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome Time frame: July 1, 1985 to December 31, 1985 (6 months) Duration of the study: Prepregnancy to delivery	Design: <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery Total Study N: Total n = 357 <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6 Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Inclusion criteria: <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control Exclusion criteria: <ul style="list-style-type: none"> Not stated 	Pregravid weight: <ul style="list-style-type: none"> Records - not stated if self reported G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5) Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4) Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) <i>P</i> < 0.05 compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) <i>P</i> < 0.0005 compared to controls G4: 23.2 (22.8) <i>P</i> < 0.0005 compared to controls G5: 13.2 (3.4) Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3712 g (614) <i>P</i> < 0.05 compared to controls G2: 3293 (362) <i>P</i> < 0.05 compared to controls G3: 3284 (880) G4: 3803 (538) <i>P</i> < 0.005 compared to controls G5: 3538 (535) Gestational diabetes,%: NR Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percentage of vaginal, forceps, vacuum, breech or cesarean deliveries by weight gain categories Groups G1: weight gain ≤ 5 kg G2: weight gain ≥ 20 kg G3: reference (normal prepregnancy weight and normal weight gain [undefined]) Normal vaginal delivery (%) G1: 90 <i>P</i> < 0.05 compared to controls G2: 64 G3: 71 Forceps or vacuum delivery (%) G1: 3 G2: 13 G3: 5 Breech (%) G1: 1 G2: 0 G3: 2 Cesarean section - elective % G1: 3 G2: 5 G3: 13 Cesarean section - emergency % G1: 3 G2: 18 G3: 9 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Graves et al., 2006</p> <p>Country and setting: USA, midwifery practices</p> <p>Enrollment Period: January 1, 1998-December 31, 2000</p> <p>Funding: NR</p> <p>Study Objective: To identify association between prepregnancy BMI, weight gain in pregnancy, and newborn birth weight on route of delivery and induction of labor in patients receiving nurse-midwifery care</p> <p>Time frame: January 1, 1998-December 31, 2000</p> <p>Duration of the study: PRN care up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,500</p> <p>Group Description: G1: Total cohort</p> <p>Group N: G1: 1,500</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Non-diabetic Entered labor after 34 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Planned cesarean delivery (n = 8) Unknown parity (in analyses in which parity was an important consideration, n = 40) Hypertension Diabetes 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Actual prepregnant weight or early first trimester weight documented in medical records <p>Pregravid BMI: G1: < 19.8: 9.4% 19.8-26.0: 52.1% 26.1-29.0: 20.6% > 29: 17.4%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: ≤ 19 years: 32.2% 20-34: 62.4% ≥ 35: 4.9%</p> <p>Parity: G1: % nulliparous: 42.3</p>	<p>Race, %: White G1: 26.9 Black G1: 18.7 Hispanic G1: 52.1 Asian/Pacific Islander NR Other G1: 2.2</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1500 G2: NR Total weight gain: G1: < 15 pounds: 12.7% 15-25: 25.2% 26-35: 29.3% 36-45: 16.3% > 45: 10.1% Categorized: <ul style="list-style-type: none"> ≤ 15 pounds 16-24, 25-35, 36-45, > 45 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: < 2500g: 3.5% 2500-3999: 84.6% 4000-4449: 9.1% ≥ 4500: 1.4% Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.8 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Association of weight gain on mode of delivery Groups G1: ≤ 45 pounds G2: > 45 pounds Results Greater weight gain in pregnancy was not associated significantly with route of delivery Confounders and effect modifiers NR Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Prepregnancy BMI category Total prenatal weight gain category Induction of labor Race/ethnicity Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age > 41 weeks Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Jain et al, 2007</p> <p>Country and setting: United States, hospitals</p> <p>Enrollment period: 2002-2005</p> <p>Funding: Not reported</p> <p>Study Objective: To analyze risks of cesarean section, macrosomia, and breastfeeding at 10 weeks postpartum using logistic regression to estimate independent effects of prepregnancy BMI and gestational weight gain</p> <p>Time frame: 2002-2005</p> <p>Duration of the study: Entry into prenatal care to 10 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 7661</p> <p>Group Description: NR</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Term (> 37 weeks) and singleton for macrosomia and breastfeeding <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Cesarean analysis limited to women with cephalic presentation-records with missing data excluded 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Cesarean delivery, primiparous and multiparous	Background: Fair
Total weight gain: • NR	Gestational diabetes, %: NR	Groups: G1: WG ≤ 15 lbs G2: WG 15-24 lbs G3: WG 25-35 lbs G4: WG ≥ 35 lbs	Sample selection: Poor
Categorized: • ≤ 15 lbs • 15-25 lbs • 25-35 lbs • 35+ lbs	Cesarean delivery, %: NR	Results: AOR for primiparous cesarean delivery (from model including interaction term for overweight/obese + > 25 lbs weight gain) G1: 0.95 (0.59-1.52) G2: 1.0 (ref) G3: 1.10 (0.76-1.60) G4: 1.62 (1.10-2.39)	Definition of maternal weight gain: Poor
Collected from: • Not outlined	Instrumental delivery, %: NR	Other maternal outcomes: NR	Definition of outcomes: Fair
Ascertained by: • Birth certificate	Episiotomy, %: NR	Other infant outcomes: NR	Source of information on exposure, outcomes, and confounders: Fair
		AOR for multiparous cesarean delivery (from model including interaction term for overweight/obese + > 25 lbs weight gain) G1: 1.11 (0.60-2.04) G2: 1.0 (ref) G3: 1.08 (0.63-1.85) G4: 1.95 (1.02-3.72)	Followup: Fair
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Maternal age • Pregravid BMI • Parity • Education • Race/ethnicity • US/foreign origin • Interaction terms for pregravid BMI and weight gain 	Analysis comparability: Fair
		Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • NA 	Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor
			Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Jensen et al., 2005</p> <p>Country and setting: Denmark, university hospitals</p> <p>Enrollment Period: Gestation through birth</p> <p>Funding: Many different funds</p> <p>Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women</p> <p>Time frame: Gestation through birth</p> <p>Duration of the study: NR</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 481</p> <p>Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg</p> <p>Group N: G1: 93 G2: 134 G3: 132 G4: 122</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n=153) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records Patient report of pregravid BMI <p>Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8)</p> <p>Parity: NR</p>	<p>Race,%: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0. 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: OR for cesarean delivery (95% CI) Groups G1: GWG 5.0-9.9 kg G2: GWG 10.0-14.9 kg G3: GWG ≥ 15 kg Results G1: 1.0 G2: 2.4 (1.1-5.3) G3: 3.0 (1.4-6.4) G4: 3.6 (1.6-7.8) <i>P</i> for trend = 0.002 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pre-gravid BMI 2h OGTT result Parity Smoking Ethnic background Clinical center Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Johnson et al., 1992 Country and setting: USA, prenatal clinics Enrollment Period: January 1, 1987-December 31, 1989 Funding: NR Study Objective: To determine influences of increased maternal prepregnancy weight and increased gestational weight gain on pregnancy outcome Time frame: January 1, 1987 to December 31, 1989 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,191 Group Description: G1: BMI < 19.8 G2: 19.8-26.0 G3: 27-29 G4: > 29 G5: All Group N: G1: 755 G2: 1,621 G3: 329 G4: 486 G5: 3191 Inclusion criteria: <ul style="list-style-type: none"> Delivery at or beyond 38 weeks of gestation Singletons Received prenatal care and delivered in Shands Hospital Exclusion criteria: <ul style="list-style-type: none"> Fetal abnormalities Oligohydramnios Polyhydramnios Medical or surgical complications (GI disorders, sickle cell hemoglobinopathy, hepatitis, hematologic disorders, malignant disease, renal disease, neurologic disease, pulmonary disease, psychiatric disorders, tuberculosis) Incomplete risk variable data or outcome variable information 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> National Academy of Sciences Age (mean, yrs): G1: NR <ul style="list-style-type: none"> < 20 years: 36.6% 20-26 years: 44.8% > 26 years: 18.7% G2: NR <ul style="list-style-type: none"> < 20 years: 30.8% 20-26 years: 46.5% > 26 years: 22.6% G3: <ul style="list-style-type: none"> < 20 years: 25.8% 20-26 years: 48.9% > 26 years: 25.2% G4: <ul style="list-style-type: none"> < 20 years: 16.5% 20-26 years: 53.9% > 26 years: 29.6% G5: <ul style="list-style-type: none"> < 20 years: 29.5% 20-26 years: 47.5 % > 26 years: 23.0% Parity: G1: % first: 49.3 G2: 43.1 G3: 37.4 G4: 31.1 G5: 42.1	Race, %: White G1: 64.5 G2: 60.0 G3: 49.8 G4: 51.9 G5: 58.7 Black G1: 33.6 G2: 37.9 G3: 48.9 G4: 47.5 G5: 39.5 Hispanic NR Asian/Pacific Islander NR Other G1: 1.9 G2: 2.1 G3: 1.2 G4: 0.6 G5: 1.7 Smoking, %: NR Diabetes mellitus, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Hypertension, %: G1: 3.4 G2: 4.6 G3: 5.8 G4: 10.7 G5: 5.4 Additional characteristics: G1: % married: 42.6 G2: 46.1 G3: 40.4 G4: 49.4 G5: 45.2 Additional characteristics: NR

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 755 G2: 1621 G3: 329 G4: 486 G5: 3191</p> <p>Total weight gain: G1: <ul style="list-style-type: none"> < 16kg: 7.8% 16-25kg: 18.5% 26-35kg: 35.1% > 35kg: 38.5% G2: <ul style="list-style-type: none"> < 16kg: 11.7% 16-25kg: 18.0% 26-35kg: 28.8% > 35kg: 41.5% G3: <ul style="list-style-type: none"> < 16kg: 19.8% 16-25kg: 19.1% 26-35kg: 28.3% > 35kg: 32.8% G4: <ul style="list-style-type: none"> < 16kg: 32.3% 16-25kg: 22.0%; </p> <p>Categorized: <ul style="list-style-type: none"> Quartiles National Academy of Sciences (below, within, or above recommended range) </p> <p>Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records </p> <p>Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at last prenatal visit (mean 6.1 days prior to delivery) </p>	<p>Birth weight: G1: <ul style="list-style-type: none"> < 2500g: 4.8% 2500-4000g: 89.1% > 4000g: 6.1% G2: <ul style="list-style-type: none"> < 2500g: 2.0% 2500-4000g: 85.2% > 4000g: 12.8% G3: <ul style="list-style-type: none"> < 2500g: 1.5% 2500-4000g: 83.0% > 4000g: 15.5% G4: <ul style="list-style-type: none"> < 2500g: 0.2% 2500-4000g: 82.5% > 4000g: 17.3% </p> <p>Gestational diabetes, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1</p> <p>Cesarean delivery, %: G1: NR G2: NR G3: NR G4: NR G5: 11.9</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: <ul style="list-style-type: none"> Frequency of macrosomia = 12.2% Frequency of cesarean = 11.9% Frequency of LBW = 2.9% </p>	<p>Outcomes Description: Adjusted odds ratio for unscheduled cesarean (95% CI)</p> <p>Groups G1: total weight gain < 16 pounds G2: total weight gain 16-25 pounds G3: total weight gain 26-35 pounds G4: total weight gain > 35 pounds</p> <p>Results G1: 1.0 G2: 0.95 (0.6-1.5) G3: 1.3 (0.86-1.95) G4: 1.95 (1.32 - 2.87)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Prepregnancy weight quartile Height (tertile) BMI category Private physician (yes/no) Maternal age Parity Diabetes Hypertension Maternal education </p> <p>Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Birth weight Gestational age </p>	<p>Background: Fair</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Fair</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 0 Good, 9 Fair, 0 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Johnson et al., 1992
(continued)

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
	<ul style="list-style-type: none"> • Frequency of postdate pregnancy = 9.8% • Frequency of labor abnormalities (40% were unscheduled cesareans) = 7.8% • Frequency of oxytocin induction = 13.7% • Frequency of oxytocin augmentation = 16.1% • Frequency of meconium staining = 21.5% <p>Other infant outcomes: NA</p>	

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Joseph et al., 2003</p> <p>Country and setting: All deliveries that occurred among residents of Nova Scotia, Canada - from Nova Scotia Atlee Perinatal Database</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: To estimate contribution of changes in maternal characteristics (namely, age, parity, prepregnancy weight, weight gain in pregnancy, smoking status) and obstetric practice (namely labor induction, epidural anesthesia, delivery by an obstetrician, midpelvic forceps delivery) to recent increases in primary cesarean delivery rates</p> <p>Time frame: NR</p> <p>Duration of the study: January 1, 1988 to December 31, 2000</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 100,259</p> <p>Group Description: G1: Births 1988-1991 G2: Births 1998-2000 G3: % Primary Cesarean Rate 1988-1991 G4: % Primary Cesarean Rate 1998-2000</p> <p>Group N: G1: 44,317 G2: 24,901 G3: 44,317 G4: 24,901</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All deliveries that occurred to residents of Nova Scotia <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with previous cesarean delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Data taken from standardized forms and hospital medical records - no mention of self-report <p>G1: < 55: 30.1% 55-59: 21.2% 60-69: 27.3% ≥ 70: 21.4%</p> <p>G2: < 55: 20.4% 55-59: 15.9% 60-69: 27.7% ≥ 70: 36.0%</p> <p>G3: < 55: 12.3% 55-59: 12.6% 60-69: 11.8% ≥ 70: 16.9%</p> <p>G4: < 55: 13.2% 55-59: 13.6% 60-69: 14.7% ≥ 70: 18.7%</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): % Age: < 20yrs:</p> <p>G1: 9.4% 20-29 yrs: 62.6% 30-34yrs: 21.4% 35-39 yrs: 5.9% ≥ 40yrs: 0.7%</p> <p>G2: 8.0% 20-29 yrs: 54.6% 30-34yrs: 25.8% 35-39 yrs: 10.1% ≥ 40yrs: 1.5%</p> <p>G3: 12.5% 20-29 yrs: 13.2% 30-34yrs: 12.3% 35-39 yrs: 14.8% ≥ 40yrs: 17.6%</p> <p>G4: 11.4% 20-29 yrs: 15.1% 30-34yrs: 16.6% 35-39 yrs: 19.6% ≥ 40yrs: 22.7%</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 32.6 G2: 23.4 G3: 27.1 G4: 28.8</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: G1: 1.4 G2: 1.2 G3: 38.7 G4: 50.3</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: AOR for cesarean delivery (95% CI)	Background: Good
Total weight gain: <ul style="list-style-type: none"> NR 	Gestational diabetes, %: NR	Groups G1: < 5 kg G2: 5-9 kg G3: 10-14 kg G4: 15-19 kg G5: ≥ 20 kg	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> < 5, 5-9, 10-14(ref), 15-19, ≥ 20 	Cesarean delivery, %: NR	Results G1: 1.10 (1.00, 1.20) G2: 1.04 (0.99, 1.10) G3: 1.00 G4: 1.09 (1.05, 1.14) G5: 1.41 (1.35, 1.47)	Definition of maternal weight gain: Poor
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Prepregnancy weight Smoking Pregnancy (singleton or multiple) Hypertension Diabetes Previous fetal death Induction Epidural Physician type Time 	Definition of outcomes: Good
Ascertained by: <ul style="list-style-type: none"> Not explained by authors - data taken from maternity records 	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Source of information on exposure, outcomes, and confounders: Poor
	Other maternal outcomes NR		Followup: Fair
	Other infant outcomes NR		Analysis comparability: Good
			Analysis of outcomes: Fair
			Interpretation: Good
			Sum of Good/Fair/Poor: 4 Good, 3 Fair, 2 Poor
			Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Joseph et al., 2003 (continued)		Parity: %Parity: Nulliparous: G1: 49.1% 1: 31.7% 2: 13.4% 3-4: 5.2% ≥ 5: 0.6% G2: 50.3% 1: 32.5% 2: 11.9% 3-4: 4.6% ≥ 5: 0.7% G3: 20.7% 1: 5.9% 2: 5.3% 3-4: 6.3% ≥ 5: 5.5% G4: 24.6% 1: 6.8% 2: 6.7% 3-4: 6.5% ≥ 5: 11.6%	

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
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Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kabiru and Raynor, 2004 Country and setting: USA, hospital Enrollment Period: 1999 to 2002 Funding: NR Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes Time frame: 1999 to 2002 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,131 Group Description: G1: No change in BMI between first prenatal visit and delivery G2: 1 category increase in BMI between first prenatal visit and delivery G3: > 1 category increase in BMI between first prenatal visit and delivery Group N: G1: 2,556 G2: 2,252 G3: 323 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	Pregravid weight: <ul style="list-style-type: none"> Measured at first prenatal visit Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 Age (mean, yrs): G1: 24.7 (6.1) G2: 24.4 (5.7) G3: 25.2 (5.9) $P < 0.001$ Parity: G1: Gravidity (mean): 1.9 (1.9) G2: 1.5 (1.7) G3: 1.2 (1.7) $P < 0.001$	Race, %: White G1: 1.9 G2: 2.6 G3: 2.8 Black G1: 84.1 G2: 82.8 G3: 88.2 Hispanic G1: 13.9 G2: 14.6 G3: 9.0 Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean weight gain: G1: 8.6 pounds (8.4) G2: 22.2 pounds (10.2) G3: 55.3 pounds (23.8) Additional characteristics: NR

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) $P < 0.001$ G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) $P = 0.015$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.2 G2: 12.6 G3: 21.0 $P < 0.001$ G4: 13.0 G5: 14.3 G6: 19.3 $P = 0.256$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Primary cesarean Groups Primary cesarean G1: normal BMI, no change in BMI between first prenatal visit and delivery G2: normal BMI, 1 category increase in BMI between first prenatal visit and delivery G3: normal BMI, > 1 category increase in BMI between first prenatal visit and delivery G4: overweight BMI, no change in BMI between first prenatal visit and delivery G5: overweight BMI, 1 category increase in BMI between first prenatal visit and delivery G6: overweight BMI, > 1 category increase in BMI between first prenatal visit and delivery Results Operative vaginal delivery G1: 11.4 G2: 12.4 G3: 12.2 $P = 0.837$ G4: 8.4 G5: 11.4 G6: 17.3 $P < 0.001$ Cesarean delivery rate for failure to progress G1: 2.5 G2: 6.5 G3: 10.2 $P = 0.203$ G4: 3.5 G5: 6.9 G6: 10.2 $P = 0.002$ Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kiel et al., 2007</p> <p>Country and setting: United States, birth registry</p> <p>Enrollment period: 1990 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women</p> <p>Time frame: 1990 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 120,170</p> <p>Group Description:</p> <p>G1: Obese Class I (BMI 30–34.9) (n = 70,536)</p> <p>G2: Obese Class II (BMI 35–39.9) (n = 30,609)</p> <p>G3: Obese Class III (BMI 40 and More) (n = 19,025)</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NR 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NIH guidelines <p>Age (mean, yrs):</p> <p>G1: <26: 46% 26–35: 47% Older than 35: 8%</p> <p>G2: <26: 44% 26–35: 48% Older than 35: 8%</p> <p>G3: <26: 40% 26–35: 52% Older than 35: 9%</p> <p>Parity: Nulliparous:</p> <p>G1: 34% G2: 33% G3: 32%</p>	<p>Race, %: White G1: 78 G2: 77 G3: 73</p> <p>Black G1: 22 G2: 23 G3: 27</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: 22</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% ($P < 0.05$) G2: SGA: 7% LGA: 16% ($P < 0.05$) G3: SGA: 6% LGA: 18% ($P < 0.05$)	Outcomes Description: Odds of preeclampsia, cesarean delivery, LGA births, SGA births	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41	Groups All obese women G1: Loss 10 lbs or more G2: Loss 2 to 9 lbs G3: No change G4: Gain 2-9 lbs G5: Gain 10-14 lbs G6: Gain 15-25 lbs G7: Gain 25-35 lbs	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> 10-lb or less loss 2 to 9 lbs loss, no weight change, 2 to 9 lbs gain, 10 to 14 lbs gain, 15–25 lb gain, 26–35 lb gain, and greater than 35 lb gain 	Instrumental delivery, %: NR Episiotomy, %: NR	Results Compared with women who gained 15–25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Magnitude differed by obesity classification, even after adjusting for known or suspected confounders	Definition of maternal weight gain: Fair Definition of outcomes: Good
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Education Poverty (enrollment in Medicaid, WIC, food stamp programs) Tobacco use Chronic hypertension 	Source of information on exposure, outcomes, and confounders: Fair
Ascertained by: NR		Infant and child confounders and effect modifiers accounted for in analysis: NR	Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 of 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>	

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Murakami et al., 2004 Country and setting: Japan, hospital Enrollment Period: 2001 Funding: NR Study Objective: To estimate risk of perinatal morbidity of mother and infant with respect to maternal prepregnancy BMI and weight gain in Japanese women Time frame: 2001 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 633 Group Description: G1: Total cohort G2: NR Group N: G1: 633 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Live, singletons delivered between 24 to 42 weeks gestation Exclusion criteria:	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 20.9 (2.8) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 29.1 (4.5) G2: NR Parity: G1: 0.6 (0.7) G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 8.5 G2: NR Diabetes mellitus, %: G1: 2.1 G2: NR Hypertension, %: NR Additional characteristics: G1: Preeclampsia - mild: 5.4%; severe: 4.1% G2: NR Additional characteristics: NR

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 633 G2: NR Total weight gain: G1: 10.5 (3.4) G2: NR Categorized: <ul style="list-style-type: none"> < 8.5kg, 8.5-12.5, > 12.5 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: last measurement was taken at hospitalization prior to delivery 	Birth weight: G1: 3,052.6 (483.8) G2: NR Gestational diabetes, %: G1: 2.1 G2: NR Cesarean delivery, %: G1: 10.3 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AOR for cesarean delivery (95% CI) Groups G1: < 8.5 kg G2: 8.5-12.5 kg G3: > 12.5 kg Results G1: 1.08 (0.56-2.07) G2: 1.00 G3: 1.23 (0.61-2.48) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Purfield and Morin, 1994</p> <p>Country and setting: Tertiary care medical center, Pennsylvania</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To determine whether a group of normal weight women with a low risk pregnancy who increased prepregnancy weight by more than 25% experienced a longer second stage of labor or higher proportion of operative deliveries than a group of normal weight women</p> <p>Time frame:</p> <p>Duration of the study: August 1991 to June 1992</p>	<p>Design:</p> <ul style="list-style-type: none"> Other observational : convenience sample Retrospective <p>Total Study N: 104</p> <p>Group Description: G1: prepregnant weight increased by 25% or less G2: prepregnant weight increased by more than 25%</p> <p>Group N: G1: 52 G2: 52</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Low risk primiparous pregnancy Normal prepregnant weight for height 18 to 40 years of age No medical or obstetric risk factors 37 to 42 weeks gestation Epidural anesthesia Delivery of singleton infant weighing between 5lb 8oz and 8lb 13oz <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Management of delivery influenced by any fetal or maternal risk factor such as fetal distress, malpresentation, cephalopelvic disproportion, or maternal infection 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 135.69 (15.43) G2: 129.81 (14.83)</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Normal weight was defined as a weight within 90-120% of standard weight for height based on Metropolitan Life Insurance Company Table of 1983 NR <p>Age (mean, yrs): G1: 25.75 (4.83) G2: 25.83 (4.81)</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 52 G2: 52</p> <p>Total weight gain: G1: % of weight gain (greater than prepregnant weight): 20.60 (3.52) G2: % of weight gain (greater than prepregnant weight): 33.21 (5.45) $t = -14.02$ $P = 0.001$</p> <p>Categorized:</p> <ul style="list-style-type: none"> > 25% of prepregnant weight and \leq 25% of prepregnant weight <p>Collected from:</p> <ul style="list-style-type: none"> Routine prenatal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at admission to hospital for birth 	<p>Birth weight: G1: 3266 (351.54) G2: 3384 (327.47) $t = -2.33$ $P = 0.02$</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NA</p> <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Rates of different modes of delivery by weight gain</p> <p>Groups G1: prepregnant weight increased by 25% or less G2: prepregnant weight increased by more than 25%</p> <p>Results Higher rate of vacuum extraction and cesarean delivery and lower rate of spontaneous vaginal delivery. with excessive weight gain</p> <p>No difference in forceps delivery and vaginal delivery by weight gain status</p> <p>Vaginal delivery G1: n=27 G2: n=9</p> <p>Vacuum extraction G1: n=14 G2: n=25</p> <p>Low forceps G1: n=8 G2: n=8</p> <p>Cesarean section G1: n=3 G2: n=10</p> <p>$\chi^2=15.87$, $P=0.001$ for all 4 modes of delivery by weight groups</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NA</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NA</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rosenberg et al., 2005</p> <p>Country and setting: USA, vital statistics data</p> <p>Enrollment Period: Birth certificates with self reported pregravid weight and weight gain</p> <p>Funding: NR</p> <p>Study Objective: To examine associations between obesity, diabetes, and 3 adverse pregnancy outcomes (primary cesarean section, preterm birth, and LBW) by race/ethnic groups</p> <p>Time frame: Birth certificates with self reported pregravid weight and weight gain</p> <p>Duration of the study: Birth certificates from 1999, 2000, and 2001</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 329988</p> <p>Group Description:</p> <p>G1: Non-hispanic blacks</p> <p>G2: Non-hispanic whites</p> <p>G3: Non-hispanic asians</p> <p>G4: Hispanics</p> <p>G5: Total</p> <p>Group N:</p> <p>G1: 86,908</p> <p>G2: 96,581</p> <p>G3: 38,570</p> <p>G4: 107,612</p> <p>G5: 329,988</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Live singleton births Information on maternal prepregnancy weight and maternal weight gain during pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: < 100 pounds: 1.7%</p> <p>100-149: 49.1%</p> <p>150-199: 37.5%</p> <p>200-299: 11.2%</p> <p>≥ 300: 0.5%</p> <p>G2: < 100 pounds: 1.8%</p> <p>100-149: 69.5%</p> <p>150-199: 24.0%</p> <p>200-299: 4.7%</p> <p>≥ 300: 0.1%</p> <p>G3: < 100 pounds: 8.1%</p> <p>100-149: 79.5%</p> <p>150-199: 11.6%</p> <p>200-299: 0.8%</p> <p>≥ 300</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs):</p> <p>G1: 27.5</p> <p>G2: 30.6</p> <p>G3: 29.7</p> <p>G4: 26.4 $P < 0.001$</p> <p>G5: 28.3</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %:</p> <p>G1: 3.7</p> <p>G2: 2.6</p> <p>G3: 6.6</p> <p>G4: 3.5</p> <p>G5: 3.7 $P < 0.001$</p> <p>Hypertension, %:</p> <p>G1: 1.7</p> <p>G2: 0.6</p> <p>G3: 0.5</p> <p>G4: 0.7</p> <p>G5: 0.9 $P < 0.001$</p> <p>Additional characteristics:</p> <p>G1: PIH 1.9</p> <p>G2: 1.2</p> <p>G3: 0.7</p> <p>G4: 1.4</p> <p>G5: 1.4 $P < 0.001$</p> <p>Additional characteristics:</p> <p>G1: Preeclampsia 2.9</p> <p>G2: 1.3</p> <p>G3: 1.2</p> <p>G4: 2.6</p> <p>G5: 2.1 $P < 0.001$</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 86,908 G2: 96,581 G3: 38,570 G4: 107,612 G5: 329,988 Total weight gain: G1: < 41pounds: 79.7% ≥ 41 pounds: 20.3% G2: < 41pounds: 83.2% ≥ 41 pounds: 16.8% <i>P</i> < 0.001 G3: < 41pounds: 89.2% ≥ 41 pounds: 10.8% G4: < 41pounds: 79.1% ≥ 41 pounds: 20.9% G5: < 41pounds: 81.6% ≥ 41 pounds: 18.4% Categorized: <ul style="list-style-type: none"> < 41, ≥ 41 pounds Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: G1: 3.7 G2: 2.6 G3: 6.6 G4: 3.5 G5: 3.7 <i>P</i> < 0.001 Cesarean delivery, %: G1: 16.2 G2: 14.7 <i>P</i> < 0.001 G3: 14.4 G4: 13.8 G5: 14.7 Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Preterm birth 10.5, 5.1, 5.9, 7.8, 7.5 <i>P</i> < 0.001 (groups defined above) LBW 9.7, 4.1, 5.7, 6.1, 6.4 <i>P</i> < 0.001 (groups defined above) 	Outcomes Description: AOR for primary cesarean (95% CI) Groups G1: < 41 pounds G2: ≥ 41 pounds Results 1.38 (1.34-1.41) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity GDM Pregnancy induced hypertension Pre-eclampsia Prepregnancy weight Chronic diabetes Chronic hypertension Marital status Maternal education Mother's birthplace Prenatal care payer Social risk Trimester prenatal care began Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Sherrard, 2007</p> <p>Country and setting: Canada, hospital</p> <p>Enrollment Period: 1978 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To quantify the effects of pre-gravid BMI and gestational weight gain on caesarian delivery</p> <p>Time frame: 1978 to 2001</p> <p>Duration of the study: 22 years</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 63,930</p> <p>Group Description:</p> <p>G1: Primary caeserean w/o labor</p> <p>G2: Primary caeserean w/ labour</p> <p>G3: Repeat w/o labour</p> <p>G4: Repeat w/ labour</p> <p>Group N:</p> <p>G1: 58039</p> <p>G2: 57468</p> <p>G3: 5351</p> <p>G4: 2206</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton term births <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NR 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> < 18.5, 18.5-24.9, 25-29.9, >30 <p>Age (mean, yrs):</p> <p>Categories by group</p> <p><20: 1.9%, 1.9%, 0.2%, 0.2%</p> <p>20 to 34: 82.2%, 82.4%, 70%, 72%</p> <p>35 or more: 15.9%, 15.7%, 29.8%, 27.8%</p> <p>Parity:</p> <p>Nulliparous- Yes</p> <p>G1: 51.5%</p> <p>G2: 51.3%</p> <p>G3: NA</p> <p>G4: NA</p>	<p>Race,%: NR</p> <p>Smoking,% (none):</p> <p>G1: 81%</p> <p>G2: 81%</p> <p>G3: 82.1%</p> <p>G4: 82.6%</p> <p>Diabetes mellitus,%: NA</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Weight gain rate Low (<0.18) G1: 18.9% G2: 18.9% G3: 19.5% G4: 19.6% Normal (0.18-0.5) G1: 75.4% G2: 75.4% G3: 74.3% G4: 74.8% High (>0.5) G1: 5.7% G2: 5.7% G3: 6.2% G4: 5.6%	Birth weight: Gestational diabetes, %: Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Cesarean delivery, primary and repeat, labored and unlabored Groups: Rate of weight gain (kg/wk) G1: Low (≤ 0.17) G2: Normal (0.18-0.50) G3: High (> 0.50) Results: AOR for unlabored cesarean, primary G1: 0.79 (0.59-1.05) G2: 1.00 (ref) G3: 1.03 (0.64-1.64) AOR for labored cesarean, primary G1: 0.77 (0.68-0.86) G2: 1.00 (ref) G3: 1.40 (1.23-1.60) AOR for unlabored cesarean, repeat G1: 0.91 (0.76-1.09) G2: 1.00 (ref) G3: 1.38 (1.04-1.83) AOR for labored cesarean, repeat G1: 0.79 (0.54-1.15) G2: 1.00 (ref) G3: 1.22 (0.72-2.09) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • BMI • Gestational diabetes • Pregnancy-induced hypertension • Macrosomia • Socioeconomic factors • Parity • Maternal age Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • NA 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Shepard et al., 1998</p> <p>Country and setting: Obstetrical practices in New Haven, CT</p> <p>Enrollment Period: 1988 to 1992</p> <p>Funding: Grants NIH</p> <p>Study Objective: To examine absolute and proportional gestational weight gain and prepregnancy BMI as predictors of primary cesarean delivery</p> <p>Time frame: 1988 to 1992</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 2,301</p> <p>Group Description: G1: Cesarean delivery G2: Vaginal delivery</p> <p>Group N: G1: 312 G2: 1,989</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Privately insured women who received prenatal care from 13 largest obstetrical practices and health maintenance organizations in greater New Haven, CT region (part of a larger study of selected environmental risk factors on pregnancy) Singleton deliveries at Yale-New Haven Hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Repeat cesareans births Missing information on key variables 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 140.9 (28.6) G2: 136.3 (25.2) $P = 0.007$</p> <p>Pregravid BMI: G1: 24.3 (4.6) G2: 22.9 (3.9) $P < 0.0001$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II: ≤ 19.4; 19.5-22.4; 22.5-28.5; > 28.5 <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 88.4 G2: 91.2</p> <p>Black G1: 5.8 G2: 4.9</p> <p>Hispanic G1: 3.5 G2: 2.3</p> <p>Asian/Pacific Islander G1: 1.3 G2: 1.1</p> <p>Other G1: 1.0 G2: 0.4</p> <p>Smoking, %: % never smokers: G1: 82.3 G2: 85.9</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: %married: G1: 95.8 G2: 92.1</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 312 G2: 1989 Total weight gain: G1: 35.4 (11.9) G2: 33.3 (11.9) $P = 0.005$ Categorized: <ul style="list-style-type: none"> Proportional weight gain based on prepregnancy weight and weight change during pregnancy Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Proportional weight gain, lb, mean: cesarean delivery - 26.5 (10.0); vaginal delivery - 25.2 (9.3) $P = 0.048$ Other infant outcomes: <ul style="list-style-type: none"> Low birth weight rate = 3.3% for entire study population 	Outcomes Description: Adjusted relative risk (95% CI) of cesarean delivery based on types of weight gain Groups G1: Proportional Weight Gain (total weight gain/ prepregnancy weight) G2: Absolute Weight Gain Results Underweight (< 19.4), \leq median G1: 1.00 G2: 1.00 Underweight (< 19.4), $>$ median G1: 2.08 (0.86-5.04) G2: 1.20 (0.56-2.59) Low-Average (19.5-22.4), \leq median G1: 1.62 (0.90-3.67) G2: 1.00 (0.54-1.84) Low-Average (19.5-22.4), $>$ median G1: 2.35 (1.06-5.21) G2: 1.62 (0.94-3.02) High-Average (22.5-28.4), \leq median G1: 2.78 (1.26-6.12) G2: 1.80 (1.01-3.21) High-Average (22.5-28.4), $>$ median G1: 3.06 (1.40-6.73) G2: 2.02 (1.14-3.57) Obese (> 28.5), \leq median G1: 3.25 (1.40-7.54) G2: 2.13 (1.12-4.08) Obese (> 28.5), $>$ median G1: 2.69 (1.18-6.16) G2: 1.65 (0.90-3.03) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Ethnicity Parity GDM Pre-eclampsia Placental problems Fetal distress Macrosomia Induction Height Marital status Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Wataba et al., 2006</p> <p>Country and setting: Japan, academic medical center</p> <p>Enrollment Period: 1981 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To analyze association of pregnancy complications with prepregnant body mass index and weight gain during pregnancy in Japanese women</p> <p>Time frame: 1981 to 1999</p> <p>Duration of the study: Entry into PNC up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base and look at medical records retrospectively Retrospective <p>Total Study N: 21,718</p> <p>Group Description: G1: Nulliparous G2: Parous women</p> <p>Group N: G1: 10413 G2: 11305</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy delivering term baby at Osaka Med Center and Research Institute for Maternal and Child Health in 1981-1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> None reported 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Not stated <p>Pregravid BMI: G1: 20.5 (2.6) G2: 21.1 (3.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in 2 kg/m² point intervals from prepregnancy weight; categorical into low, medium, high BMI groups (< 18, 18-23.9, > 24) <p>Age (mean, yrs): G1: 27.8 (4.1) G2: 30.45 (3.9)</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 10413 G2: 11305</p> <p>Total weight gain: G1: kg/wk: 0.25 (SD 0.09) G2: kg/wk: 0.24 (0.09) $P < 0.01$</p> <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in kg/wk using prepregnancy weight and weight at delivery divided by gestational age of infant at birth <p>Collected from:</p> <ul style="list-style-type: none"> Rate of weight gain determined by: total weight gain divided by weeks ga <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: and subtracting prepregnancy weight 	<p>Birth weight: G1: SGA: 5.4% LGA 5.2% G2: SGA 6.5% LGA 5.2%</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: <ul style="list-style-type: none"> NR </p> <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Adjusted odds ratio for cesarean deliveries by weight gain categories</p> <p>Groups Rate of weight gain, categorized differently across different BMI groups</p> <p>Results For nulliparous, low BMI women: Higher risk of cesarean delivery for women with weight gain ≥ 0.4 kg/week (AOR: 2.30 [95% CI 1.06-4.98] compared with women gaining 0.25-0.3 kg/week)</p> <p>For nulliparous, medium BMI women: Higher risk of cesarean delivery for women with weight gain ≥ 0.4 kg/week (AOR: 1.61 [95% CI 1.21-2.14] compared with women gaining 0.25-0.3 kg/week) and for women with weight gain 0.35-0.4 kg/week (AOR: 1.68 [95% CI 1.22-2.30] compared with women gaining 0.25-0.3 kg/week)</p> <p>For nulliparous, high BMI women: No increased risk</p> <p>For parous, medium BMI women: Higher risk of cesarean delivery for women with weight gain 0.25-0.3 kg/week (AOR: 1.49 [95% CI 1.09-2.04] compared with women gaining 0.20-0.25 kg/week)</p> <p>No data presented on cesarean delivery for other BMI groups for parous women</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor</p> <p>Final Quality Score: Poor</p>

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
 Wataba et al., 2006
 (Continued)

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Baseline BMI • Parity <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NR</p>	

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Witter et al., 1995</p> <p>Country and setting: Obstetric database, Johns Hopkins Hospital, MD</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: To determine whether greater weight gain during pregnancy is associated with an increased risk of cesarean delivery and, if so, whether this effect is explained by positive influence of weight gain on birth weight and if there is a threshold of pregnancy weight gain above which risk of cesarean delivery is increased differentially</p> <p>Time frame: NR</p> <p>Duration of the study: 1987 to 1989</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 4,346</p> <p>Group Description: G1: Cesarean deliveries G2: Vaginal deliveries</p> <p>Group N: G1: 1,086 G2: 3,260</p> <p>Group 3Inclusion criteria:</p> <ul style="list-style-type: none"> Women who delivered infants ≥ 28 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Incomplete data 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>Pregravid BMI: G1: 24.7 (5.9) G2: 23.1 (4.7)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 26.9 (6.7) G2: 24.3 (6.1)</p> <p>Parity: NR</p>	<p>Race,%: White G1: 40.3 G2: 29.0 Black G1: 59.7 G2: 71.0 Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 27.3 G2: 29.6</p> <p>Diabetes mellitus,%: G1: 6.1 G2: 2.6</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1,086 G2: 3,260 Total weight gain: G1: 14.56 (6.53) * <i>P</i> < 0.05 compared to vaginal deliveries G2: 13.49 (6.44) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: used weight recorded at last visit prior to delivery 	Birth weight: G1: 3,128 (841) G2: 3,181 (618) Gestational diabetes, %: G1: 6.1 G2: 2.6 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Incidence of cesarean in study population was 25% Other infant outcomes <ul style="list-style-type: none"> NA 	Outcomes Description: AOR for cesarean (95% CI) Groups NA, continuous pregnancy weight gain (kg) Results 1.04 (1.02-1.05) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pre-gravid BMI Height At least 1 previous viable pregnancy Diagnosis of preeclampsia during the current pregnancy Previous cesarean delivery Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Young et al., 2002</p> <p>Country and setting: USA, private practice</p> <p>Enrollment Period: Feb 1993 to June 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine body mass index and pregnancy weight gain as risk factors for primary cesarean delivery in nulliparous women in middle-class private practice</p> <p>Time frame: Feb 1993 to June 2001</p> <p>Duration of the study: From entry into prenatal care up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 3,375 (hard to tell from tables however as #'s don't add up to this)</p> <p>Group Description: G1: BMI < 20 G2: BMI 20-25 G3: BMI 25-30 G4: BMI > 30 G5: All</p> <p>Group N: G1: 551 G2: 1616 G3: 709 G4: 500 G5: 3361</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Primiparous deliveries between Feb 1993 and June 13,2001 in large private practice obstetric clinic <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing BMI data on mother 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported Routine pre-natal care <p>Pregravid BMI: G1: 16.3% G2: 47.8% G3: 21% G4: 14.8%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical based on American Bariatric Society definition of obesity and categories used by Cnattingius et al <p>Age (mean, yrs): G1: NR G2: NR G3: NR G4: NR G5: < 20: 8.91%, 20-29: 62.57%, 30-34: 20.1%, > 35: 8.43%</p> <p>Parity: NR</p>	<p>Race, %: White G1: NR G2: NR G3: NR G4: NR G5: 90.6%</p> <p>Black G1: NR G2: NR G3: NR G4: NR G5: 7.56%</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander G1: NR G2: NR G3: NR G4: NR G5: 1.88%</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 11. Gestational weight gain and mode of delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 551 G2: 1616 G3: 709 G4: 500 Total weight gain: G1: * (computed these percentages from n values) < 30#: 40.7% 30-35#: 27.2% > 35#: 32.1% G2: < 30#: 35.5% 30-35#: 27.6% > 35#: 36.9% G3: < 30#: 44.6% 30-35#: 21.6% > 35#: 33.8% G4: < 30#: 63.6% 30-35#: 12.8% > 35#: 23.6% Categorized: • Less than 30#, 30-35#, > 35# Collected from: • Routine pre-natal care or maternity records Ascertained by: • Based on last clinically measured weight prior to delivery: last weight minus first wt	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: G1: 12.7 G2: 18.44 G3: 24.96 G4: 37.6 Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> • CPD rate doubles in women with BMI of < 25 kg/m² with excessive weight gain Other infant outcomes: NR	Outcomes Description: Rate of cesarean deliveries by weight gain categories Groups G1: < 30 lbs G2: 30-35lbs G3: > 35 lbs Results Increase in overall cesarean delivery rate with increased weight gain was significant at all BMI levels Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Poor Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 3 Fair, 6 Poor Final Quality Score: Poor

Evidence Table 12. Gestational weight gain and vaginal birth after cesarean

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Juhasz et al., 2005</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Prepregnancy weight as defined by patient and weight at last prenatal visit</p> <p>Funding: NR</p> <p>Study Objective: To estimate whether excessive weight gain or obesity are risk factors affecting success for vaginal birth after cesarean (VBAC)</p> <p>Time frame: Prepregnancy weight as defined by patient and weight at last prenatal visit</p> <p>Duration of the study: January 1, 1996 to December 31, 2000</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,213</p> <p>Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI 26.1-29.0 G4: BMI > 29.0</p> <p>Group N: G1: 160 G2: 715 G3: 137 G4: 201</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women attempting VBAC per chart entry <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestation More than one previous cesarean delivery Previous uterine scar other than low transverse Malpresentation in current pregnancy Presence of an intrauterine fetal demise Delivery at less than 36 weeks of gestation Incomplete information for a patient 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 32.4 G2: 31.8 G3: 31.1 G4: 29.9 $P < 0.001$</p> <p>Parity: G1: gravidity (mean) 3.4 G2: 3.6 G3: 4.0 G4: 4.7</p>	<p>Race, %: White G1: 75.6 G2: 63.9 G3: 48.2 G4: 31.3</p> <p>Black G1: 6.9 G2: 9.1 G3: 22.6 G4: 32.8</p> <p>Hispanic G1: 10.0 G2: 20.6 G3: 24.8 G4: 34.8</p> <p>Asian/Pacific Islander G1: 7.5 G2: 5.2 G3: 2.9 G4: 1.0</p> <p>Other G1: 0 G2: 1.3 G3: 1.5 G4: 0 P for race < 0.001</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: diabetes: 4.0 G2: 6.0 G3: 16.0 G4: 20.0 $P < 0.001$</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 12. Gestational weight gain and vaginal birth after cesarean (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 160 G2: 715 G3: 137 G4: 201 Total weight gain: Categorized: <ul style="list-style-type: none"> ≤ 40 pounds, > 40 pounds Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self-reported prepregnancy weight and weight at last prenatal visit 	Birth weight: G1: 3,345.0 G2: 3,367.8 G3: 3,486.6 G4: 3,448.9 <i>P</i> = 0.004 Gestational diabetes, %: G1: Diabetes: 4.0 G2: 6.0 G3: 16.0 G4: 20.0 <i>P</i> < 0.001 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Vaginal birth after cesarean Groups: G1: ≤ 40 pounds G2: > 40 pounds Results: <ul style="list-style-type: none"> Adjusted odds of VBAC success with respect to excessive weight gain, adjusted for previous NSVD, previous VBAC, diabetes, induction, birth weight > 4000g, recurrent indication, one-layer closure, and complications with respect to pregnancy weight gain, VBAC success rate was 79.1% in those who gained < 40 pounds and 66.8% for those who gained more than 40 pounds during the pregnancy, <i>P</i> < 0.001 A higher VBAC success rate was still noted in group gaining less than 40 pounds when controlling for previous normal spontaneous vaginal delivery (NSVD), previous VBAC, indication for previous cesarean, birth weight, and diabetes, OR 1.58 (1.04-2.40) Those who were successful at VBAC gained significantly less weight than those who failed VBAC (29 +/-10.1 pounds and 31.4 +/-12.7 pounds, respectively, <i>P</i> = 0.005) There were fewer patients who gained more than 40 pounds in successful VBAC group (13.6%) than in failed VBAC group (22.7%, <i>P</i> < 0.001). Although there were more uterine ruptures in group that gained more than 40 pounds (2.1% vs. 1.5%), this difference was not statistically significant, <i>P</i> = 0.515- weight gain specifically was found to decrease VBAC success, OR 0.65 (0.42-0.98) 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 12. Gestational weight gain and vaginal birth after cesarean (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Juhasz et al., 2005
(continued)

Evidence Table 12. Gestational weight gain and vaginal birth after cesarean (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Previous NVSD • Previous VBAC • Diabetes • Induction • Birth weight > 4000g • Recurrent indication • One layer closure • Complications <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NR</p>	

Evidence Table 13. Gestational weight gain and vaginal lacerations

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kabiru and Raynor, 2004</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1999 to 2002</p> <p>Funding: NR</p> <p>Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes</p> <p>Time frame: 1999 to 2002</p> <p>Duration of the study: Prenatal through birth</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 5,131</p> <p>Group Description:</p> <p>G1: No change in BMI between first prenatal visit and delivery</p> <p>G2: 1 category increase in BMI between first prenatal visit and delivery</p> <p>G3: > 1 category increase in BMI between first prenatal visit and delivery</p> <p>Group N:</p> <p>G1: 2,556</p> <p>G2: 2,252</p> <p>G3: 323</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancies <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured at first prenatal visit <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 <p>Age (mean, yrs):</p> <p>G1: 24.7 (6.1)</p> <p>G2: 24.4 (5.7)</p> <p>G3: 25.2 (5.9) $P < 0.001$</p> <p>Parity:</p> <p>G1: Gravidity (mean): 1.9 (1.9)</p> <p>G2: 1.5 (1.7)</p> <p>G3: 1.2 (1.7) $P < 0.001$</p>	<p>Race, %:</p> <p>White</p> <p>G1: 1.9</p> <p>G2: 2.6</p> <p>G3: 2.8</p> <p>Black</p> <p>G1: 84.1</p> <p>G2: 82.8</p> <p>G3: 88.2</p> <p>Hispanic</p> <p>G1: 13.9</p> <p>G2: 14.6</p> <p>G3: 9.0</p> <p>Asian/Pacific Islander</p> <p>NR</p> <p>Other</p> <p>NR</p> <p>Smoking, %:</p> <p>NR</p> <p>Diabetes mellitus, %:</p> <p>NR</p> <p>Hypertension, %:</p> <p>NR</p> <p>Additional characteristics:</p> <p>Mean weight gain:</p> <p>G1: 8.6 pounds (8.4)</p> <p>G2: 22.2 pounds (10.2)</p> <p>G3: 55.3 pounds (23.8)</p> <p>Additional characteristics:</p> <p>NR</p>

Evidence Table 13. Gestational weight gain and vaginal lacerations (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) $P < 0.001$ G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) $P = 0.015$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.2 G2: 12.6 G3: 21.0 $P < 0.001$ G4: 13.0 G5: 14.3 G6: 19.3 $P = 0.256$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Third/fourth degree lacerations Groups Primary cesarean G1: normal BMI, no change in BMI between first prenatal visit and delivery G2: normal BMI, 1 category increase in BMI between first prenatal visit and delivery G3: normal BMI, > 1 category increase in BMI between first prenatal visit and G4: overweight BMI, no change in BMI between first prenatal visit and delivery G5: overweight BMI, 1 category increase in BMI between first prenatal visit and delivery G6: overweight BMI, > 1 category increase in BMI between first prenatal visit and delivery Results Third/fourth degree lacerations (%) G1: 24.0 G2: 29.3 G3: 31.7 $P < 0.001$ G4: 26.3 G5: 27.5 G6: 30.8 $P = 0.780$ Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 13. Gestational weight gain and vaginal lacerations (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ekblad and Grenman, 1992</p> <p>Country and setting: Finland, hospital</p> <p>Enrollment Period: July 1, 1985 - December 31, 1985 (6 months)</p> <p>Funding: NR</p> <p>Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome</p> <p>Time frame: July 1, 1985 to December 31, 1985 (6 months)</p> <p>Duration of the study: Prepregnancy to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery <p>Total Study N: Total n = 357</p> <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls <p>Group Description:</p> <p>G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6</p> <p>Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Not stated 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records - not stated if self reported <p>G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5)</p> <p>Pregravid BMI:</p> <p>G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height <p>Age (mean, yrs):</p> <p>G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4)</p> <p>Parity:</p> <p>G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 13. Gestational weight gain and vaginal lacerations (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) <i>P</i> < 0.05 compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) <i>P</i> < 0.0005 compared to controls G4: 23.2 (22.8) <i>P</i> < 0.0005 compared to controls G5: 13.2 (3.4) Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3712 g (614) <i>P</i> < 0.05 compared to controls G2: 3293 (362) <i>P</i> < 0.05 compared to controls G3: 3284 (880) G4: 3803 (538) <i>P</i> < 0.005 compared to controls G5: 3538 (535) Gestational diabetes, %: NR Cesarean delivery, %: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Vaginal repair II/ III % Groups G1: weight gain ≤ 5 kg G2: weight gain ≥ 20 kg G3: reference (normal prepregnancy weight and normal weight gain [undefined]) Results G1: 4/0 G2: 5/0 G3: 2/0 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 14. Maternal weight gain and shoulder dystocia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ekblad and Grenman, 1992</p> <p>Country and setting: Finland, hospital</p> <p>Enrollment Period: July 1, 1985 - December 31, 1985 (6 months)</p> <p>Funding: NR</p> <p>Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome</p> <p>Time frame: July 1, 1985 to December 31, 1985 (6 months)</p> <p>Duration of the study: Prepregnancy to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery <p>Total Study N: Total n = 357</p> <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls <p>Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6</p> <p>Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Not stated 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records - not stated if self reported <p>G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5)</p> <p>Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height <p>Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4)</p> <p>Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 14. Maternal weight gain and shoulder dystocia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) P < 0.05 compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) P < 0.0005 compared to controls G4: 23.2 (22.8) P < 0.0005 compared to controls G5: 13.2 (3.4) Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3712 g (614) P < 0.05 compared to controls G2: 3293 (362) P < 0.05 compared to controls G3: 3284 (880) G4: 3803 (538) P < 0.005 compared to controls G5: 3538 (535) Gestational diabetes,%: NR Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percentage of shoulder dystocia cases by weight gain categories Groups G1: weight gain ≤ 5 kg G2: weight gain ≥ 20 kg G3: reference (normal prepregnancy weight and normal weight gain [undefined]) Results G1: 3 G2: 2 G3: 0.6 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 14. Maternal weight gain and shoulder dystocia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Geary et al., 1995</p> <p>Country and setting: Ireland, hospital</p> <p>Enrollment Period: March 1991 - December 1992</p> <p>Funding: NR</p> <p>Study Objective: To determine if routine clinical indicators are useful predictors for shoulder dystocia</p> <p>Time frame: March 1991 - December 1992</p> <p>Duration of the study: Pregnancy through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Prospective <p>Total Study N: 363</p> <p>Group Description: G1: Cases G2: Controls</p> <p>Group N: G1: 66 G2: 297</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All cases of shoulder dystocia during study period Controllofs consisted consecutive women recruited mid-way through study period: must have had delivery in same hospital, singleton births and cephalic, vaginal delivery at term <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> not stated <p>G1: < 90 kg: 98.5% G2: 98.0</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): G1: ≥ 30: 48.5% G2: 42.1</p> <p>Parity: G1: %Multiparous: 89.4 G2: 56.6</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 14. Maternal weight gain and shoulder dystocia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 66 G2: 297 Total weight gain: G1: < 12kg: 59.1% G2: 74.1 Categorized: <ul style="list-style-type: none"> < 12kg and ≥ 12kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated 	Birth weight: G1: ≥ 4000g: 87.9% G2: 16.8 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Shoulder dystocia by weight gain categories Groups Weight gain < 12 kg and ≥ 12 kg for cases with shoulder dystocia and controls G1: Cases with shoulder dystocia G2: Controls Results maternal weight gain < 12 kg G1: 59.1% G2: 74.1% OR 2.0 (1.6-2.2) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Previous birth ≥ 4000g Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Poor

Evidence Table 14. Maternal weight gain and shoulder dystocia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kabiru and Raynor, 2004 Country and setting: USA, hospital Enrollment Period: 1999 to 2002 Funding: NR Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes Time frame: 1999 to 2002 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,131 Group Description: G1: No change in BMI between first prenatal visit and delivery G2: 1 category increase in BMI between first prenatal visit and delivery G3: > 1 category increase in BMI between first prenatal visit and delivery Group N: G1: 2,556 G2: 2,252 G3: 323 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	Pregravid weight: <ul style="list-style-type: none"> Measured at first prenatal visit Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 Age (mean, yrs): G1: 24.7 (6.1) G2: 24.4 (5.7) G3: 25.2 (5.9) $P < 0.001$ Parity: G1: Gravidity (mean): 1.9 (1.9) G2: 1.5 (1.7) G3: 1.2 (1.7) $P < 0.001$	Race, %: White G1: 1.9 G2: 2.6 G3: 2.8 Black G1: 84.1 G2: 82.8 G3: 88.2 Hispanic G1: 13.9 G2: 14.6 G3: 9.0 Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean weight gain: G1: 8.6 pounds (8.4) G2: 22.2 pounds (10.2) G3: 55.3 pounds (23.8) Additional characteristics: NR

Evidence Table 14. Maternal weight gain and shoulder dystocia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) $P < 0.001$ G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) $P = 0.015$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 8.2 G2: 12.6 G3: 21.0 $P < 0.001$ G4: 13.0 G5: 14.3 G6: 19.3 $P = 0.256$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Rates of shoulder dystocia by weight gain categories (%) Groups G1: normal BMI, no change in BMI between first prenatal visit and delivery G2: normal BMI, 1 category increase in BMI between first prenatal visit and delivery G3: normal BMI, > 1 category increase in BMI between first prenatal visit and delivery G4: overweight BMI, no change in BMI between first prenatal visit and delivery G5: overweight BMI, 1 category increase in BMI between first prenatal visit and delivery G6: overweight BMI, > 1 category increase in BMI between first prenatal visit and delivery Preeclampsia Results G1: 0.5 G2: 1.4 G3: 1.1 $P = 0.278$ for associations within normal BMI categories G4: 1.0 G5: 1.8 G6: 1.9 $P = 0.357$ for associations within overweight BMI categories Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 15. Gestational weight gain and cephalopelvic disproportion

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Devader et al., 2007</p> <p>Country and setting: United States, birth certificate data</p> <p>Enrollment period: 1999 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI</p> <p>Time frame: 1999 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 94,696</p> <p>Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs</p> <p>Group N: G1: 16,852 G2: 37,292 G3: 40,552</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8 –26.0 kg/m2) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized: NR</p> <p>Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4%</p> <p>Parity: NR</p>	<p>Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7</p> <p>Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 15. Gestational weight gain and cephalopelvic disproportion (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR Total weight gain: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: NR	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 	Outcomes Description: Adjusted Odds Ratios for Women With Normal Prepregnancy BMI (19.8 –26.0 kg/m ²) by GWG Category for cephalopelvic disproportion (95% CI) Groups: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs Results: CPD G1: 0.64 (0.55–0.75) G2: 1.0 G3: 1.58 (1.44–1.75) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Education Income Alcohol use Height Prior pregnancy Inadequate prenatal care use Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Child's gender Birth year 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 15. Gestational weight gain and cephalopelvic disproportion (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Devader et al., 2007
(combined)

Evidence Table 15. Gestational weight gain and cephalopelvic disproportion (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	Other infant outcomes: NR	•	

Evidence Table 15. Gestational weight gain and cephalopelvic disproportion (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Young et al., 2002</p> <p>Country and setting: USA, private practice</p> <p>Enrollment Period: Feb 1993 to June 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine body mass index and pregnancy weight gain as risk factors for primary cesarean delivery in nulliparous women in middle-class private practice</p> <p>Time frame: Feb 1993 to June 2001</p> <p>Duration of the study: From entry into prenatal care up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 3,375 (computed)</p> <p>Group Description:</p> <p>G1: BMI < 20 G2: BMI 20-25 G3: BMI 25-30 G4: BMI > 30 G5: All</p> <p>Group N:</p> <p>G1: 551 G2: 1616 G3: 709 G4: 500 G5: 3361</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Primiparous deliveries between Feb 1993 and June 13, 2001 in large private practice obstetric clinic <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing BMI data on mother 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported Routine pre-natal care <p>Pregravid BMI:</p> <p>G1: 16.3% G2: 47.8% G3: 21% G4: 14.8%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical based on American Bariatric Society definition of obesity and categories used by Cnattingius et al <p>Age (mean, yrs):</p> <p>G1: NR G2: NR G3: NR G4: NR G5: < 20: 8.91%, 20-29: 62.57%, 30-34: 20.1%, > 35: 8.43%</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White G1: NR G2: NR G3: NR G4: NR G5: 90.6%</p> <p>Black G1: NR G2: NR G3: NR G4: NR G5: 7.56%</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander G1: NR G2: NR G3: NR G4: NR G5: 1.88%</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 15. Gestational weight gain and cephalopelvic disproportion (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 551 G2: 1616 G3: 709 G4: 500 Total weight gain: G1: (computed these percentages from n values) < 30 lbs: 40.7% 30-35 lbs: 27.2% > 35 lbs: 32.1% G2: < 30 lbs: 35.5% 30-35 lbs: 27.6% > 35 lbs: 36.9% G3: < 30 lbs: 44.6% 30-35 lbs: 21.6% > 35 lbs: 33.8% G4: < 30 lbs: 63.6% 30-35 lbs: 12.8% > 35 lbs: 23.6% Categorized: <ul style="list-style-type: none"> Less than 30 lbs, 30-35 lbs, > 35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: last weight minus first wt 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: G1: 12.7 G2: 18.44 G3: 24.96 G4: 37.6 Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> CPD rate doubles in women with BMI of < 25 kg/m2 with excessive weight gain Other infant outcomes: NR	Outcomes Description: OR for cephalopelvic disproportion (95% CI) Groups: G1: < 30 pounds G2: 30-35 pounds G3: > 35 pounds BMI < 20: G1: 1.0 G2: - G3: 3.8 (3-4.6) $P < 0.01$ BMI 20-25: G1: 1.0 G2: - G3: 1.85 (1.63-2.06) $P < 0.0001$ BMI 25-30: G1: 1.0 G2: - G3: NS BMI > 30: G1: 1.0 G2: - G3: NS Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Obesity: BMI at first prenatal visit Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Poor Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 3 Fair, 6 Poor Final Quality Score: Poor

Evidence Table 16. Gestational weight gain and complications of labor and delivery

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Marshall, 1991 Country and setting: USA, hospital Enrollment Period: not stated Funding: NR Study Objective: To examine relationships between a healthful lifestyle, demonstrated by selected health practices, and complications in term labor Time frame: Not stated Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 493 Group Description: G1: total cohort G2: NR Group N: G1: 493 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Women who had reached but not exceeded term (37-41 weeks) Exclusion criteria: <ul style="list-style-type: none"> Women who delivered at an outside hospital 	Pregravid weight: <ul style="list-style-type: none"> Medical records Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Weight for height < 110% of ideal and > 111% of ideal Age (mean, yrs): G1: < 18 years: 4% 18-25: 68% 26-34: 25% > 34: 3% G2: NR Parity:	Race, %: White G1: 77 G2: NR Black G1: 18 G2: NR Hispanic NR Asian/Pacific Islander NR Other G1: 5 G2: NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: % married: G1: 44 G2: NR

Evidence Table 16. Gestational weight gain and complications of labor and delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> 20-40 lbs and < 20/ > 40 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: from medical records 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Specific complications that were examined: dystocia, retained placenta, postpartum hemorrhage, PIH Other infant outcomes: Specific complications that were examined: fetal distress and neonatal distress	Outcomes Description: Risk of complications (dystocia, retained placenta, pp hemorrhage PIH, fetal distress and neonatal distress) Groups: G1: <20 lbs G2: 20-40 lbs G3: > 40 lbs Results: In multivariate analysis a gestational weight gain of > 40 pounds increased the risk of complications (dystocia, retained placenta, pp hemorrhage PIH, fetal distress and neonatal distress) by 40%; Three variables, smoking, weight for height, and gestational weight gain explain 15% of the outcome; of note: smoking was associated with a protective effect (with a beta coefficient of .593 (p=.021) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Exercise Alcohol Drugs Sleep Breakfast Snacks Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 16. Gestational weight gain and complications of labor and delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Thorsdottir et al., 2002</p> <p>Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight</p> <p>Time frame: NR</p> <p>Duration of the study: 1998</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 614</p> <p>Group Description: G1: No complication G2: Complications in pregnancy or delivery G3: Complications in pregnancy G4: Complications in delivery</p> <p>Group N: G1: 452 G2: 162 G3: 56 G4: 106</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.1 (6.2) G2: 62.0 (5.6) $P = 0.059$ G3: 61.7 (4.8) $P = 0.174$ G4: 62.2 (6.1) $P = 0.274$</p> <p>Pregravid BMI: G1: 22.2 G2: 22.4 (1.6) $P = 0.270$ G3: 22.4 (1.5) $P = 0.338$ G4: 22.3 $P = 0.584$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29 G2: 29 $P = 0.857$ G3: 29 $P = 0.404$ G4: 29 $P = 0.398$</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Proportional weight gain, %: G1: 26.0 G2: 28.0 $P = 0.018$ G3: 30.0 $P = 0.005$ G4: 27.0 $P = 0.546$</p> <p>Additional characteristics: NR</p>

Evidence Table 16. Gestational weight gain and complications of labor and delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) $P = 0.080$ G3: 18.4 (5.1) $P = 0.013$ G4: 16.9 (5.1) $P = 0.887$ Categorized: <ul style="list-style-type: none"> According to IOM < 11.5, 11.-16.0, 16.1-20, ≥ 20, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3789 (469) G2: 3749 (565) $P = 0.389$ G3: 3643 (526) $P = 0.032$ G4: 3806 (578) $P = 0.529$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Rates of complications in pregnancy and delivery and neonatal outcome by maternal weight gain categories based on IOM recommendations for women of normal weight before pregnancy and additionally at 20.0kg (G1 to G4) Relative risk for complications in pregnancy and delivery by quartiles of weight gain in pregnancy adjusted for age, height, parity, gestational length, and birth weight (G5-G9) Groups: G1: < 11.5 G2: 11.-16.0 G3: 16.1-20 G4: ≥ 20 kg G5: < 12.5 kg G6: 12.5-15.5kg G7: > 15.5-17.8 G8: > 17.8-20.8 G9: > 20.8 Results for quartiles: Complications in pregnancy or delivery G1: 29 G2: 20.7 ($P < 0.05$ compared to > 20kg) G3: 28 G4: 32.1 $P = 0.105$ Complications in pregnancy G1: 5.8 G2: 6.8 ($P < 0.05$ compared to > 20kg) G3: 10.2 G4: 13.1 $P = 0.24$ Complications in delivery G1: 23.2 G2: 14 G3: 17.7 G4: 19 $P = 0.866$ Results for quintiles: Complications in pregnancy or delivery n = 162 G5: 1.16 (0.63-2.13) G6: 1.00 G7: 1.02 (0.54-1.90) G8: 1.61 (0.88-2.93) G9: 1.88 (1.04-3.4)	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 16. Gestational weight gain and complications of labor and delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Thorsdottir et al., 2002
(continued)

Evidence Table 16. Gestational weight gain and complications of labor and delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		Complications in pregnancy n = 56 G5: 1.17 (0.40-3.41) G6: 1.00 G7: 2.0 (0.73-5.42) G8: 2.69 (1.01-7.18) G9: 3.58 (1.36-9.4)	
		Complications in delivery n = 106 G5: 1.13 (0.58-2.21) G6: 1.00 G7: 0.71 (0.34-1.47) G8: 1.10 (0.55-2.10) G9: 1.14 (0.57-2.2)	
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Parity • Height 	
		Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Gestational age • Birth weight 	

Evidence Table 17. Gestational weight gain and preterm birth

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Carmichael et al., 1997</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1980 to 1990</p> <p>Funding: Grant HD27347-05 from National Institute of Child Health and Human Development</p> <p>Study Objective: To investigate usefulness of monitoring weight gain during pregnancy and mechanisms by which weight gain pattern relate to preterm delivery</p> <p>Time frame: 1980 to 1990</p> <p>Duration of the study: Initiation of prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 7,259</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 7,259 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All deliveries during time study period at study hospital Spontaneous preterm deliveries <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple births (n = 642) Randomly selected 1 delivery for those women who experienced more than 1 pregnancy during study period (n = 2412) Obese women (BMI > 29) Women with diabetes or hypertension during pregnancy Deliveries with congenital malformations Women who reported "other" race/ethnicity Non-spontaneous or medically indicated preterm deliveries Women lacking data on pattern of weight gain Women with missing data on at least 1 covariate 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 28.0 G2: NR</p> <p>Parity: G1: Nulliparous: 55% G2: NR</p>	<p>Race,%: White G1: 52 G2: NR</p> <p>Black G1: 10 G2: NR</p> <p>Hispanic G1: 12 G2: NR</p> <p>Asian/Pacific Islander G1: 26 G2: NR</p> <p>Other NR</p> <p>Smoking,%: G1: 16 G2: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 7,259 G2: NR Total weight gain: G1: Mean estimated total weight gain 16.8 kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self reported pre-pregnancy weight and last measured weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Spontaneous preterm birth Gestational age 	Outcomes Description: AOR (95% CI) of spontaneous preterm birth/ kg increase in total weight gain Groups Total gestational weight gain (continuous) Results Linear regression analysis of gestational age (days) as dependent variable and gestational weight gain (kg) as independent variable: Regression coefficient= 0.51; t-statistic=13.1; $P < 0.001$ AOR (95% CI) of spontaneous preterm birth/ kg increase in total weight gain: 0.84 (0.82-0.87) Maternal confounders and effect modifiers accounted for in analysis: BMI, maternal age, infant sex cigarettes per day maternal height, parity, race, pattern of gain derived from quadratic curves Infant and child confounders and effect modifiers accounted for in analysis: Infant sex	Background: Poor Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Dietz et al., 2006 Country and setting: USA, PRAMS data Enrollment Period: 1996-2001 Funding: NR Study Objective: Objective of study to estimate combined effects of prepregnancy BMI and pregnancy weight gain on preterm delivery of singleton births Time frame: 1996-2001 Duration of the study: Cross-sectional	Design: <ul style="list-style-type: none"> Cross-sectional Retrospective Total Study N: 113,019 Group Description: G1: Total G2: NR Group N: G1: 113,019 G2: NR Inclusion criteria: <ul style="list-style-type: none"> New mothers delivering live birth in states participating in PRAMS with annual response rate of 70% or higher during 1996-2001 Stratified, systematic sample Exclusion criteria: <ul style="list-style-type: none"> Missing or implausible estimates of birth weight, pre-pregnancy BMI, weight gain during pg, gestational age; multiple births 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Underweight < 19.8 16% (20,352) Normal 19.8–26 54% (59,088) Overweight 26.1–28.9 12% (12,928) Obese 29–34.9 12% (13,910) Very obese > 35 6% (6744) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines redefined obese as 29.0-34.9 and added additional category for very obese: BMI > 35 Age (mean, yrs): G1: < 20: 13% (13,258) 20–34: 75% (81,157) 35+: 12% (18,586) G2: NR Parity: G1: 0: 43% (51,918) 1–2: 49% (50,648) > 3: 8% (10,050) G2: NR	Race, %: White G1: 67 G2: NR Black G1: 18 G2: NR Hispanic G1: 11 G2: NR Asian/Pacific Islander NR Other G1: 4 G2: NR Smoking, %: G1: 17 G2: NR Diabetes mellitus, %: G1: 5 (pre-existing or gestational) G2: NR Hypertension, %: G1: 11 (pre-existing or during pg) G2: NR Additional characteristics: NR

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 20,352 G2: 59,088 G3: 12,928 G4: 13,910 G5: 6,744</p> <p>Total weight gain: G1: Weight gain during second and third trimesters of pregnancy: < 0.12 21% (763) 0.12–0.22 4.4% (1299) 0.23–0.68 75.6% (14,905) 0.69–0.79 9.1% (1632) > 0.79 8.8% (1753) G2: Weight gain during second and third trimesters of pregnancy: < 0</p> <p>Categorized:</p> <ul style="list-style-type: none"> Based on weight gain second and third trimesters of pregnancy (kg/wk) <p>Collected from:</p> <ul style="list-style-type: none"> Weight gain data from birth certificate - presumably measured at prenatal visits, self report- however rates were determined by formula <p>Ascertained by:</p> <ul style="list-style-type: none"> Birth certificate data and PRAMS survey 	<p>Birth weight: G1: Moderately Preterm (32-36 weeks) 4188 Very Preterm (20-31 weeks) 1,753 G2: Moderately Preterm (32-36 weeks): 9,495 Very Preterm (20-31 weeks): 4291 G3: Moderately Preterm (32-36 weeks): 2047 Very Preterm (20-31 weeks): 1,143 G4: Moderately</p> <p>Gestational diabetes, %: G1: 5 (pre-existing or gestational) G2: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NR</p> <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Risk of preterm birth</p> <p>Groups Categories of mean rate of gestational weight gain (kg/wk) during second and third trimesters stratified by pregravid BMI and type of preterm birth (very preterm, 20-31 weeks; moderate preterm, 32-36 weeks): G1: < 0.12 G2: 0.12-0.22 G3: 0.23-0.68 G4: 0.69-0.79 G5: > 0.79</p> <p>Results In general, in comparison to women with normal BMI in G3: underweight women in G1- G5 and normal weight women in G1, G2, and G5 were at increased risk of very preterm births (AOR: 1.5-9.8). Underweight women in G1-G3 and G5 and normal women in G1, G2, and G5 were at increased risk moderate preterm births (AOR: 1.4-3.1). Overweight and obese women in G1 and G5 were at increased risk of very preterm birth (AOR: 2.3-2.5) but had no elevated risk of moderate preterm birth. Very obese women with G1, G4, G5 had increased risks of very preterm births (AOR: 2.1-2.8) and with G4 had increased risks of moderate preterm birth (AOR: 1.3)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Race, Medicaid recipient, parity, marital status</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Good</p> <p>Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Jensen et al., 2005</p> <p>Country and setting: Denmark, university hospitals</p> <p>Enrollment Period: Gestation through birth</p> <p>Funding: Many different funds</p> <p>Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women</p> <p>Time frame: Gestation through birth</p> <p>Duration of the study: NR</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 481</p> <p>Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg</p> <p>Group N: G1: 93 G2: 134 G3: 132 G4: 122</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n-153) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records Patient report of pregravid BMI <p>Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8)</p> <p>Parity: NR</p>	<p>Race, %: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0, 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percentage of preterm delivery Groups: Total gestational weight gain categories (kg): G1: < 5.0 G2: 5.0-9.9 G3: 10.0-14.9 G4: > 15.0 Results Percent (%) preterm delivery by weight gain categories: G1: 6.5 G2: 6.0 G3: 4.6 G4: 2.5 <i>P</i> for trend = 0.11 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kramer et al., 1995 Country and setting: Canada, university hospitals Enrollment Period: July 1990- July 1992 Funding: National Health Research and Development Program, Health Canada Study Objective: To assess etiologic role of maternal short stature, low prepregnancy BMI, and low rate of gestational weight gain in idiopathic preterm labor Time frame: July 1990 to July 1992 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Case-control Retrospective Total Study N: 555 Group Description: G1: Cases G2: Controls Group N: G1: 244 G2: 311 Inclusion criteria: <ul style="list-style-type: none"> Women with spontaneous onset of labor before 37 weeks - 1 subsample composed of women with spontaneous onset of labor before 34 weeks and another subsample with spontaneous onset of labor before 37 weeks in index pregnancy plus a history of prior preterm delivery or second trimester miscarriage Cases were matched with 1 control by history of smoking (and race in early preterm labor subsample) To qualify as a case, 1 of following a priori criteria had to be met: (1) cervical dilation at least 2cm and effacement at least 75% on admission, (2) documented increase in cervical dilation or effacement during observation in hospital, or (3) at least 6 uterine contractions per hour for at least 2 hours documented during observation in hospital 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 21.8 (4.2) G2: 22.7 (4.0) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines < 19.8 vs. ≥ 19.8 Age (mean, yrs): G1: < 20: 7.8%; 20-34: 79.1%; ≥ 35: 13.1% G2: < 20: 2.6%; 20-34: 75.8%; ≥ 35: 21.6% Parity: %primiparous: G1: 44.3% G2: 41.2%	Race, %: White G1: 72.5 G2: 79.7 Black G1: 13.9 G2: 10.9 Hispanic NR Asian/Pacific Islander NR Other G1: 13.5 G2: 9.3 Smoking, %: G1: 24.6 during pregnancy G2: 25.7 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: G1: % married: 73.4 G2: 80.7 Additional characteristics: NR

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 244 G2: 311 Total weight gain: G1: 0.35 (0.15) kg/wk G2: 0.37 (0.13) kg/wk Categorized: <ul style="list-style-type: none"> Rate of weight gain < 0.27kg/wk Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: used rate of weight gain since cases had preterm labor 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AOR (95% CI) for cases with preterm delivery versus controls Groups Gestational weight gain categories (kg/wk): G1: < 0.27 G2: ≥ 0.27 Results G1: 1.56 (0.94-2.58) G2: 1.00 (reference) labor subsample Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Marital status English-speaking Education Matched on smoking history Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kramer et al., 1995 (continued)	Exclusion criteria: <ul style="list-style-type: none"> • Multifetal gestation • Known uterine malformation • History of exposure to diethylstilbestrol in utero • Cervical incompetence documented before pregnancy • Rupture of membranes on admission • Placenta previa • Abruptio placentae • Chronic illnesses known to predispose to preterm labor • Severely growth retarded fetuses 		

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
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Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nohr et al., 2007</p> <p>Country and setting: Denmark, primary care</p> <p>Enrollment period: 1996 to 2002</p> <p>Funding: Ellen Aagaard Nohr is supported by a grant (No.2002B020) from Health Insurance Foundation. Danish National Research Foundation established Danish Epidemiology Science Centre, which initiated and created Danish National Birth Cohort. Cohort is also result of major grant from this Foundation. Additional support for Danish National Birth Cohort obtained from Pharmacy Foundation, Egmont Foundation, March of Dimes Birth Defects Foundation and Augustinus Foundation</p> <p>Study Objective: Aim of present study to assess impact of obesity and gestational weight gain on risk of subtypes of preterm birth</p> <p>Time frame: 1996 to 2002</p> <p>Duration of the study: Entry into prenatal care - delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 0</p> <p>Group Description: G1: Total</p> <p>Group N: G1: 62,167</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with singleton pregnancies who provided an interview at approximately 16 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data on weight gain in pregnancy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs): G1: < 25: 7,757 (12.5%) 25 to 29: 26,152 (42.1%) 30 to 34: 21,181 (34.1%) 35+: 7,077 (11.4%)</p> <p>Parity: G1: 47% primiparous</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 84.1% nonsmoker</p> <p>Diabetes mellitus,%: G1: 1.2%</p> <p>Hypertension,%: G1: 1.6%</p> <p>Additional characteristics: NR</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 62 167 G2: 2751 G3: 41 991 G4: 12 270 G5: 5155</p> <p>Total weight gain: G1: Weekly weight gain (g) >275g: (15.3%) 276–675g: (68.3%) 676g+ (16.4%)</p> <p>Categorized:</p> <ul style="list-style-type: none"> Weekly weight gain categorised into 3 groups (low, medium, high) using cutpoints at 275 and 675 g, which were similar to those used in other studies <p>Collected from:</p> <ul style="list-style-type: none"> Does not specify-women self-reported weight gain status <p>Ascertained by:</p> <ul style="list-style-type: none"> Self-reported 	<p>Birth weight: NR</p> <p>Gestational diabetes, %: G1: 1.2%</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Before 34 weeks of gestation, risk of induced preterm delivery potentiated among obese women with high weight gain, and after 34 weeks, risk was potentiated at extremes, namely among underweight women with a low weight gain and obese women with a high weight gain <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Rate of gestational weight gain for women with early or late preterm birth by PPROM</p> <p>Groups Rate of gestational weight gain (g/wk) for women with early preterm birth (22-33 weeks) with PPROM :</p> <p>G1: < 275 G2: 276-675 G3: ≥ 676</p> <p>Rate of gestational weight gain (g/wk) for women with early preterm birth (22-33 weeks) without PPROM :</p> <p>G4: < 275 G5: 276-675 G6: ≥ 676</p> <p>Rate of gestational weight gain (g/wk) for women with late preterm birth (34-36 weeks) with PPROM:</p> <p>G7: < 275 G8: 276-675 G9: ≥ 676</p> <p>Rate of gestational weight gain (g/wk) for women with late preterm birth (34-36 weeks) without PPROM:</p> <p>G10: < 275 G11: 276-675 G12: ≥ 676</p> <p>Results HR (95% CI): G1: 2.1 (1.5-3.0) G2: 1.0 (ref) G3: 1.2 (0.8-1.8)</p> <p>HR (95% CI): G4: 1.9 (1.3-2.6) G5: 1.0 (ref) G6: 1.9 (1.3-2.6)</p> <p>HR (95% CI): G7: 1.3 (1.0-1.6) G8: 1.0 (ref) G9: 1.2 (1.0-1.5)</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Good</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Good</p> <p>Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Nohr et al., 2007
(continued)

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		HR (95% CI): G10: 1.0(0.9-1.2) G11: 1.0(ref) G12: 1.0 (0.9-1.2) Maternal confounders and effect modifiers accounted for in analysis: Pregravid BMI, age, height, parity, socio-occupational status, smoking alcohol consumption Infant and child confounders and effect modifiers accounted for in analysis: NR	

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rosenberg et al., 2005</p> <p>Country and setting: USA, vital statistics data</p> <p>Enrollment Period: Birth certificates with self reported pregravid weight and weight gain</p> <p>Funding: NR</p> <p>Study Objective: To examine associations between obesity, diabetes, and 3 adverse pregnancy outcomes (primary cesarean section, preterm birth, and LBW) by race/ethnic groups</p> <p>Time frame: Birth certificates with self reported pregravid weight and weight gain</p> <p>Duration of the study: Birth certificates from 1999, 2000, and 2001</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 329988</p> <p>Group Description:</p> <p>G1: Non-hispanic blacks</p> <p>G2: Non-hispanic whites</p> <p>G3: Non-hispanic asians</p> <p>G4: Hispanics</p> <p>G5: Total</p> <p>Group N:</p> <p>G1: 86,908</p> <p>G2: 96,581</p> <p>G3: 38,570</p> <p>G4: 107,612</p> <p>G5: 329,988</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Live singleton births Information on maternal prepregnancy weight and maternal weight gain during pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: < 100 pounds: 1.7%</p> <p>100-149: 49.1%</p> <p>150-199: 37.5%</p> <p>200-299: 11.2%</p> <p>≥ 300: 0.5%</p> <p>G2: < 100 pounds: 1.8%</p> <p>100-149: 69.5%</p> <p>150-199: 24.0%</p> <p>200-299: 4.7%</p> <p>≥ 300: 0.1%</p> <p>G3: < 100 pounds: 8.1%</p> <p>100-149: 79.5%</p> <p>150-199: 11.6%</p> <p>200-299: 0.8%</p> <p>≥ 300</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs):</p> <p>G1: 27.5</p> <p>G2: 30.6</p> <p>G3: 29.7</p> <p>G4: 26.4 P < 0.001</p> <p>G5: 28.3</p> <p>Parity: NR</p>	<p>Race,%:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%:</p> <p>G1: 3.7</p> <p>G2: 2.6</p> <p>G3: 6.6</p> <p>G4: 3.5</p> <p>G5: 3.7 P < 0.001</p> <p>Hypertension,%:</p> <p>G1: 1.7</p> <p>G2: 0.6</p> <p>G3: 0.5</p> <p>G4: 0.7</p> <p>G5: 0.9 P < 0.001</p> <p>Additional characteristics:</p> <p>G1: PIH 1.9</p> <p>G2: 1.2</p> <p>G3: 0.7</p> <p>G4: 1.4</p> <p>G5: 1.4 P < 0.001</p> <p>Additional characteristics:</p> <p>G1: Preeclampsia 2.9</p> <p>G2: 1.3</p> <p>G3: 1.2</p> <p>G4: 2.6</p> <p>G5: 2.1 P < 0.001</p> <p>Additional characteristics: NR</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 86,908 G2: 96,581 G3: 38,570 G4: 107,612 G5: 329,988 Total weight gain: G1: < 41pounds: 79.7% ≥ 41 pounds: 20.3% G2: < 41pounds: 83.2% ≥ 41 pounds: 16.8% <i>P</i> < 0.001 G3: < 41pounds: 89.2% ≥ 41 pounds: 10.8% G4: < 41pounds: 79.1% ≥ 41 pounds: 20.9% G5: < 41pounds: 81.6% ≥ 41 pounds: 18.4% Categorized: • < 41, ≥ 41 pounds Collected from: • Routine pre-natal care or maternity records Ascertained by: • Based on last clinically measured weight prior to delivery	Birth weight: NR Gestational diabetes, %: G1: 3.7 G2: 2.6 G3: 6.6 G4: 3.5 G5: 3.7 <i>P</i> < 0.001 Cesarean delivery, %: G1: 16.2 G2: 14.7 <i>P</i> < 0.001 G3: 14.4 G4: 13.8 G5: 14.7 Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Preterm birth 10.5, 5.1, 5.9, 7.8, 7.5 <i>P</i> < 0.001 (groups defined above) LBW 9.7, 4.1, 5.7, 6.1, 6.4 <i>P</i> < 0.001 (groups defined above) 	Outcomes Description: AOR (95% CI) for Preterm Birth Groups Categories of total gestational weight gain (lbs): G1: <41 G2: ≥ 41 Results AOR (95% CI) for Preterm Birth: G1: 1.00 (reference) G2: 0.54 (0.52-0.57) Maternal confounders and effect modifiers accounted for in analysis: Pregravid weight, chronic diabetes, GDM, chronic hypertension, PIH preeclampsia, maternal age marital status maternal education maternal birthplace, prenatal care payer, social risk, parity, trimester that prenatal care began Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Schieve et al., 1999</p> <p>Country and setting: USA, Pregnancy Nutrition Surveillance System of women participating in federally funded prenatal public health programs</p> <p>Enrollment Period: 1990 to 1993</p> <p>Funding: NR</p> <p>Study Objective: To examine associations between weight gain per week of pregnancy and net weight gain per week of pregnancy and preterm delivery</p> <p>Time frame: 1990 to 1993</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 266,172</p> <p>Group Description: G1: Total sample G2: NR</p> <p>Group N: G1: 266,172 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, black, or hispanic women Women attending WIC clinics both prenatally and postnatally Liveborn, singletons delivered between 26 to 42 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data for prepregnancy BMI, pregnancy weight gain, or infant birth weight Incompatible birth weight for gestational age 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 12.0-19.7: 17.0% 19.8-26.0: 50.9% 26.1-29.0: 12.7% 29.1-61.0 : 19.5% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 10-14y: 0.7% 15-19y: 24.8% 20-29y: 58.3% 30-34y: 11.5% 35-39y: 3.9% 40-55y: 0.7% G2: NR</p> <p>Parity: Primiparous: G1: 40.9% G2: NR</p>	<p>Race, %: White G1: 63.4 G2: NR Black G1: 20.5 G2: NR Hispanic G1: 16.1 G2: NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 266,172 G2: 45,142 G3: 135,390 G4: 33,697 G5: 51943 Total weight gain: G1: 14.19 (6.70) kg G2: 15.15 (5.75) G3: 14.97 (6.27) G4: 13.78 (6.94) G5: 11.56 (7.62) Categorized: <ul style="list-style-type: none"> Weight gain/week was calculated as weight gain (kg) divided by completed weeks gestation Weight gain/week and net weight gain/week were categorized on basis of percentile distributions in total sample Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Mean weight gain rate (kg/wk) for total sample: 0.36 (0.17) Mean net weight gain (= weight gain-birth weight) (kg) for total sample: 10.86 (6.60) Mean net weight gain rate (kg/wk) for total sample: 0.28 (0.17) Other infant outcomes: <ul style="list-style-type: none"> 6.8% delivered at 32-36 weeks gestation 0.7% delivered at 20-31 weeks gestation 	Outcomes Description: RD of preterm birth Groups Rate of weight gain (kg/week) in percentiles stratified by Low, Average, High, and Obese pregravid BMI: G1: 5th,0.10 G2: 10th, 0.16 G3: 25th,0.26 G4: 50th,0.35 G5: 75th, 0.46 G6: 90th, 0.57 G7: 95th, 0.65 Results Reference category of rate of weight gain: 0.35-<0.46 kg/wk RD of preterm birth varied by prepregnant BMI and gestational weight gain. Overall, women gaining 0.26-0.46 kg/wk had the lowest RD of preterm birth. The highest RD occurred for women gaining the least and most amount of weight, irrespective of prepregnant BMI; however, the highest RD of preterm births were among women of low BMI Maternal confounders and effect modifiers accounted for in analysis: None Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Siega-Riz et al., 1996 Country and setting: USA, public health clinics Enrollment Period: 1983 to 1987 Funding: State of California Maternal and Child Health Branch, March of Dimes, and University of North Carolina Department of Nutrition Study Objective: To examine differences in pattern of weight gain according to trimesters of pregnancy and analyze effects on preterm delivery Time frame: 1983 to 1987 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 7589 Group Description: G1: Preterm G2: Term Group N: G1: 517 G2: 7072 Inclusion criteria: <ul style="list-style-type: none"> Pregnant women attending public health clinics who were eligible to participate in Prematurity Prevention Project Exclusion criteria: <ul style="list-style-type: none"> Mismatched prenatal and birth outcome files Unreasonable gestational age Stillbirths Missing data Multiple gestations Medical inductions Inability to determine timing of PPRM or PTL 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 57.6 (0.53) G2: 59.0 (0.15) Pregravid BMI: G1: 23.7 (0.22) G2: 24.5 (0.06) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 24.9 (0.25) G2: 24.9 (0.06) Parity: %primiparous: G1: 36.9 G2: 34.4	Race, %: White G1: 8.7 G2: 8.9 Black G1: 10.3 G2: 4.9 Hispanic G1: 76.1 G2: 82.8 Asian/Pacific Islander G1: 4.0 G2: 3.3 Other NR Smoking, %: G1: 5.4 G2: 3.8 Diabetes mellitus, %: NR Hypertension, %: G1: 4.8 G2: 2.5 Additional characteristics: NR

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AOR (95% CI) for rate of preterm birth, preterm labor, PPRM Groups Categories of 3 rd trimester weekly weight gain rates (kg/week): G1: Inadequate (Underweight, < 0.34; Normal weight, < 0.35; Overweight/ Obese, < 0.30) G2: Adequate (Underweight, > 0.34; Normal, > 0.35; Overweight/Obese, > 0.30) Results Preterm birth: G1: 1.91 (1.40-2.61) G2: 1.00 (reference) Preterm labor: G1: 1.75 (1.15-2.64) G2: 1.00 (reference) PPROM: G1: 2.70 (1.35-5.42) G2: 1.00 (reference) Maternal confounders and effect modifiers accounted for in analysis: Iron status, parity combined with maternal age, ethnicity, hypertension (chronic or pregnancy induced), smoking status, week prenatal care began	Background: Good Sample selection: Fair Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 8 Good, 1 Fair, 0 Poor Final Quality Score: Good

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Spinillo et al., 1998 Country and setting: Italy, University Hospital Enrollment Period: 1988 to 1995 Funding: NR Study Objective: To investigate whether maternal anthropometric factors interact with 1 another or with other risk factors, thus modifying risk of spontaneous preterm delivery Time frame: 1988 to 1995 Duration of the study: NR	Design: <ul style="list-style-type: none"> Case-control Prospective Total Study N: 690 Group Description: G1: Cases G2: Controls Group N: Inclusion criteria: <ul style="list-style-type: none"> Cases were patients with spontaneous preterm delivery between 24 and 35 weeks gestation Exclusion criteria: <ul style="list-style-type: none"> PROM indicated premature delivery associated with abruptio placentae, placenta previa, preeclampsia, impaired fetal growth, diabetes, or other severe maternal diseases prior to pregnancy Severe fetal malformations Missing data 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 55.7 (10.3) G2: 57.7 (9.7) Pregravid BMI: G1: 21.3 (3.7) G2: 21.8 (3.4) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> ≤ 19.5 or > 19.5 Age (mean, yrs): G1: 28.7+/- 5.2 G2: 29.6+/-4.6 Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Dichotomized into second/third trimester weight gain ≤ 0.37 kg/wk and > 0.37 kg/wk. Also, net weight gain ≤ 0.135 kg/wk or > 0.135 kg/wk Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Crude ORs for spontaneous preterm delivery: BMI $< 19.5 = 1.68(1.20-2.38)$ Second/third trimester weight gain ≤ 0.37 kg/wk: 2.40 (1.69 - 3.42); Net weight gain ≤ 0.135 kg/wk 2.31 (1.45-3/68) Other infant outcomes: NR	Outcomes Description: AOR for spontaneous preterm delivery Groups G1: Prepregnancy BMI ≤ 19.5 and 2nd/3rd trimester weight gain ≤ 0.37 kg/wk G2: Prepregnancy BMI > 19.5 and 2nd/3rd trimester weight gain ≤ 0.37 kg/wk G3: Prepregnancy BMI ≤ 48 kg and 2nd/3rd trimester weight gain ≤ 0.37 kg/wk G4: Prepregnancy BMI > 48 kg and 2nd/3rd trimester weight gain ≤ 0.37 kg/wk Results AOR (95% CI) for cases with spontaneous preterm delivery versus controls: G1: 5.63 (2.35-13.8) G2: 2.45 (1.60-3.75) $P = 0.06$ for interaction between G1 and G2 G3: 5.29 (1.45-20.90) G4: 2.42 (1.65-3.55) $P = 0.21$ for interaction between G3 and G4 Maternal confounders and effect modifiers accounted for in analysis: Pregavid BMI, pregravid weight, height, age, parity, smoking, social class education Infant and child confounders and effect modifiers accounted for in analysis: Gender	Background: Poor Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 2 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stotland et al., 2006</p> <p>Country and setting: USA, academic medical center</p> <p>Enrollment Period: 1976 to 2001</p> <p>Funding: NIH</p> <p>Study Objective: To study how relationship between gestational weight gain and spontaneous preterm birth interacts with maternal race or ethnicity and previous preterm birth status</p> <p>Time frame: 1976 to 2001</p> <p>Duration of the study: From entry into prenatal care until delivery (actually used a perinatal data base and looked at info)</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base review Retrospective <p>Total Study N: 15,101</p> <p>Group Description: G1: Total G2: White G3: African American G4: Latina G5: Asian</p> <p>Group N: G1: 15,101 G2: 6,513 G3: 1,533 G4: 1,614 G5: 3,440</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of low or normal prepregnancy BMI delivering singleton during study period with complete data on all variables considered <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Hypertension Diabetes Delivery before 24 weeks of gestation Congenital anomalies Missing data on any key variables Prepregnancy BMI of 26 or greater Transport from another hospital 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported data base <p>Pregravid BMI: G1: Low 29.6%; Normal 70.4% G2: Low 25.9%; Normal 74.1% G3: Low 23.0%; Normal 77% G4: Low 19%; Normal 81% G5: Low 42.2%; 57.9%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines Low (< 19.8) Normal (19.8-25.9) but this is not explicitly stated <p>Age (mean, yrs): G1: 28.19 G2: 29.43 G3: 24.25 G4: 26.17 G5: 29.10</p> <p>Parity: Nulliparous G1: 53.8% G2: 57.5 G3: 48.0 G4: 49.0 G5: 52.9</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 10.9% G2: 14.5% G3: 21.4% G4: 6.7% G5: 4.5%</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Previous preterm birth (%) G1: NR G2: 4.4 G3: 4.1 G4: 8.3 G5: 5.58 G6: 2.91</p> <p>Additional characteristics: NR</p>

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 15,101 G2: 6513 G3: 1533 G4: 1614 G5: 3440 Group 6 Total weight gain: G1: Below IOM: 20.5%; % Within IOM 39.1%; Above 40.4% P < .001 G2: Below 15.5%; Within 38.5%; above 46.1% P < .001 G3: Below 16.9%; Within 30.9%; Above 41.2% P < .001 G4: Below 21.1%; Within 37.4%; Above 41.5% P < .001 G5: Below 25.4%; Within Categorized: <ul style="list-style-type: none"> • Continuous • According to IOM3-way categorical variable, low (less than 0.27 kg/wk), normal (between 0.27 and 0.52 kg/wk), and high (greater than 0.52kg/wk) Collected from: <ul style="list-style-type: none"> • Rate of weight gain was determined by: total weight gain divided by GA minus 2 weeks Ascertained by: <ul style="list-style-type: none"> • Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> • Spontaneous PTB for all women 4.0% white 3.6%, blacks 6.8%, latinas 4.4% asians 3.6% Other infant outcomes: NR	Outcomes Description: Rates of preterm delivery at 34 and 37 weeks Groups Categories of rate of gestational weight gain (kg/wk): G1: < 0.27 G2: 0.27 to 0.52 G3: > 0.52 Results AOR (95% CI) for preterm delivery < 37 weeks: G1: 2.6 (2.1-3.2) G2: 1.0 (reference) G3: 1.0 (0.8-1.2) AOR (95% CI) for preterm delivery < 34 weeks: G1: 3.0 (2.0-4.8) G2: 1.0 (ref) Maternal confounders and effect modifiers accounted for in analysis: Race, age pregravid BMI, year of delivery, parity, previous preterm birth, number of days between last weighing and delivery, smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Velonakis et al., 1997 Country and setting: France, hospital Enrollment Period: 1988 Funding: NR Study Objective: To identify impact of various biological, occupational, and socioeconomic factors on gestational age and birth weight Time frame: 1988 Duration of the study: First prenatal visit through delivery	Design: <ul style="list-style-type: none"> Cohort Total Study N: 2,040 Group Description: Group N: Inclusion criteria: <ul style="list-style-type: none"> Women with regular cycle not exceeding 32 days Last menstrual period was not withdrawal bleed from pill Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: calculated by subtracting prepregnancy weight, fetal and placental weight from final weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Risk for preterm birth Groups NA, total gestational weight gain (continuous) Results Regression analysis with gestational age (weeks) as the dependent variable and net gestational weight gain as the independent variable: $B = 0.191$ (SE, 0.06) $P = 0.001$ Maternal confounders and effect modifiers accounted for in analysis: Age, race, gravidity, previous diseases, parity, abortions, marital status, pathology of index pregnancy, , height, pregravid weight, job classification, alcohol, smoking, duration of pregnancy Infant and child confounders and effect modifiers accounted for in analysis: Infant sex, APGAR score	Background: Poor Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 6 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Wen et al., 1990 Country and setting: USA, hospital Enrollment Period: January 1983 to December 1987 Funding: NIH contract N01-HD-4-2811 Study Objective: To determine effect of factors related to LBW on IUGR and preterm delivery Time frame: January 1983 to December 1987 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 17,149 Group Description: G1: Total G2: IUGR G3: Preterm delivery Group N: G1: 100% G2: 7.4% G3: 12.6% Inclusion criteria: <ul style="list-style-type: none"> Women seen for prenatal care and delivered of infants at study location Exclusion criteria: <ul style="list-style-type: none"> Diabetes Pregnancies involving multiple births Fetal death Congenital malformation 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal careweight at first prenatal visit was used G1: (Prepregnancy?) Maternal weight (kg) < 50: 10.6%, 50-60: 32.6%, 61-72: 28.7%, 73-84: 14.5%, > 85: 13.6% G2: (Prepregnancy?) Maternal weight (kg) < 50: 12.9%, 50-60: 8.5%, 61-72: 6.4%, 73-84: 5.5%, > 85: 4.8% G3: (Prepregnancy?) Maternal wei Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: < 17: 7.5%, 17-19: 22.7%, 20-25: 43.1%, 26-30: 17.5%, 31-35: 7.0%, > 36: 2.3% G2: < 17: 8.0%, 17-19: 6.6%, 20-25: 7.4%, 26-30: 7.6%, 31-35: 8.2%, > 36: 8.6% G3: < 17: 15.4%, 17-19: 13.0%, 20-25: 11.6%, 26-30: 12.9%, 31-35: 14.3%, > 36: 13.4% Parity: G1: Parity 0: 44.1, 1: 29.9, > 1: 26.0 G2: Parity 0: 8.4, 1: 6.3, > 1: 6.6 G3: Parity 0: 12.5, 1: 12.3, > 1: 12.8	Race, %: White G1: 29.7 G2: NR Black G1: 70.3 G2: NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.4 G2: 10.3 G3: 13.3 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: G1: Married: 38.0% G2: Married: 6.6% G3: Married: 10.6% Additional characteristics: Education: G1: < 12: 41.1%, 12: 41.6%, > 12: 15.8% G2: < 12: 7.7%, 12: 7.3%, > 12: 7.6% G3: < 12: 12.8%, 12: 12.1%, > 12: 12.2% Additional characteristics: NR

Evidence Table 17. Gestational weight gain and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: Weight gain/week (after the 20th week) in kg: < 0.24: 12.2%, 0.24-0.57: 54.4%, 0.58-0.74: 19.2%, ≥ 0.75: 14.3% G2: Weight gain/week (after the 20th week) in kg: < 0.24: 9.9%, 0.24-0.57: 7.9%, 0.58-0.74: 5.2%, ≥ 0.75: 5.7% G3: Weight gain/ Categorized: <ul style="list-style-type: none"> Ave weight gain per week after 20th week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Maternal weight at delivery not available, so total weight gain not calculated 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Risk for preterm birth Groups Rate of weight gain (kg/wk) after 20 weeks gestation G1: < 0.24 G2: 0.24-0.57 G3: 0.58-0.74 G4: ≥0.75 Results AOR for preterm birth: G1: 1.52 ($P < 0.05$) G2: 1.11 (NS) G3: 1.00 (ref) G4: 1.71 ($P < 0.05$) Maternal confounders and effect modifiers accounted for in analysis: Race, parity, infant sex, marital status, education, age, previous preterm delivery, smoking, alcohol consumption, drug use, height, pregravid weight Infant and child confounders and effect modifiers accounted for in analysis: Gender	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Abrams et al., 1995 Country and setting: USA, university hospital Enrollment Period: 1980-1990 Funding: NICHD grant Study Objective: To determine relationship between maternal weight gain pattern and birth weight Time frame: 1980-1990 Duration of the study: initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 4,420 Group Description: G1: total sample G2: NR Group N: G1: 2994 G2: NR Inclusion criteria: <ul style="list-style-type: none"> White women delivering at hospital Exclusion criteria: <ul style="list-style-type: none"> Multiple gestation Fetal congenital abnormalities Maternal diabetes Hypertensive disorders Maternal obesity (BMI > 29.0) Missing data 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 58.5 (7.8) kg G2: NR Pregravid BMI: G1: 21.5 (2.5) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 28.8 (5.4) G2: NR Parity: G1: 0.6 (0.9) G2: NR	Race, %: White G1: 100 G2: NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: cigarettes per day: 2.0 (5.6) G2: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 2994 G2: NR Total weight gain: G1: 16.7 (0.5) G2: NR Categorized: <ul style="list-style-type: none"> Weight gain by trimester - 25th percentile was used to define low (L) vs. not low (N) maternal gain in each trimester (i.e. below 25th percentile and above 25th percentile) Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: using weight at last prenatal visit prior to delivery 	Birth weight: G1: 3485.8 (523.1) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> First trimester, 25th percentile value (kg) = -0.05 Second trimester, 25th percentile value (kg) = 5.7 Third trimester, 25th percentile value (kg) = 4.8 First-trimester gain (kg): 2.1 (3.3) Second-trimester gain (kg): 7.7 (2.9) Third-trimester gain (kg): 6.6 (2.7) Other infant outcomes: NR	Outcomes Description: Infant weight gain Groups NA, weight gain as continuous variable Results Infant BW among nonobese women 3,485.8g \pm 523.1 Increase in birth weight per 1 kg increase in total pregnancy weight gain β = 22.6g (P < 0.001) Increase in birth weight per 1 kg increase in first trimester weight gain β = 18.0g \pm 2.4 (P < 0.001) Increase in birth weight per 1 kg increase in second trimester weight gain β = 32.8g \pm 2.8 (P < 0.001) Increase in birth weight per 1 kg increase in third trimester weight gain β = 17.0g \pm 2.9 (P < 0.001) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, pregravid BMI, height, smoking, difference in weeks between the last measured weight and delivery Infant and child confounders and effect modifiers accounted for in analysis: Infant sex, gestational age	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Bianco et al., 1998 Country and setting: Mount Sinai Medical Center, New York City Enrollment period: Funding: NR Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women Time frame: NR Duration of the study: 1988 to 1995	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 613 morbidly obese 11,313 nonobese Group Description: G1: Obese G2: Controls Group N: G1: 613 G2: 11,313 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years Exclusion criteria: <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$) Pregravid BMI: <ul style="list-style-type: none"> NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$) Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)	Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$) Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$) Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$) Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Increase in birthweight Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 3,302 G2: 3,192 G3: 3,337 G4: 3,506 G5: 3,453 ($P < 0.05$) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Brown et al., 2002</p> <p>Country and setting: USA, primary care clinics</p> <p>Enrollment Period: 1989 to 1993</p> <p>Funding: NIH</p> <p>Study Objective: To identify effects of maternal weight change by trimester of pregnancy on weight, length, head circumference, and ponderal index (PI; in kg/m³) of newborns</p> <p>Time frame: 1989 - 1993</p> <p>Duration of the study: From preconception or entry into prenatal care through 6 to 8 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 389</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 389 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women aged 22-35 years enrolled in Group Health managed care organization Intended to become pg within enrollment period Had not been attempting pg for > 3 mo Had delivered last infant > 12 mo before enrollment Did not intend to use contraceptives during study Delivery of live, singleton infants Pg lasting > 241 days from conception <p>Exclusion criteria:</p> <ul style="list-style-type: none"> History of hypertension, renal disease, DM, heart disease, infertility No data on preconceptional weight and height within 6 months of conception or 2 weeks after conception Missing data on weight with 25 days of end of each trimester 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured by study investigators Weight was measured < 6 months before conception for 364 women by study investigators <p>G1: 61.2 ± 9.4 (50.7, 73.2) G2: NR</p> <p>Pregravid BMI: G1: 22.5 ± 3.2 (19.2, 26.9) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.4 ± 3.1 (25.3, 33.7) G2: NR</p> <p>Parity: G1: 0.5 ± 0.7 (0, 1) G2: NR</p>	<p>Race, %: White G1: 97 G2: NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 389 G2: NR Total weight gain: G1: 15.6 ± 4.1 (10.5–21.4) ² G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigatorsRoutine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3575g ± 448 (3033–4167) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: Although nonsignificant, a trend was noted that suggested, among women with lower preconception weight, an increased effect of first-trimester weight gain on weight of their newborns (51 kg preconception weight, 51 g/kg weight gain; 62 kg preconceptional	Outcomes Description: Increase in birthweight Groups NA, weight gain as continuous variable Results Increase in birth weight per 1 kg increase in total pregnancy weight gain $\beta = 20\text{g}$ $(P < 0.0001)$ Increase in birth weight per 1 kg increase in first trimester weight gain $\beta = 31\text{g}$ $(P < 0.0007)$ Increase in birth weight per 1 kg increase in second trimester weight gain $\beta = 26\text{g}$ $(P < 0.007)$ Increase in birth weight per 1 kg increase in third trimester weight gain $\beta = 7\text{g}$ $(P < 0.40)$ Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, pregravid BMI, height Infant and child confounders and effect modifiers accounted for in analysis: Gestational age, sex (female)	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 8 Good, 1 Fair, 0 Poor Final Quality Score: Good

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Butte et al., 2003</p> <p>Country and setting: USA, children's nutrition center</p> <p>Enrollment Period: NR</p> <p>Funding: US Department of Army and US Department of Agriculture/Agriculture Research Service</p> <p>Study Objective: To evaluate how changes in gestational weight and body composition affect infant birth weight and maternal fat retention after delivery in underweight, normal weight and overweight women</p> <p>Time frame: NR</p> <p>Duration of the study: Prior to preg through pp</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 63</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 63 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Nonsmokers 18-40 years parity ≤ 4 Physically active (20 to 30 minutes of moderate exercise at least 3 times/week) No long term medicine use No alcohol/drug abuse <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiparous Preterm deliveries Miscarriage Preeclampsia 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured by study investigators <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 31 (4) G2: NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 77 G2: NR</p> <p>Black G1: 10 G2: NR</p> <p>Hispanic G1: 10 G2: NR</p> <p>Asian/Pacific Islander G1: 3 G2: NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 15.0 (3.8) kg G2: 14.5 (4.5) kg G3: 17.9 (5.4) kg Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth weight 	Outcomes Description: Infant birthweight Groups G1: Correlation coefficient G2: Variability in BW accounted for by gestational age, pregravid weight, and total pregnancy weight gain Results G1: 0.28 G2: 37.9% Maternal confounders and effect modifiers accounted for in analysis: Race, pre-gravid BMI Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cherry et al., 1993 Country and setting: USA, hospital Enrollment Period: NR Funding: NR Study Objective: NR-to examine effect of zinc on birth outcomes Time frame: NR Duration of the study: 9 months-from time of enrollment in to prenatal care up to delivery	Design: <ul style="list-style-type: none"> RCT Total Study N: 599 Group Description: G1: Total G2: NR Group N: G1: 599 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Adolescents in prenatal clinic at Charity Hospital of New Orleans Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Measured by study investigators G1: 53% were 90-110% Expected Weight (EW); 26% < 90% EW; 21% were > 110% EW G2: NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Calculated weight for age and height Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Grams gained per week per cm height Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Table 1 provided data above-LBW, wt for length of infant, % of infants in high risk nursery Other infant outcomes: NA	Outcomes Description: Infant BW by Quartiles of weight gain Groups Quartiles defined as weekly weight gain in g per cm height G1: Quartile 1 (≤ 1.87 g) G2: Quartile 2 (1.88-2.68g) G3: Quartile 3 (2.69-3.58g) G4: Quartile 4 (≥ 3.59 g) Results G1: 2,829g G2: 2,990g G3: 3,112g G4: 3,189g Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Poor Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 3 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cianni et al., 2003 Country and setting: Italy, clinic Enrollment Period: not stated Funding: NR Study Objective: To determine predictive value of serum triglyceride levels for neonatal weight in pregnant women with positive diabetic screening but normal glucose tolerance Time frame: Not stated Duration of the study: 24 to 30 weeks GA to birth	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 180 Group Description: G1: Total cohort G2: NR Group N: G1: 180 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Positive diabetic screening performed at 24-30th week of gestation Exclusion criteria: <ul style="list-style-type: none"> Hypertensive disorders Thyroid disorder Lupus Antiphospholipid syndrome 	Pregravid weight: <ul style="list-style-type: none"> Not stated G1: 64 (11) G2: NR Pregravid BMI: G1: 23.6 (4) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 33 (4) G2: NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 180 G2: NR Total weight gain: G1: 8 (3) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Not stated Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated 	Birth weight: G1: 3,442 (440) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight Groups NA continuous measure Results F statistic = 3.16, $P = 0.08$ Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Maternal triglycerides Plasma glucose Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Edwards et al., 1996 Country and setting: USA, hospital Enrollment Period: 1997-1993 Funding: NR Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change Time frame: 1997-1993 Duration of the study: 1997-1993	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,443 Group Description: G1: Obese G2: Normal Weight G3: total sample Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births Exclusion criteria: <ul style="list-style-type: none"> Missing data Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 G2: 61 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) Age (mean, yrs): G1: 27.1 G2: 25.4 Parity: NR	Race, %: White G1: NR G2: NR G3: 69.0 (Total sample) Black G1: NR G2: NR G3: 21.0 (Total sample) Hispanic G1: NR G2: NR G3: 7.0 (Total sample) Asian/Pacific Islander NR Other G1: NR G2: NR G3: 4.0 (Total sample) Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight Groups G1: Increase in birth weight per 1 kg increase in total pregnancy weight gain for obese women G2: Increase in birth weight per 1 kg increase in total pregnancy weight gain for normal weight women Results G1: $\beta = 11g \pm 2$ ($P \leq 0.001$) G2: $\beta = 15g \pm 2$ ($P \leq 0.001$) Maternal confounders and effect modifiers accounted for in analysis: Age, parity, pregravid BMI, pregnancy-induced hypertension, adequacy of prenatal care, alcohol use, drug use, smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Ekblad and Grenman, 1992 Country and setting: Finland, hospital Enrollment Period: July 1, 1985 - December 31, 1985 (6 months) Funding: NR Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome Time frame: July 1, 1985 to December 31, 1985 (6 months) Duration of the study: Prepregnancy to delivery	Design: <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery Total Study N: Total n = 357 <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6 Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Inclusion criteria: <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control Exclusion criteria: <ul style="list-style-type: none"> Not stated 	Pregravid weight: <ul style="list-style-type: none"> Records - not stated if self reported G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5) Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4) Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) $P < 0.05$ compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) $P < 0.0005$ compared to controls G4: 23.2 (22.8) $P < 0.0005$ compared to controls G5: 13.2 (3.4) Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3712 g (614) $P < 0.05$ compared to controls G2: 3293 (362) $P < 0.05$ compared to controls G3: 3284 (880) G4: 3803 (538) $P < 0.005$ compared to controls G5: 3538 (535) Gestational diabetes,%: NR Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight Groups G1: Normal prepregnancy weight and normal weight gain G2: Weight gain ≤5 kg G3: Weight gain ≥20 kg Results G1: 3,538g ± 535 G2: 3,284g ± 880 G3: 3,803g ± 538 ($P < 0.005$ compared to G1) Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Groff et al., 1997</p> <p>Country and setting: USA, multispecialty clinics</p> <p>Enrollment Period: 1991-1993</p> <p>Funding: National Cancer Institute grant</p> <p>Study Objective: To determine effects of smoking status and maternal weight gain on infant birthweight</p> <p>Time frame: 1991-1993</p> <p>Duration of the study: Entry into prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 341</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 341 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Adult, white, non-Hispanic pregnant women beginning prenatal care before 14 weeks gestation who self-identified as never smokers, continuing smokers, and women who stopped smoking during pregnancy First or second pregnancies, singletons with recorded weights at 12,26, and 39 weeks (+/- 2 weeks) Documented infant birth weight <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Gestation > 42 weeks Black women Diabetics Hispanics 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported Routine pre-natal care first prenatal visit for 18%, self-report for 82% <p>Pregravid BMI: G1: 23.9 G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26.4 G2: NR</p> <p>Parity: G1: Nulliparous: 52.8% G2: NR</p>	<p>Race,%: White G1: 100% G2: NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 32% Never smoked G2: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: Married/living with partner: G1: 73.9% G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain:</p> <p>G1: 39.68 lb (15.42)</p> <p>G2: 32.75 lb (13.23)</p> <p>G3: 34.16 lb (11.77)</p> <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Collected from:</p> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> NR 	<p>Birth weight:</p> <p>G1: 3732 g (501)</p> <p>G2: 3440 g (465)</p> <p>G3: 3693 g (443)</p> <p>Gestational diabetes, %:</p> <p>NR</p> <p>Cesarean delivery, %:</p> <p>NR</p> <p>Instrumental delivery, %:</p> <p>NR</p> <p>Episiotomy, %:</p> <p>NR</p> <p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Significant effects were found for weight gain by smoking status @ < 0.001) and weight gain over time ($P < 0.001$) First trimester slopes differed slightly, but not significantly, among 3 groups ($P = 0.075$) Second trimester slopes differed significantly ($P = 0.013$), with women who reported stopping smoking gaining more weight than never smokers during this period (difference of 2.57 lb, 99% CI = 0.46, 8.07) Third trimester slopes also differed significantly ($P = 0.003$). Pairwise contrasts revealed significant differences in weight gain during third trimester between women who stopped smoking and continuing smokers (difference of 4.31 lb, 99% CI = 1.88, 12.00) and between women who stopped and never smokers (difference of 1.25 lb, 99% CI = 0.56, 10.49) <p>Other infant outcomes:</p> <ul style="list-style-type: none"> Statistically significant proportion of variance in infant birthweight was accounted for by both maternal weight gain and maternal smoking status. However, interaction of maternal weight gain with smoking status did not contribute significantly 	<p>Outcomes Description:</p> <p>Increase in birthweight</p> <p>Groups</p> <p>G1: Increase in birth weight per 1 lb increase in total pregnancy weight gain</p> <p>Results</p> <p>G1: $\beta = 10.1\text{g} \pm 1.76$ ($P \leq 0.001$)</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Pre-gravid BMI Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Gender 	<p>Background:</p> <p>Good</p> <p>Sample selection:</p> <p>Good</p> <p>Definition of maternal weight gain:</p> <p>Fair</p> <p>Definition of outcomes:</p> <p>Good</p> <p>Source of information on exposure, outcomes, and confounders:</p> <p>Good</p> <p>Followup:</p> <p>Good</p> <p>Analysis comparability:</p> <p>Fair</p> <p>Analysis of outcomes:</p> <p>Fair</p> <p>Interpretation:</p> <p>Fair</p> <p>Sum of Good/Fair/Poor:</p> <p>5 Good, 4 Fair, 0 Poor</p> <p>Final Quality Score:</p> <p>Good</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Guihard-Costa et al., 2004</p> <p>Country and setting: France, hospital database</p> <p>Enrollment Period: 1980-1990</p> <p>Funding: NR</p> <p>Study Objective: To determine relative influences of maternal factors on infant skinfold thickness and other outcomes</p> <p>Time frame: 1980-1990</p> <p>Duration of the study: Pregnancy to birth</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 13,972</p> <p>Group Description:</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Liveborn singletons Term infants (37 to 41 weeks) Both parents born in France No maternal smoking during gestation All data available, specifically subscapular skinfold thickness French metropolitan mothers <p>Exclusion criteria:</p> <ul style="list-style-type: none"> French mothers born in French Caribbean Islands or outside of France 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from database 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Effect of pregnancy weight gain on infant birth weight Groups G1: Standardized coefficient for effect of pregnancy weight gain on infant birth weight. Standardized coefficients are regression coefficients calculated as if all of the independent variables had a variance of 1 Results G1: SC = 0.199 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Height Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Hediger et al., 1994 Country and setting: USA, setting NR Enrollment Period: 1985 Funding: NICHD grant Study Objective: To study relationship between changes in maternal subcutaneous fat and infant birth weight Time frame: 1985 Duration of the study: Initiation of prenatal care to 4 to 6 weeks postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 608 Group Description: G1: Teenagers 13-15 years G2: Teenagers 16-18 years G3: Adults 19-29 Group N: G1: 197 G2: 207 G3: 204 Inclusion criteria: <ul style="list-style-type: none"> Primigravid and multigravid teenagers (< 19 years) with first pregnancy at < 16 y Older women ages 18 to 29 years at first pregnancy Exclusion criteria: <ul style="list-style-type: none"> History of serious nonobstetric problems (seizure disorders, leukemia or drug or alcohol abuse) Fetal demise Multiple pregnancy Missing data on study variables Women who breast fed after delivery or who were still breastfeeding at 4 to 6 weeks postpartum 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 56.00 (0.84) kg G2: 59.95 (0.82) G3: 60.91 (0.82) Pregravid BMI: G1: 21.81 (0.30) G2: 23.02 (0.29) G3: 23.18 (0.29) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 14.49 (0.14) G2: 17.41 (0.13) G3: 22.63 (0.14) Parity: % primiparous: G1: 93.9 G2: 37.2 G3: 36.3	Race, %: White G1: 7.6 G2: 9.2 G3: 8.8 Black G1: 69.5 G2: 57.5 G3: 61.8 Hispanic G1: 22.8 G2: 33.3 G3: 29.4 Asian/Pacific Islander NR Other NR Smoking, %: G1: 20.8 G2: 34.8 G3: 40.2 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean change in arm muscle area, cm ² : G1: 2.19 (0.44) G2: 1.78 (0.38) G3: 2.00 (0.39) Change in arm fat area, cm ² : G1: -0.46 (0.48) G2: -1.18 (0.43) G3: -1.26 (0.44) Change in triceps skinfold, mm Change in subscapular skinfold, mm: G1: -0.85 (0.38) -1.13 (0.38) G2: 1.22 (0.33) -0.87 (0.33) G3: -1.25 (0.34) -1.53 (0.34)

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 197 G2: 207 G3: 204 Total weight gain: G1: 14.85 (0.54) kg G2: 13.82 (0.47) G3: 14.12 (0.48) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery, infant sex 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Anthropometric measurements taken were: mid-upper arm circumference, triceps, and subscapular skinfold thickness from left side of body - upper arm muscle and fat area Other infant outcomes: NA	Outcomes Description: Infant birthweight by maternal weight gain Groups G1: Increase in birth weight per 1 kg increase in total pregnancy weight gain Results G1: $\beta = 16.7g \pm 2.5$ ($P = 0.001$) Maternal confounders and effect modifiers accounted for in analysis: Age, race/ethnicity, parity, pregravid weight, height, prior poor outcome, fat loss, pregravid weight: low weight, fat accretion, smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1990</p> <p>Country and setting: United States, prenatal clinics</p> <p>Enrollment Period: Does not state</p> <p>Funding: Supported by Garry A Weber Graduate Fellowship in Anthropology, Southern Methodist University, and through University Affiliated Center, Department of Pediatrics, University of Texas Southwestern Medical Center at Dallas, Maternal and Child Health Training Grant MCJ-2000, Department of Health and Human Services</p> <p>Study Objective: Present study was designed to (1) determine prevalence of low maternal weight-for-height near term among low income black and Hispanic women attending public prenatal clinics, and (2) compare maternal weight-for-height near term with current guidelines</p> <p>Time frame: Does not state</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 325</p> <p>Group Description: G1: Black G2: Hispanic</p> <p>Group N: G1: 172 G2: 153</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Black and Hispanic pregnant women aged ≥ 17 who subsequently delivered singleton infants free from congenital malformations <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women whose last prenatal weight was recorded > 14 days before delivery, gestational diabetes, other medical or obstetrical conditions, missing records, moved to another city before delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: NR</p> <ul style="list-style-type: none"> $< 90\%$ standard: 27.3% 90-119%: 44.2% $\geq 120\%$ standard: 21.5% <p>G2: NR</p> <ul style="list-style-type: none"> $< 90\%$ standard: 15.7% 90-119%: 38.6% $\geq 120\%$ standard: 9.8% <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): G1: 22.65 ± 4.48 G2: 23.18 ± 4.78</p> <p>Parity: G1: 0.98 ± 1.23 G2: 1.10 ± 1.50</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> % of standard weight for height by use of nomogram and chart developed by Rosso Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Weight gain Groups Infant BW for groups defined by maternal weight near term (% of standard weight-for-height) G1: > 135%, Black G2: > 135%, Hispanic G3: 120-135%, Black G4: 120-135%, Hispanic G5: 110-119%, Black G6: 110-119%, Hispanic G7: 100-109%, Black G8: 100-109%, Hispanic G9: < 100%, Black G10: < 100%, Hispanic Results G1: 3,325g ± 460 G2: 3,543g ± 410 G3: 3,200g ± 389 G4: 3,381g ± 385 G5: 3,157g ± 373 G6: 3,282g ± 400 G7: 3,025g ± 494 G8: 3,154g ± 375 G9: 2,813g ± 289 G10: 3,205g ± 472 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 2 Fair, 0 Poor Final Quality Score: Good

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Jensen et al., 2005</p> <p>Country and setting: Denmark, university hospitals</p> <p>Enrollment Period: Gestation through birth</p> <p>Funding: Many different funds</p> <p>Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women</p> <p>Time frame: Gestation through birth</p> <p>Duration of the study: NR</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 481</p> <p>Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg</p> <p>Group N: G1: 93 G2: 134 G3: 132 G4: 122</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n=153) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Records Patient report of pregravid BMI <p>Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8)</p> <p>Parity: NR</p>	<p>Race,%: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0. 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight Groups G1: MWG < 5.0 kg G2: MWG 5.0-9.9 kg G3: MWG 10-14.9 kg G4: MWG ≥ 15.0 kg Results G1: 3,456g ± 620 G2: 3,624g ± 675 G3: 3,757g ± 582 G4: 3,784g ± 597 <i>P</i> < 0.0001 Increase in birth weight per 1 kg increase in total pregnancy weight gain G1: β = 18.4g (<i>P</i> < 0.001) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, pregravid BMI, smoking, gestational age, result of 2-hour oral glucose tolerance test Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Johnson et al., 1992 Country and setting: USA, prenatal clinics Enrollment Period: January 1, 1987- December 31, 1989 Funding: NR Study Objective: To determine influences of increased maternal prepregnancy weight and increased gestational weight gain on pregnancy outcome Time frame: January 1, 1987 to December 31, 1989 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,191 Group Description: G1: BMI < 19.8 G2: 19.8-26.0 G3: 27-29 G4: > 29 G5: All Group N: G1: 755 G2: 1,621 G3: 329 G4: 486 G5: 3191 Inclusion criteria: <ul style="list-style-type: none"> Delivery at or beyond 38 weeks of gestation Singletons Received prenatal care and delivered in Shands Hospital Exclusion criteria: <ul style="list-style-type: none"> Fetal abnormalities Oligohydramnios Polyhydramnios Medical or surgical complications (GI disorders, sickle cell hemoglobinopathy, hepatitis, hematologic disorders, malignant disease, renal disease, neurologic disease, pulmonary disease, psychiatric disorders, tuberculosis) Incomplete risk variable data or outcome variable information 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> National Academy of Sciences Age (mean, yrs): G1: NR <ul style="list-style-type: none"> < 20 years: 36.6% 20-26 years: 44.8% > 26 years: 18.7% G2: NR <ul style="list-style-type: none"> < 20 years: 30.8% 20-26 years: 46.5% > 26 years: 22.6% G3: <ul style="list-style-type: none"> < 20 years: 25.8% 20-26 years: 48.9% > 26 years: 25.2% G4: <ul style="list-style-type: none"> < 20 years: 16.5% 20-26 years: 53.9% > 26 years: 29.6% G5: <ul style="list-style-type: none"> < 20 years: 29.5% 20-26 years: 47.5 % > 26 years: 23.0% Parity: G1: % first: 49.3 G2: 43.1 G3: 37.4 G4: 31.1 G5: 42.1	Race, %: White G1: 64.5 G2: 60.0 G3: 49.8 G4: 51.9 G5: 58.7 Black G1: 33.6 G2: 37.9 G3: 48.9 G4: 47.5 G5: 39.5 Hispanic NR Asian/Pacific Islander NR Other G1: 1.9 G2: 2.1 G3: 1.2 G4: 0.6 G5: 1.7 Smoking, %: NR Diabetes mellitus, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Hypertension, %: G1: 3.4 G2: 4.6 G3: 5.8 G4: 10.7 G5: 5.4 Additional characteristics: G1: % married: 42.6 G2: 46.1 G3: 40.4 G4: 49.4 G5: 45.2 Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 755 G2: 1621 G3: 329 G4: 486 G5: 3191 Total weight gain: G1: <ul style="list-style-type: none"> < 16kg: 7.8% 16-25kg: 18.5% 26-35kg: 35.1% > 35kg: 38.5% G2: <ul style="list-style-type: none"> < 16kg: 11.7% 16-25kg: 18.0% 26-35kg: 28.8% > 35kg: 41.5% G3: <ul style="list-style-type: none"> < 16kg: 19.8% 16-25kg: 19.1% 26-35kg: 28.3% > 35kg: 32.8% G4: <ul style="list-style-type: none"> < 16kg: 32.3% 16-25kg: 22.0%; Categorized: <ul style="list-style-type: none"> Quartiles National Academy of Sciences (below, within, or above recommended range) Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Birth weight: G1: <ul style="list-style-type: none"> < 2500g: 4.8% 2500-4000g: 89.1% > 4000g: 6.1% G2: <ul style="list-style-type: none"> < 2500g: 2.0% 2500-4000g: 85.2% > 4000g: 12.8% G3: <ul style="list-style-type: none"> < 2500g: 1.5% 2500-4000g: 83.0% > 4000g: 15.5% G4: <ul style="list-style-type: none"> < 2500g: 0.2% 2500-4000g: 82.5% > 4000g: 17.3% Gestational diabetes, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Cesarean delivery, %: G1: NR G2: NR G3: NR G4: NR G5: 11.9 Instrumental delivery, %: NR Episiotomy, %: NR	Outcomes Description: Infant birthweight by maternallweight gain Groups G1: Increase in birth weight per 1 lb increase in net pregnancy weight gain Results G1: $\beta = 15.4g \pm 2.2$ ($P < 0.0001$) Maternal confounders and effect modifiers accounted for in analysis: Race, parity, pregravid BMI, height, pregravid weight, marital status, education, tobacco/alcohol/drug use, pregnancy-induced hypertension, macrosomia Infant and child confounders and effect modifiers accounted for in analysis: Gestational age, infant sex, macrosomia	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 9 Fair, 0 Poor Final Quality Score: Fair

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Johnson et al., 1992
(continued)

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at last prenatal visit (mean 6.1 days prior to delivery) 	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Frequency of macrosomia = 12.2% Frequency of cesarean = 11.9% Frequency of LBW = 2.9% Frequency of postdate pregnancy = 9.8% Frequency of labor abnormalities (40% were unscheduled cesareans) = 7.8% Frequency of oxytocin induction = 13.7% Frequency of oxytocin augmentation = 16.1% Frequency of meconium staining = 21.5% <p>Other infant outcomes: NA</p>		

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kieffer et al., 2006</p> <p>Country and setting: United States, community health center</p> <p>Enrollment Period: Jan 1999 to Feb 2001</p> <p>Funding: This study was supported by National Institutes of Diabetes and Digestive and Kidney Diseases (grant R18DK 062344); Biostatistics and Measurement Cores of Michigan Diabetes Research and Training Center (grant NIH5P60 DK20572); General Clinic Center, National Institutes of Health (grant M01 RR00042); the Maternal and Child Health Bureau (grant R40 MC00115-03); and Detroit Community Academic Urban Research Center</p> <p>Study Objective: Our study assessed combined influence of maternal weight and other anthropometric and metabolic characteristics on birthweights of Latino infants</p> <p>Time frame: Jan 1999 to Feb 2001</p> <p>Duration of the study: From entry into prenatal care up til delivery. Average at entry was 17 weeks</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1,041</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 1041 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Latino women entering prenatal care during study period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestation Late entry into prenatal care Previous participation in study Miscarriage Stillbirth Missing records 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported when unknown or missing - used weight obtained within first 10 weeks of pregnancy <p>G1: 63.4 \pm12.9 G2: NR</p> <p>Pregravid BMI: G1: 25.9 \pm5.0 G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 25.2 \pm5.1 G2: NR</p> <p>Parity: G1: Multiparous, no. (%)0 429 (41.2) 1st 574 (55.1) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic G1: 100% G2: NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 9%before; 2% during G2: NR</p> <p>Diabetes mellitus, %: G1: 6.8 G2: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: total n = 933 G2: NR Total weight gain: G1: Adjusted R2: 0.30 kg [PE 8.2, SE 2.2, $P < 0.01$] G2: NR Categorized: <ul style="list-style-type: none"> Continuous According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: G1: 6.8 G2: NR Cesarean delivery, %: Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> Women with GDM had significantly lower average weight gain than those without GDM, but weight gain was not significantly related to glucose category Maternal waist, hip, and upper-arm circumference and upper-arm fat area were associated with increasingly abnormal glucose categories among women with and without GDM Significant linear increase in birthweight with increasing glucose level was maintained after further adjustment for maternal age, parity, BMI, weight gain, hypertensive disorders, and family history of diabetes Other infant outcomes: NR	Outcomes Description: Infant birth weight Groups G1: Increase in birth weight per 1 kg increase in total pregnancy weight gain Results G1: $\beta = 19.7g \pm 2.8$ ($P < 0.01$) Maternal confounders and effect modifiers accounted for in analysis: Parity, pregravid BMI, height, 1-hour glucose value Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 2 Fair, 0 Poor Final Quality Score: Good

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kirchengast and Hartmann, 2003</p> <p>Country and setting: Singleton births that took place at University Clinic for Gynecology and Obstetrics in Vienna, Austria</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: Examine impact of biological factors such as young maternal age and maternal somatic characteristics on pregnancy outcome among group of adolescent mothers who gave birth between 39th and 41st week of gestation after period of intensive psychological support</p> <p>Time frame: NR</p> <p>Duration of the study: 1985 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 8,011</p> <p>Group Description: G1: 12 to 16 years G2: 17 to 19 years G3: 20 to 29 years</p> <p>Group N: G1: 215 G2: 1,336 G3: 6,460</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women ages 12 to 29 All prenatal check-ups of mother-child passport were performed Delivery of single infant without congenital malformations Receiving psychosocial support by family and/or specially trained social worker within young adolescent group (12 to 16 years) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Coincident medical diseases such as diabetes mellitus or nephropathy Drug or alcohol abuse Twin birth IVF Registered maternal diseases before and during pregnancy Hypertension (BP < 150/90 mmHG) Protein or glucose in urine Pregnancy related immunization 	<p>Pregravid weight: Estimated by means of retrospective method and first weight determination, which was carried out at first prenatal visit (8th week of gestation) G1: 56.0 G2: 57.2 G3: 59.2</p> <p>Pregravid BMI: G1: 21.45 G2: 21.59 G3: 22.10</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 14.5 G2: 17.8 G3: 24.1</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Age at menarche: G1: 12.2 G2: 12.9 G3: 13.3 Gynecological age: G1: 3.4 G2: 5.3 G3: 10.8</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 215 G2: 1,336 G3: 6,460 Total weight gain: G1: 13.1 G2: 13.1 G3: 13.1 ($P = .10$) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3237.6 (significantly different from 17-19 and 20-29) G2: 3298.3 (significantly different from < 17 and 20-29) G3: 3368.9 (significantly different from < 17 and 17-19) ($F = 24.1$, $P < .0001$) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Chronological age Age at menarche Gynecological age Height Distancia spinarum Distancia chrstarum Prepregnancy weight Weight at end of pregnancy Other infant outcomes <ul style="list-style-type: none"> Birth length Head circumference Acromial circumference Diameter frontooccipitale 	Outcomes Description: Increase in birth weight per 1 kg increase in total pregnancy weight gain Groups NA, weight gain as continuous variable Results Increase in birth weight per 1 kg increase in total pregnancy weight gain (95% CI) G1: $\beta = 17.32$ (14.62, 20.03) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, age at menarche, pregravid weight, height, distantia cristarum Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Luke et al., 1996 Country and setting: USA, clinic Enrollment Period: March 1, 1974 to June 15, 1979 Funding: NR Study Objective: Reanalysis of original data to examine contribution of maternal weight gain to infant birth weight and retained maternal weight in immediate postpartum period, and effect of weight gains below, at, and above IOM guidelines on both infant birth weight and retained maternal weight Time frame: March 1, 1974 to June 15, 1979 Duration of the study: Prenatal visit through 2 days postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 487 Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI > 26.0 Group N: G1: 104 G2: 268 G3: 115 Inclusion criteria: <ul style="list-style-type: none"> Referred for nutrition counseling > 37- < 43 weeks gestation Singleton pregnancy Exclusion criteria: <ul style="list-style-type: none"> Women with history of or concurrent metabolic disease, such as diabetes, seizure disorder, hypertension, cardiac disease, asthma, or drug dependence Women developing antepartum complications such as preeclampsia, GDM, or multiple gestation 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 47.9 (5.1) G2: 58.7 (6.3) G3: 83.9 (16.9) Pregravid BMI: G1: 18.3 (1.0) G2: 22.6 (1.7) G3: 31.7 (5.3) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 23.1 (5.5) G2: 23.8 (5.5) G3: 27.4 (6.2) Parity: % primipara: G1: 60.6 G2: 48.1 G3: 27.0	Race, %: White NR Black G1: 48.1 G2: 48.8 G3: 63.5 Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 17.3 G2: 15.3 G3: 13.0 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 104 G2: 268 G3: 115 Total weight gain: G1: 12.6 (0.7) G2: 13.2 (0.4) G3: 11.7 (0.7) <i>Significantly different from mean for normal BMI group at $P < 0.05$</i> <i>Categorized:</i> <ul style="list-style-type: none"> According to IOM <i>Collected from:</i> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <i>Ascertained by:</i> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: total weight gain: difference between last measurement and pregravid weight; net weight gain: difference between pregravid weight and last measured weight minus infant birth weight 	Birth weight: G1: 3,067 (44) $P < 0.05$ significantly different from mean for normal BMI G2: 3308 (27) G3: 3300 (43) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Net gain (kg): 9.5 (0.6), 9.9 (0.4), 7.8 (0.6) significantly different from mean for normal BMI group at $P < 0.05$ Retained weight (kg): 6.6 (0.6), 6.6 (0.4), 4.2 (0.6) significantly different from mean for normal BMI group at $P < 0.05$ Percent retained weight (%): 11.4 (0.9), 9.4 (0.5), 4.4 (0.8) significantly different from mean for normal BMI group at $P < 0.05$ Other infant outcomes: NA	Outcomes Description: Infant birthweight for total weight gain and net weight gain Groups G1: Underweight G2: Normal weight G3: Overweight Results Increase in birth weight per 1 kg increase in total pregnancy weight gain for BMI categories G1: $\beta = 44.9\text{g} \pm 6.8$ ($P < 0.01$) G2: $\beta = 22.9\text{g} \pm 3.9$ ($P < 0.01$) G3: $\beta = 11.9\text{g} \pm 5.2$ ($P < 0.05$) Increase in birth weight per 1 kg increase in net pregnancy weight gain for BMI categories: G1: $\beta = 41.9\text{g} \pm 7.5$ ($P < 0.01$) G2: $\beta = 19.2\text{g} \pm 3.9$ ($P < 0.01$) G3: $\beta = 9.1\text{g} \pm 5.3$ Maternal confounders and effect modifiers accounted for in analysis: Age, parity, black ethnicity, smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age, infant sex	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Muscati et al., 1996</p> <p>Country and setting: Canada, public health department</p> <p>Enrollment Period: 1979 to 1989</p> <p>Funding: NR</p> <p>Study Objective: To examine association of extent and timing of pregnancy weight gain with infant birth weight and postpartum weight retention</p> <p>Time frame: 1979 to 1989</p> <p>Duration of the study: Pregnancy through 6 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 371</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 371 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, low income, non-smoking women Pregnant women <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Prematurity < 37 weeks Adolescents < 16 years Women > 40 years Maternal health problems Women who consume alcohol or drugs Pregnancy complications such as proteinuria, hypertension, diabetes, negative weight gain, missing values 	<p>Pregravid weight: Family physicians' records G1: 62.8 +/- 16.0 kg G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Pregravid weight status categorized into 3 groups as a percentage of standard weight: underweight < 90%, normal 90-120%, and overweight > 120% <p>Age (mean, yrs): G1: 24.5 +/- 5.6 G2: NR</p> <p>Parity: G1: Primiparous 52% G2: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: G1: PPWR: 5.3 +/- 5.7 kg G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 16.1 +/- 6.4 kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: From Table 1: Pearson's Correlation Coefficient and determination coefficient of maternal weight gain with PP weight retention and Infant BW. Maternal PP weight retention and Preg weight gain: [Total amount $r = 0.808$, R square 65.3%, $P < 0.001$], [Up to week 20 $r = 0.682$, R square 46.5%, $P < 0.001$], [Weeks 21-30 $r = 0.411$, R square 16.9%, $P < 0.001$], [Week 31 - term $r = 0.414$, R square 17.1%, $P < 0.001$] Other infant outcomes: Pregnancy Weight Gain and Infant Birth Weight (from Table 1): [Total amount $r = 0.216$, R square 4.7%, $P < 0.001$], [Up to week 20 $r = 0.114$, R-square 1.3%, $P < 0.05$], [Weeks 21-30 $r = 0.157$, R square 2.5%, $P < 0.01$], [Week 31 - term $r = 0.160$, R square 2.6%, $P < 0.01$]	Outcomes Description: Infant birthweight Groups G1: Increase in birth weight per 1 kg increase in total weight gain up to week 20 G2: Increase in birth weight per 1 kg increase in total weight gain from weeks 21 to 30 G3: Increase in birth weight per 1 kg increase in total weight gain from weeks 31 to term Results G1: $\beta = 22g \pm 6$ ($P < 0.01$) G2: $\beta = 31g \pm 7$ ($P < 0.001$) G3: $\beta = 12g \pm 6$ ($P < 0.05$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Pregravid standard weight Pregravid excess weight, Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Birth length Infant gender 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Paauw et al., 2005 Country and setting: USA, hospital Enrollment Period: 1995 to 1998 Funding: NR Study Objective: To evaluate relationship of maternal hyperemesis gravidarum to neonatal birth weight, infant hospital length of stay, and other birth outcomes Time frame: 1995 to 1998 Duration of the study: Initiation of prenatal care to delivery (+any time in NICU or NIMU)	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 351 Group Description: G1: Controls G2: HG patients Group N: G1: 306 G2: 45 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancy Exclusion criteria: <ul style="list-style-type: none"> Multiple or molar gestation Diabetes or GDM Causes of nausea such as appendicitis or pyelonephritis 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 65.2 (1.2) kg G2: 66.7 (3.3) Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: 25.9 (0.3) G2: 25.5 (0.7) Parity: NR	Race, %: White G1: 83.7 G2: 67.4 ($P < .05$ vs controls) Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 21.9 G2: 11.1 Diabetes mellitus, %: G1: 0.7 G2: 2.2 Hypertension, %: G1: 3.6 G2: 4.4 Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 306 G2: 45 Total weight gain: G1: 14.9 (0.3) G2: 10.6 (1.3) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not explained by authors 	Birth weight: G1: 3523 (29) G2: 3232 (88) ($P < 0.05$) Gestational diabetes, %: G1: 0.7 G2: 2.2 Cesarean delivery, %: Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight by maternal weight gain Groups G1: Increase in birth weight per 1 kg increase in total pregnancy weight gain Results G1: $\beta = 21.0g$ Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Race Prepravid weight Marital status Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Pezzarossa et al., 1996</p> <p>Country and setting: Italy, not stated</p> <p>Enrollment Period: Not stated</p> <p>Funding: NR</p> <p>Study Objective: To evaluate effects of gestational weight gain on neonatal birthweight in women who were diagnosed with gestational diabetes after 3second week gestation</p> <p>Time frame: Not stated</p> <p>Duration of the study: Initiation of prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 192</p> <p>Group Description: G1: Normal G2: GDM</p> <p>Group N: G1: 132 G2: 60</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Caucasian women who had 1 or more risk factors for GDM: BMI > 28.6, gestational weight gain > 12kg, previous GDM, or previous neonatal macrosomia and underwent a diagnostic oral glucose tolerance test for GDM after 3second week of gestation - women with positive tests formed GDM group while women with negative test results formed normal singleton <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Smoking Hypertension Underweight (BMI < 19.6) Previous metabolic treatment Diabetic counseling 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 25.7 (0.5) G2: 25.4 (0.8)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.1 (0.4) G2: 28.07 (0.6)</p> <p>Parity: NR</p>	<p>Race,%: White G1: 100 G2: 100 Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 132 G2: 60 Total weight gain: G1: 13.4 (0.5) G2: 12.2 (0.6) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: used weight at last prenatal visit 	Birth weight: G1: 3576.8 (41.3) G2: 3678.7 (69.3) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: macrosomia	Outcomes Description: Infant birthweight by maternal weight gain Groups Increase in birth weight per 1 kg increase in total pregnancy weight gain for: G1: Controls (normal glucose tolerance) G2: GDM Results G1: $\beta = 27.8\text{g}$ ($P = 0.0001$) G2: $\beta = 39.5$ ($P = 0.0001$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Fasting plasma glucose Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Shapiro et al., 2000 Country and setting: USA, community hospital Enrollment Period: NR Funding: NR Study Objective: To ascertain whether increased weight gain during pregnancy resulted in higher birth weight infants in women delivering at a community hospital Time frame: NR Duration of the study: First prenatal visit (0-15 wks of gestation) to 2 weeks after birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 159 Group Description: G1: total cohort G2: NR Group N: G1: 159 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Randomly selected from hospital database Ages 19 to 37 Term delivery Exclusion criteria: <ul style="list-style-type: none"> Smokers Drug abusers Chronic hypertensivers Preeclampsia requiring magnesium sulfate Underlying systemic disease such as lupus or diabetes Patients not screened for GDM 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care G1: 144.4 (36.0) G2: NR Pregravid BMI: G1: 24.5 (5.7) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> < 25 > 25 Age (mean, yrs): G1: 27.8 (4.6) G2: NR Parity: G1: 1.3 G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 159 G2: NR Total weight gain: G1: 30.3 lbs (11.4) G2: NR Categorized: <ul style="list-style-type: none"> < 35, > 35 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between weight measured at first visit (0-15 weeks gestation) and weight at last visit (35-41 weeks) 	Birth weight: G1: 3513.4 gms (468.8) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight Groups G1: Low BMI (< 25), Low gain (< 35lbs) G2: Low BMI (< 25), High gain (> 35lbs) G3: High BMI (> 25), Low gain (< 35lbs) G4: High BMI (> 25), High gain (> 35lbs) Results G1: 3,363g G2: 3,636g G3: 3,565g G4: 3,774g Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Poor Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Shepard et al., 1998</p> <p>Country and setting: Obstetrical practices in New Haven, CT</p> <p>Enrollment Period: 1988 to 1992</p> <p>Funding: Grants NIH</p> <p>Study Objective: To examine absolute and proportional gestational weight gain and prepregnancy BMI as predictors of primary cesarean delivery</p> <p>Time frame: 1988 to 1992</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 2,301</p> <p>Group Description: G1: Cesarean delivery G2: Vaginal delivery</p> <p>Group N: G1: 312 G2: 1,989</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Privately insured women who received prenatal care from 13 largest obstetrical practices and health maintenance organizations in greater New Haven, CT region (part of a larger study of selected environmental risk factors on pregnancy) Singleton deliveries at Yale-New Haven Hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Repeat cesareans births Missing information on key variables 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 140.9 (28.6) G2: 136.3 (25.2) $P = 0.007$</p> <p>Pregravid BMI: G1: 24.3 (4.6) G2: 22.9 (3.9) $P < 0.0001$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II: ≤ 19.4; 19.5-22.4; 22.5-28.5; > 28.5 <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 88.4 G2: 91.2</p> <p>Black G1: 5.8 G2: 4.9</p> <p>Hispanic G1: 3.5 G2: 2.3</p> <p>Asian/Pacific Islander G1: 1.3 G2: 1.1</p> <p>Other G1: 1.0 G2: 0.4</p> <p>Smoking, %: % never smokers: G1: 82.3 G2: 85.9</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: %married: G1: 95.8 G2: 92.1</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 312 G2: 1989 Total weight gain: G1: 35.4 (11.9) G2: 33.3 (11.9) $P = 0.005$ Categorized: <ul style="list-style-type: none"> Proportional weight gain based on prepregnancy weight and weight change during pregnancy Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Proportional weight gain, lb, mean: cesarean delivery - 26.5 (10.0); vaginal delivery - 25.2 (9.3) $P = 0.048$ Other infant outcomes: <ul style="list-style-type: none"> Low birth weight rate = 3.3% for entire study population 	Outcomes Description: Infant birthweight Groups Infant BW for mothers with: G1: Low average BMI (19.5 to 22.4), proportional weight gained > median G2: Low average BMI (19.5 to 22.4), gained < median G3: High average BMI (22.5 to 28.5), gained > median G4: High average BMI (22.5 to 28.5), gained < median G5: Obese (> 28.5 BMI), gained > median G6: Obese (> 28.5 BMI), gained < median Results G1: 3,231g G2: 3,553g G3: 3,395g G4: 3,620g G5: 3,685g G6: 3,453g Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Springer et al., 1992 Country and setting: USA, university hospital Enrollment Period: Sept 1988 Funding: NIH-nursing Study Objective: Purpose of study to examine relationship between early weight gain and other nutrition-related risk factors and 2 pregnancy outcomes: length of gestation and birth weight Time frame: Sept 1988 Duration of the study: Entry into prenatal care up to delivery	Design: <ul style="list-style-type: none"> Other observational Retrospective Total Study N: 107 Group Description: Group N: G1: 107 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Women giving birth during September 1988 at University of Michigan Women's Hospital Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Listed on medical record G1: Underweight 96.1 lbs Normal weight 128.4 lbs Overwt 188.5 lbs G2: NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Weight standards published by Metropolitan Life Insurance Company Age (mean, yrs): G1: 28 G2: NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 32% G2: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Weight gain at 10 and 20 weeks ascertained to within 5 weeks NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: Estimated weight gain at 20 weeks' gestation was positively related to both length of gestation and birth weight; this association was statistically significant ($P = .02$) for birth weight, as shown by a simple regression.	Outcomes Description: Infant birthweight by maternal weight gain Groups G1: Increase in birth weight per 1 lb increase in total pregnancy weight gain Results G1: $\beta = 20.1g$ Maternal confounders and effect modifiers accounted for in analysis: Maternal age, pregravid weight, length of gestation, smoking, weight gain at 20 weeks Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Velonakis et al., 1997 Country and setting: France, hospital Enrollment Period: 1988 Funding: NR Study Objective: To identify impact of various biological, occupational, and socioeconomic factors on gestational age and birth weight Time frame: 1988 Duration of the study: First prenatal visit through delivery	Design: <ul style="list-style-type: none"> Cohort Total Study N: 2,040 Group Description: Group N: Inclusion criteria: <ul style="list-style-type: none"> Women with regular cycle not exceeding 32 days Last menstrual period was not withdrawal bleed from pill Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: calculated by subtracting prepregnancy weight, fetal and placental weight from final weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight Groups G1: Increase in birth weight for net pregnancy weight gain Results G1: $\beta = 111.17g \pm 12.94$ ($P = 0.000$) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, pathology of previous/current pregnancy, previous diseases, reproductive history, marital status, employment, height weight, smoking, alcohol use, nationality Infant and child confounders and effect modifiers accounted for in analysis: Infant sex, APGAR score, gestational age	Background: Poor Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 6 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 18. Gestational weight gain and birthweight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Zaren et al., 1997</p> <p>Country and setting: Norway and Sweden, university hospitals</p> <p>Enrollment Period: January 1986 to March 1988</p> <p>Funding: NR</p> <p>Study Objective: To assess effects of maternal smoking on birthweight in term pregnancies among mothers with different anthropometric stature</p> <p>Time frame: January 1986 to March 1988</p> <p>Duration of the study: Initiation of prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1,099</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 1,099 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 10% random sample of nonsmoking mothers 50% random sample of smokers from Successive Small for Gestational Age Births Women speaking Swedish or Norwegian Para 1 and 2 First prenatal visit before 17 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Preterm delivery Incomplete information 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: ≤ 55: 30.9%; 56-66: 45.8%; ≥ 67: 23.3%</p> <p>G2: NR</p> <p>Pregravid BMI: G1: ≤ 19.8: 26.6%; 19.9-23.4: 48.5%; ≥ 23.5: 24.9%</p> <p>G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> ≤ 19.8, 19.9-23.4, ≥ 23.5 <p>Age (mean, yrs): G1: 15-19 years: 0.5%; 20-24: 13.7%; 25-29: 42.4%; 30-34: 32.2%; ≥ 35: 11.2%</p> <p>G2: NR</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 70.4% G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 18. Gestational weight gain and birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1099 G2: NR Total weight gain: G1: ≤ 11kg: 30.8%; 12-16kg: 45.6%; ≥ 17: 23.6% G2: NR Categorized: <ul style="list-style-type: none"> ≤ 11, 12-16, ≥ 17 kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: β is estimated change in infant BW (g) Groups G1: MWG ≤ 11 kg: G2: MWG ≥ 17 kg Results G1: $\beta = -131$ ($P = 0.0001$) G2: $\beta = 164$ ($P = 0.0001$) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, height, pregravid weight, smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: LBW (%) Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 2.0 G2: 11.1 G3: 8.3 G4: 5.2 G5: 3.8 Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cherry et al., 1993 Country and setting: USA, hospital Enrollment Period: NR Funding: NR Study Objective: NR-to examine effect of zinc on birth outcomes Time frame: NR Duration of the study: 9 months-from time of enrollment in to prenatal care up to delivery	Design: <ul style="list-style-type: none"> RCT Total Study N: 599 Group Description: G1: Total G2: NR Group N: G1: 599 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Adolescents in prenatal clinic at Charity Hospital of New Orleans Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Measured by study investigators G1: 53% were 90-110% Expected Weight (EW); 26% < 90% EW; 21% were > 110% EW G2: NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Calculated weight for age and height Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Grams gained per week per cm height Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Table 1 provided data above-LBW, wt for length of infant, % of infants in high risk nursery Other infant outcomes: NA	Outcomes Description: Percentage of low birth weight for each shifting of EW category. Groups Light: < 90% EW Normal: 90 to 110% of EW Heavy: > 110% EW G1: Heavy to normal G2: Normal to light G3: Normal to heavy G4: Light to normal Results G1: 5% G2: 32% G3: 3.1% G4: 2.7% Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Poor Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 3 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cogswell et al., 1994 Country and setting: USA, Pregnancy Nutrition Surveillance System Enrollment Period: 1990-1991 Funding: NR Study Objective: To determine association between increased gestational weight gain and birth weight outcomes for low income women Time frame: 1990-1991 Duration of the study: Women in WIC but everything is self reported so it is when they were first enrolled in WIC until delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 53,541 Group Description: G1: Average weight G2: Overweight G3: Very overweight Group N: G1: 33,809 G2: 7,661 G3: 12,071 Inclusion criteria: <ul style="list-style-type: none"> White, black and hispanic women who delivered single, liveborn, term infants Exclusion criteria: <ul style="list-style-type: none"> Low or high values for; birth weight, prepregnancy BMI, or weight gain during pregnancy Missing data on one or more study variables Underweight women Only 1 infant was used in analysis for women who delivered more than once during study period 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 11-17 yr: 11.9% 18-34yr: 85.0% 35-54 yr: 3.1% G2: 11-17 yr: 6.9% 18-34yr: 88.7% 35-54 yr: 4.4% G3: 11-17 yr: 4.0% 18-34yr: 90.1% 35-54 yr: 6.0% Parity: NR	Race, %: White G1: 75.1 G2: 72.4 G3: 74.5 Black G1: 13.8 G2: 14.1 G3: 16.1 Hispanic G1: 11.1 G2: 13.5 G3: 9.4 Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.9 G2: 28.3 G3: 25.7 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 33,809 G2: 7,661 G3: 12,071 Total weight gain: G1: < 15 lb: 6.2% 15-19: 5.8% 20-24: 11.2% 25-29: 14.4% 30-34: 17.1% 35-39: 13.9% ≥ 40: 31.4% G2: < 15 lb: 11.4% 15-19: 7.8% 20-24: 13.0% 25-29: 12.7% 30-34: 15.9% 35-39: 11.2% ≥ 40: 28.1% G3: < 15 lb: 25.1% 15-19: 10.1% 20-24: 1 Categorized: <ul style="list-style-type: none"> 4 lbs increments starting at 15 lbs Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: < 2500g: 2.7% 2500-4000g: 87.5% > 4000-4500: 8.5% > 4500g: 1.4% G2: < 2500g: 2.5% 2500-4000g: 83.9% > 4000-4500: 11.7% > 4500g: 2.0% G3: < 2500g: 2.1% 2500-4000g: 81.1% > 4000-4500: 13.2% > 4500g: 3.6% Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratio (95% CI) for LBW by MWG and prepregnancy BMI Groups G1: Normal BMI, MWG < 15lbs G2: Normal BMI, MWG ≥40lbs G3: Normal BMI, MWG 25-29lbs (Reference for Normal BMI) G4: Overweight BMI, MWG 30-34lbs G5: Overweight BMI, MWG 35-39 G6: Overweight BMI, MWG ≥40lbs G7: Overweight BMI, MWG 15-19lbs (Reference for Overweight BMI) Results G1: 2.1 (1.6-2.6) G2: 0.5 (0.4-0.6) G3: 1.0 G4: 0.5 (0.3-0.8) G5: 0.6 (0.3-1.1) G6: 0.4 (0.3-0.7) G7: 1.0 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race height Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Sex of infant 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Desjardins and Hardwick, 1999</p> <p>Country and setting: Canada, Healthiest Babies Possible Program</p> <p>Enrollment Period: January 1, 1987 - December 31, 1996</p> <p>Funding: Health Information and Research Services, Toronto Public Health</p> <p>Study Objective: To evaluate HBP program as mediator of impact of smoking, adolescence, prepregnancy underweight, and erratic weight gain/initial weight loss on LBW</p> <p>Time frame: January 1, 1987 - December 31, 1996</p> <p>Duration of the study:</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1,892 (1883 completed program to delivery - used in regression analyses)</p> <p>Group Description: G1: N - total sample G2: LBW - 6.8% of total sample</p> <p>Group N: G1: 1892 G2: 128</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton births Women who remained in HBP program until delivery (31% did not complete program - mainly because they moved out of area) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women for whom number of visits for HBP program was missing 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: % underweight: 20.5 G2: % underweight: 8.8</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Dichotomized as prepregnancy BMI < 20 (underweight) and ≥ 20, done for women older than 19 years women younger than 19 years were determined to be underweight or not by program nurse/dietitian <p>Age (mean, yrs): G1: % less than 19 years: 19.1 G2: % less than 19 years: 8.3</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 29.0 G2: 9.1</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: % Inadequate weight gain G1: 39.9 G2: 7.3</p> <p>Additional characteristics: NR</p>

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 793 G2: 528 G3: 562 Total weight gain: Categorized: <ul style="list-style-type: none"> NR Collected from: <ul style="list-style-type: none"> Home visitor's scale Ascertained by: <ul style="list-style-type: none"> Dichotomized as inadequate (determined by nurse/dietitian as weight loss, lack of weight gain, or very inadequate weight gain since conception) or not 	Birth weight: % < 2500g: G1: 8.8 G2: 5.1 G3: 5.5 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratio (95% CI) for LBW and inadequate weight gain Groups G1: LBW and inadequate weight gain (defined by dietician) Results G1: 1.15 (0.78-1.67) Maternal confounders and effect modifiers accounted for in analysis: Gestational age, adolescence, pregravid underweight, number of Healthiest Baby Possible visits Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1990</p> <p>Country and setting: United States, prenatal clinics</p> <p>Enrollment Period: Does not state</p> <p>Funding: Supported by Garry A Weber Graduate Fellowship in Anthropology, Southern Methodist University, and through University Affiliated Center, Department of Pediatrics, University of Texas Southwestern Medical Center at Dallas, Maternal and Child Health Training Grant MCJ-2000, Department of Health and Human Services</p> <p>Study Objective: Present study was designed to (1) determine prevalence of low maternal weight-for-height near term among low income black and Hispanic women attending public prenatal clinics, and (2) compare maternal weight-for-height near term with current guidelines</p> <p>Time frame: Does not state</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 325</p> <p>Group Description: G1: Black G2: Hispanic</p> <p>Group N: G1: 172 G2: 153</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Black and Hispanic pregnant women aged ≥ 17 who subsequently delivered singleton infants free from congenital malformations <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women whose last prenatal weight was recorded > 14 days before delivery, gestational diabetes, other medical or obstetrical conditions, missing records, moved to another city before delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: NR</p> <ul style="list-style-type: none"> $< 90\%$ standard: 27.3% 90-119%: 44.2% $\geq 120\%$ standard: 21.5% <p>G2: NR</p> <ul style="list-style-type: none"> $< 90\%$ standard: 15.7% 90-119%: 38.6% $\geq 120\%$ standard: 9.8% <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): G1: 22.65 ± 4.48 G2: 23.18 ± 4.78</p> <p>Parity: G1: 0.98 ± 1.23 G2: 1.10 ± 1.50</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> % of standard weight for height by use of nomogram and chart developed by Rosso Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Infant birthweight Groups G1: Percent BW < 3,000, Low weight gain < 120% of standard G2: Percent BW ≥ 3,000, Low weight gain < 120% of standard G3: Percent BW < 3,000, Acceptable weight gain ≥120% of standard G4: Percent BW ≥ 3,000, Acceptable weight gain ≥120% of standard Results G1: 38.2 G2: 61.8 G3: 22.1 G4: 77.9 Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 2 Fair, 0 Poor Final Quality Score: Good

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Johnson et al., 1992 Country and setting: USA, prenatal clinics Enrollment Period: January 1, 1987- December 31, 1989 Funding: NR Study Objective: To determine influences of increased maternal prepregnancy weight and increased gestational weight gain on pregnancy outcome Time frame: January 1, 1987 to December 31, 1989 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,191 Group Description: G1: BMI < 19.8 G2: 19.8-26.0 G3: 27-29 G4: > 29 G5: All Group N: G1: 755 G2: 1,621 G3: 329 G4: 486 G5: 3191 Inclusion criteria: <ul style="list-style-type: none"> Delivery at or beyond 38 weeks of gestation Singletons Received prenatal care and delivered in Shands Hospital Exclusion criteria: <ul style="list-style-type: none"> Fetal abnormalities Oligohydramnios Polyhydramnios Medical or surgical complications (GI disorders, sickle cell hemoglobinopathy, hepatitis, hematologic disorders, malignant disease, renal disease, neurologic disease, pulmonary disease, psychiatric disorders, tuberculosis) Incomplete risk variable data or outcome variable information 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> National Academy of Sciences Age (mean, yrs): G1: NR <ul style="list-style-type: none"> < 20 years: 36.6% 20-26 years: 44.8% > 26 years: 18.7% G2: NR <ul style="list-style-type: none"> < 20 years: 30.8% 20-26 years: 46.5% > 26 years: 22.6% G3: <ul style="list-style-type: none"> < 20 years: 25.8% 20-26 years: 48.9% > 26 years: 25.2% G4: <ul style="list-style-type: none"> < 20 years: 16.5% 20-26 years: 53.9% > 26 years: 29.6% G5: <ul style="list-style-type: none"> < 20 years: 29.5% 20-26 years: 47.5 % > 26 years: 23.0% Parity: G1: % first: 49.3 G2: 43.1 G3: 37.4 G4: 31.1 G5: 42.1	Race, %: White G1: 64.5 G2: 60.0 G3: 49.8 G4: 51.9 G5: 58.7 Black G1: 33.6 G2: 37.9 G3: 48.9 G4: 47.5 G5: 39.5 Hispanic NR Asian/Pacific Islander NR Other G1: 1.9 G2: 2.1 G3: 1.2 G4: 0.6 G5: 1.7 Smoking, %: NR Diabetes mellitus, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Hypertension, %: G1: 3.4 G2: 4.6 G3: 5.8 G4: 10.7 G5: 5.4 Additional characteristics: G1: % married: 42.6 G2: 46.1 G3: 40.4 G4: 49.4 G5: 45.2 Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 755 G2: 1621 G3: 329 G4: 486 G5: 3191 Total weight gain: G1: <ul style="list-style-type: none"> < 16kg: 7.8% 16-25kg: 18.5% 26-35kg: 35.1% > 35kg: 38.5% G2: <ul style="list-style-type: none"> < 16kg: 11.7% 16-25kg: 18.0% 26-35kg: 28.8% > 35kg: 41.5% G3: <ul style="list-style-type: none"> < 16kg: 19.8% 16-25kg: 19.1% 26-35kg: 28.3% > 35kg: 32.8% G4: <ul style="list-style-type: none"> < 16kg: 32.3% 16-25kg: 22.0%; Categorized: <ul style="list-style-type: none"> Quartiles National Academy of Sciences (below, within, or above recommended range) Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at last prenatal visit (mean 6.1 days prior to delivery) 	Birth weight: G1: <ul style="list-style-type: none"> < 2500g: 4.8% 2500-4000g: 89.1% > 4000g: 6.1% G2: <ul style="list-style-type: none"> < 2500g: 2.0% 2500-4000g: 85.2% > 4000g: 12.8% G3: <ul style="list-style-type: none"> < 2500g: 1.5% 2500-4000g: 83.0% > 4000g: 15.5% G4: <ul style="list-style-type: none"> < 2500g: 0.2% 2500-4000g: 82.5% > 4000g: 17.3% Gestational diabetes, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Cesarean delivery, %: G1: NR G2: NR G3: NR G4: NR G5: 11.9 Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Frequency of macrosomia = 12.2% Frequency of cesarean = 11.9% Frequency of LBW = 2.9% 	Outcomes Description: Odds ratio (95% CI) for LBW Groups G1: Net WG < 14.9 lbs (Reference) G2: Net WG 14.9-23.5 lbs G3: Net WG 24-33 lbs G4: Net WG > 33 lbs Results G1: 1.0 (Reference) G2: 0.51 (0.27-0.98) G3: 0.54 (0.28-1.04) G4: 0.38 (0.2-0.8) Maternal confounders and effect modifiers accounted for in analysis: Maternal race, parity, pregravid BMI, height, pregravid weight, marital status, education, tobacco/alcohol/drug use, pregnancy-induced hypertension Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex Macrosomia 	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 9 Fair, 0 Poor Final Quality Score: Fair

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<ul style="list-style-type: none"> • Frequency of postdate pregnancy = 9.8% • Frequency of labor abnormalities (40% were unscheduled cesareans) = 7.8% • Frequency of oxytocin induction = 13.7% • Frequency of oxytocin augmentation = 16.1% • Frequency of meconium staining = 21.5% <p>Other infant outcomes: NA</p>		

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kiel et al., 2007 Country and setting: United States, birth registry Enrollment period: 1990 to 2001 Funding: NR Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women Time frame: 1990 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NIH guidelines Age (mean, yrs): G1: <26: 46% 26–35: 47% Older than 35: 8% G2: <26: 44% 26–35: 48% Older than 35: 8% G3: <26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 Black G1: 22 G2: 23 G3: 27 Hispanic NR Asian/Pacific Islander NR Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% ($P < 0.05$)	Outcomes Description: Odds of low birth weight	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	G2: SGA: 7% LGA: 16% ($P < 0.05$) G3: SGA: 6% LGA: 18% ($P < 0.05$) Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Groups G1: Odds of LBW for weight gain > 25 lbs G2: OR of LBW for weight gain < 15 lbs G3: Reference Weight gain 15-25 lbs Results G1: Lower for women in this group G2: Higher for women in this group Numerical value for ORs not reported in study Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in Medicaid, WIC, food stamp programs) • Smoking • Chronic hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, and • greater than 35 lb gain 			
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 			
Ascertained by: NR			

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 to 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kirchengast and Hartmann, 2003</p> <p>Country and setting: Singleton births that took place at University Clinic for Gynecology and Obstetrics in Vienna, Austria</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: Examine impact of biological factors such as young maternal age and maternal somatic characteristics on pregnancy outcome among group of adolescent mothers who gave birth between 39th and 41st week of gestation after period of intensive psychological support</p> <p>Time frame: NR</p> <p>Duration of the study: 1985 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 8,011</p> <p>Group Description: G1: 12 to 16 years G2: 17 to 19 years G3: 20 to 29 years</p> <p>Group N: G1: 215 G2: 1,336 G3: 6,460</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women ages 12 to 29 All prenatal check-ups of mother-child passport were performed Delivery of single infant without congenital malformations Receiving psychosocial support by family and/or specially trained social worker within young adolescent group (12 to 16 years) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Coincident medical diseases such as diabetes mellitus or nephropathy Drug or alcohol abuse Twin birth IVF Registered maternal diseases before and during pregnancy Hypertension (BP < 150/90 mmHG) Protein or glucose in urine Pregnancy related immunization 	<p>Pregravid weight: Estimated by means of retrospective method and first weight determination, which was carried out at first prenatal visit (8th week of gestation)</p> <p>G1: 56.0 G2: 57.2 G3: 59.2</p> <p>Pregravid BMI: G1: 21.45 G2: 21.59 G3: 22.10</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 14.5 G2: 17.8 G3: 24.1</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Age at menarche: G1: 12.2 G2: 12.9 G3: 13.3 Gynecological age: G1: 3.4 G2: 5.3 G3: 10.8</p>

Evidence Table 18. Gestational weight gain and low birthweight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 215 G2: 1,336 G3: 6,460 Total weight gain: G1: 13.1 G2: 13.1 G3: 13.1 ($P = .10$) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3237.6 (significantly different from 17-19 and 20-29) G2: 3298.3 (significantly different from < 17 and 20-29) G3: 3368.9 (significantly different from < 17 and 17-19) ($F = 24.1$, $P < .0001$) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Chronological age Age at menarche Gynecological age Height Distancia spinarum Distancia chrstarum Prepregnancy weight Weight at end of pregnancy Other infant outcomes <ul style="list-style-type: none"> Birth length Head circumference Acromial circumference Diameter frontooccipitale 	Outcomes Description: OR and 95% CI, for LBW Groups NA, weight gain as continuous variable Results 0.90 (0.85-0.95) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, age at menarche, pregravid weight, height, distantia cristarum Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Lasker et al., 2005 Country and setting: USA, hospital Enrollment period: November 1997 to October 1999 Funding: NR Study Objective: To investigate predictors of LBW in population of Eastern Pennsylvania Time frame: November 1997 to October 1999 Duration of the study: NA, retrospective	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,528 Group Description: G1: Total cohort G2: NR Group N: G1: 5,528 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Women delivering in 1 of 2 hospitals in a single hospital network Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> WHO International Taskforce BMI at delivery Age (mean, yrs): G1: <ul style="list-style-type: none"> < 15: 0.5% 15-19.9: 8.2% 20-24.9: 17.2% 25-29.9: 34.7% 30-34.9: 23.6% 35-39.9: 13.5% 40-50: 2.3% G2: NR Parity: NR	Race, %: White G1: 74.1 G2: NR Black G1: 3.3 G2: NR Hispanic G1: 11.0 G2: NR Asian/Pacific Islander NR Other G1: 11.5 G2: NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> < 10, 11-20, 21-30, > 30 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> 490 (8.9%) delivered LBW babies (< 2500g) 103 (1.9%) delivered VLBW babies (< 1500g) 	Outcomes Description: Odds ratio (95% CI) for LBW Groups G1: MWG < 10 lbs G2: MWG > 30 lbs G3: MWG 21-30 lbs (Reference) Results G1: 2.43 (1.45-4.05) G2: 0.63 (0.47-0.85) G3: 1.00 Maternal confounders and effect modifiers accounted for in analysis: Maternal age, maternal race, marital status, prenatal care, prior term births, prior abortions, prior preterm births, BMI at delivery, preeclampsia, bleeding, smoking, multiple births, premature birth, congenital anomaly, incompetent cervix, smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Murakami et al., 2004 Country and setting: Japan, hospital Enrollment Period: 2001 Funding: NR Study Objective: To estimate risk of perinatal morbidity of mother and infant with respect to maternal prepregnancy BMI and weight gain in Japanese women Time frame: 2001 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 633 Group Description: G1: Total cohort G2: NR Group N: G1: 633 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Live, singletons delivered between 24 to 42 weeks gestation Exclusion criteria:	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 20.9 (2.8) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 29.1 (4.5) G2: NR Parity: G1: 0.6 (0.7) G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 8.5 G2: NR Diabetes mellitus, %: G1: 2.1 G2: NR Hypertension, %: NR Additional characteristics: G1: Preeclampsia - mild: 5.4%; severe: 4.1% G2: NR Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 633 G2: NR Total weight gain: G1: 10.5 (3.4) G2: NR Categorized: <ul style="list-style-type: none"> < 8.5kg, 8.5-12.5, > 12.5 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: last measurement was taken at hospitalization prior to delivery 	Birth weight: G1: 3,052.6 (483.8) G2: NR Gestational diabetes, %: G1: 2.1 G2: NR Cesarean delivery, %: G1: 10.3 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratio (95% CI) for LBW Groups G1: MWG < 8.5 kg G2: MWG 8.5-12.5 kg G3: MWG > 12.5 kg Results G1: 1.26 (0.57-2.75) G2: Reference G3: 0.62 (0.24-1.62) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Rosenberg et al., 2005 Country and setting: USA, vital statistics data Enrollment Period: Birth certificates with self reported pregravid weight and weight gain Funding: NR Study Objective: To examine associations between obesity, diabetes, and 3 adverse pregnancy outcomes (primary cesarean section, preterm birth, and LBW) by race/ethnic groups Time frame: Birth certificates with self reported pregravid weight and weight gain Duration of the study: Birth certificates from 1999, 2000, and 2001	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 329988 Group Description: G1: Non-hispanic blacks G2: Non-hispanic whites G3: Non-hispanic asians G4: Hispanics G5: Total Group N: G1: 86,908 G2: 96,581 G3: 38,570 G4: 107,612 G5: 329,988 Inclusion criteria: <ul style="list-style-type: none"> Live singleton births Information on maternal prepregnancy weight and maternal weight gain during pregnancy Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: < 100 pounds: 1.7% 100-149: 49.1% 150-199: 37.5% 200-299: 11.2% ≥ 300: 0.5% G2: < 100 pounds: 1.8% 100-149: 69.5% 150-199: 24.0% 200-299: 4.7% ≥ 300: 0.1% G3: < 100 pounds: 8.1% 100-149: 79.5% 150-199: 11.6% 200-299: 0.8% ≥ 300 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: 27.5 G2: 30.6 G3: 29.7 G4: 26.4 $P < 0.001$ G5: 28.3 Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: G1: 3.7 G2: 2.6 G3: 6.6 G4: 3.5 G5: 3.7 $P < 0.001$ Hypertension, %: G1: 1.7 G2: 0.6 G3: 0.5 G4: 0.7 G5: 0.9 $P < 0.001$ Additional characteristics: G1: PIH 1.9 G2: 1.2 G3: 0.7 G4: 1.4 G5: 1.4 $P < 0.001$ Additional characteristics: G1: Preeclampsia 2.9 G2: 1.3 G3: 1.2 G4: 2.6 G5: 2.1 $P < 0.001$ Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 86,908 G2: 96,581 G3: 38,570 G4: 107,612 G5: 329,988 Total weight gain: G1: < 41pounds: 79.7% ≥ 41 pounds: 20.3% G2: < 41pounds: 83.2% ≥ 41 pounds: 16.8% <i>P</i> < 0.001 G3: < 41pounds: 89.2% ≥ 41 pounds: 10.8% G4: < 41pounds: 79.1% ≥ 41 pounds: 20.9% G5: < 41pounds: 81.6% ≥ 41 pounds: 18.4% Categorized: <ul style="list-style-type: none"> < 41, ≥ 41 pounds Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: G1: 3.7 G2: 2.6 G3: 6.6 G4: 3.5 G5: 3.7 <i>P</i> < 0.001 Cesarean delivery, %: G1: 16.2 G2: 14.7 <i>P</i> < 0.001 G3: 14.4 G4: 13.8 G5: 14.7 Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Preterm birth 10.5, 5.1, 5.9, 7.8, 7.5 <i>P</i> < 0.001 (groups defined above) LBW 9.7, 4.1, 5.7, 6.1, 6.4 <i>P</i> < 0.001 (groups defined above) 	Outcomes Description: Odds ration (95% CI) for LBW Groups G1: MWG ≥ 41 lbs G2: MGW < 41 lbs Results G1: 0.41 (0.39-0.43) G2: Reference Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, GDM, pregnancy-induced hypertension, preeclampsia, pregravid weight, chronic diabetes, chronic hypertension, marital status, maternal education, mother's birthplace, prenatal care payer, social risk, trimester prenatal care began Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Shepard et al., 1998</p> <p>Country and setting: Obstetrical practices in New Haven, CT</p> <p>Enrollment Period: 1988 to 1992</p> <p>Funding: Grants NIH</p> <p>Study Objective: To examine absolute and proportional gestational weight gain and prepregnancy BMI as predictors of primary cesarean delivery</p> <p>Time frame: 1988 to 1992</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 2,301</p> <p>Group Description: G1: Cesarean delivery G2: Vaginal delivery</p> <p>Group N: G1: 312 G2: 1,989</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Privately insured women who received prenatal care from 13 largest obstetrical practices and health maintenance organizations in greater New Haven, CT region (part of a larger study of selected environmental risk factors on pregnancy) Singleton deliveries at Yale-New Haven Hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Repeat cesareans births Missing information on key variables 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 140.9 (28.6) G2: 136.3 (25.2) $P = 0.007$</p> <p>Pregravid BMI: G1: 24.3 (4.6) G2: 22.9 (3.9) $P < 0.0001$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II: ≤ 19.4; 19.5-22.4; 22.5-28.5; > 28.5 <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 88.4 G2: 91.2</p> <p>Black G1: 5.8 G2: 4.9</p> <p>Hispanic G1: 3.5 G2: 2.3</p> <p>Asian/Pacific Islander G1: 1.3 G2: 1.1</p> <p>Other G1: 1.0 G2: 0.4</p> <p>Smoking, %: % never smokers: G1: 82.3 G2: 85.9</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: %married: G1: 95.8 G2: 92.1</p> <p>Additional characteristics: NR</p>

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 312 G2: 1989 Total weight gain: G1: 35.4 (11.9) G2: 33.3 (11.9) $P = 0.005$ Categorized: <ul style="list-style-type: none"> Proportional weight gain based on prepregnancy weight and weight change during pregnancy Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Proportional weight gain, lb, mean: cesarean delivery - 26.5 (10.0); vaginal delivery - 25.2 (9.3) $P = 0.048$ Other infant outcomes: <ul style="list-style-type: none"> Low birth weight rate = 3.3% for entire study population 	Outcomes Description: Percent low birth weight Groups G1: Proportional WG < median, underweight (BMI < 19.4) G2: Proportional WG < median, obese (BMI > 28.5) G3: Proportional WG > median, underweight (BMI < 19.4) G4: Proportional WG > median, Low-average BMI (19.5-22.4) G5: Proportional WG > median, High-average BMI (22.5-28.5) G6: Proportional WG > median, obese (BMI > 28.5) Results G1: 3.5% G2: 7.4% G3: 2.1% G4: 2.8% G5: 2.1% G6: 4.6% Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Zhou and Olsen, 1997 Country and setting: Denmark, two communities Enrollment Period: April 1984 to April 1987 Funding: Danish National Research Foundation and Sygekassernes Helsefond Study Objective: To study association between gestational weight gain and different birth weight indicators considering prepregnancy BMI Time frame: April 1984 to April 1987 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 7122 Group Description: G1: Entire study G2: NR Group N: G1: 7122 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Women who provided detailed information on lifestyle during pregnancy Singletons Non-diabetic women who gave birth between weeks 37 and 42 for whom weight gain was reported Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: % < 19.8: 27.2; %19.8-26: 63.7; %26+: 9.1 G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): % < 25: G1: 30.3 G2: NR Parity: %nulliparous: G1: 48.9 G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: %non-smoking: G1: 60.0 G2: NR Diabetes mellitus, %: G1: 0 G2: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 19. Gestational weight gain and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 7122 G2: NR Total weight gain: G1: % < 11kg: 35.2; %12-15: 35.5; %16+: 29.3 G2: NR Categorized: <ul style="list-style-type: none"> ≤ 11, 12-15, ≥ 16 kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between last measured weight prior to delivery and prepregnancy weight 	Birth weight: G1: %LBW: 1.7; %normal: 96.8; %HBW: 1.5 G2: NR Gestational diabetes, %: G1: 0 G2: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Low birth weight (< 2500g) High birth weight (> 4500g) Growth retarded were newborns with a birth weight below 3000g in spite of a placenta weight higher than 66 percentile (491g) 	Outcomes Description: Odds ratio (95% CI) for LBW for MWG categories by BMI Groups G1: MWG < 11 kg, Underweight (Reference) G2: MWG < 11 kg, Normal weight G3: MWG < 11 kg, Overweight G4: MWG 12-15 kg, Underweight, G5: MWG 12-15 kg, Normal weight G6: MWG 12-15 kg, Overweight G7: MWG ≥16 kg, Underweight G8: MWG ≥16 kg, Normal weight G9: MWG ≥16 kg, Overweight Results G1: 1.0 G2: 0.9 (0.5-1.5) G3: 0.8 (0.3-2.0) G4: 0.5 (0.2-1.0) G5: 0.8 (0.4-1.5) G6: 0.9 (0.2-3.8) G7: 0.3 (0.1-1.0) G8: 0.4 (0.2-0.8) G9: 0.0 (0.0-2500) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Alcohol No diabetes Term delivery Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex 	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Bergmann, 2003 Country and setting: Hospital deliveries in Berlin collected by Berlin Medical Board Enrollment period: NR Funding: NR Study Objective: To investigate trend in prevalence of neonatal macrosomia and to evaluate influences of potential determinants, key features of 206,308 hospital deliveries (97% of all) in Berlin in years 1993 to 1999, collected by Berlin Medical Board Time frame: NR Duration of the study: 1993 to 1999	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 206,308 Group Description: G1: 1993 G2: 1994 G3: 1995 G4: 1996 G5: 1997 G6: 1998 (1999) Group N: G1: 25,449 G2: 25,070 G3: 24,784 G4: 27,100 G5: 27,753 G6: 27,653 (27,513) Inclusion criteria: <ul style="list-style-type: none"> Recorded hospital birth by Berlin Perinatal ReGistry Exclusion criteria: <ul style="list-style-type: none"> Multiple births Preterm infants 	Pregravid weight: <ul style="list-style-type: none"> Hospital records Pregravid BMI: G1: % \geq 20-26 \geq 26: 62.3, 17.8 G2: 62.1, 19.0 G3: 62.4, 19.7 G4: 62.2, 20.6 G5: 63.1, 20.6 G6: 61.4, 21.5 (61.2,21.1) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> \geq 20-26, \geq 26 Age (mean, yrs): % \geq 30: G1: 34.9 G2: 37.5 G3: 40.6 G4: 43.4 G5: 45.7 G6: 47.7 (48.5) Parity: Multiparity: G1: % 49.2 G2: 51.1 G3: 50.4 G4: 49.9 G5: 49.1 G6: 50.3 (49.2)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 18.9 G2: 18.8 G3: 19.2 G4: 17.2 G5: 17.9 G6: 18.0 (18.3) Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 25,449 G2: 25,070 G3: 24,784 G4: 27,100 G5: 27,753 G6: 27,653 Total weight gain: %10-16kg: G1: 62.3 G2: 62.1 G3: 62.4 G4: 62.2 G5: 63.1 G6: 61.4 Categorized: 10-16kg and ≥ 16kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Method not mentioned by authors 	Birth weight: % ≥ 4000g: G1: 10.0 G2: 10.2 G3: 10.6 G4: 10.9 G5: 11.0 G6: 11.3 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> % weight gain: ≥ 26: 21.0, 21.0, 21.4, 22.3, 22.2, 24.2 1999: n = 27513 % birthweight ≥ 4000g, 11.3% % weight gain ≥ 10-16kg, 45.3 % weight gain ≥ 16kg, 25.0% Other infant outcomes NR	Outcomes Description: Odds ratio (95% CI) of macrosomia Groups G1: WG < 10 kg (Reference) G2: WG 10-16 kg G3: WG ≥ 16 kg Results G1: 1.0 G2: 1.85 (1.77-1.93) G3: 3.37 (3.22-3.53) Maternal confounders and effect modifiers accounted for in analysis: Pregravid BMI, height, parity, smoking, diabetes, postterm delivery Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: : 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Brennand et al., 2005 Country and setting: Canada, medical records Enrollment Period: Prenatal to birth Funding: cree board of health and social services of James Bay (Quebec) Study Objective: To determine effect of pregravid weight and pregnancy weight gain on pregnancy outcomes in Cree women Time frame: Prenatal to birth Duration of the study: 7 year period: January 1994 to December 2000	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 603 Group Description: G1: Normal: BMI 18.5 - 24.9 G2: Overweight: BMI 25-29.9 G3: Obese: BMI \geq 30 G4: Total Group N: G1: 139 G2: 168 G3: 296 G4: 603 Inclusion criteria: <ul style="list-style-type: none"> Used only Cree women First birth observed per woman during study time period Must have first weight recorded within first 14 weeks gestation and final weight recorded within 4 weeks of birth Exclusion criteria: <ul style="list-style-type: none"> Women with secondary pregnancy in dataset (n = 792) Women with first weight record > 14 weeks gestation (n = 314) Women with final weight record > 4 weeks from birth (n = 202) Women with both first weight record > 14 weeks and final weight record > 4 weeks (n = 70) Women missing data on first or final weight (n = 3) 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care Medical records Measured within 14 weeks of gestation G1: 59.7 (5.0) G2: 73.0 (4.3) G3: 93.6 (12.3) G4: 80.0 (16.9) Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> Yes Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 20.8 (5.2) G2: 23.8 (5.4) G3: 25.5 (5.5) G4: 24.0 (5.7) Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: G1: 4.3 G2: 14.9 G3: 27.4 G4: 18.6 Hypertension, %: G1: 1.4 G2: 1.8 G3: 4.8 G4: 3.2 Additional characteristics: % low weight gain: G1: 20.1 G2: 10.1 G3: 28.0 G4: 21.2 % acceptable weight gain: G1: 28.8 G2: 32.1 G3: 33.4 G4: 32.0 % excessive weight gain: G1: 51.1 G2: 57.7 G3: 38.5 G4: 46.6

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 139 G2: 168 G3: 296 Total weight gain: Categorized: <ul style="list-style-type: none"> 1999 Canadian guidelines Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: within 4 weeks of birth 	Birth weight: NR Gestational diabetes, %: G1: 4.3 G2: 14.9 G3: 27.4 G4: 18.6 Cesarean delivery, %: G1: 10.8 G2: 11.3 G3: 24.1 ($p < 0.001$) Instrumental delivery, %: Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Definition of low, adequate, and excessive weight gains: For normal weight women - adequate weight gain is 11.5 to 16 kg For overweight women, adequate weight gain is 7 to 11.5 kg For obese women, adequate weight gain is 7 to 11.5 kg Weight gain below specified range is "low" and weight gain above specified range is "excessive" Other infant outcomes: > 4000g, > 4500g	Outcomes Description: Percentage of macrosomia among obese women only Groups G1: Low WG, < 7 kg G2: Acceptable WG, 7-11.5 kg G3: Excessive WG, > 11.5 kg Results >4500g G1: 16.9% G2: 15.3% G3: 18.4% ($P = 0.834$) >4000g G1: 47.0% G2: 42.9% G3: 54.4% ($P = 0.234$) Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Brennand et al., 2005 (continued)	<ul style="list-style-type: none"> • Pregnancies with factors that may have influenced maternal weight gain such as 1 parent being non-Cree (n = 13), preterm deliveries (n = 91), twin pregnancies (n = 6), missing gestational age (n = 9) • Women with unknown glycemic status (n = 30), type 2 DM (n = 8), glycemic abnormalities before pregnancy not followed for diagnosis (n = 70) • Women classified as underweight (n = 5) 		

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
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Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Clausen et al., 2005</p> <p>Country and setting: Norway, university hospital</p> <p>Enrollment Period: 1995-1996 (21 months)</p> <p>Funding: NR</p> <p>Study Objective: To investigate prospectively if maternal metabolic parameters associated with maternal weight were independent determinants of large baby size at term</p> <p>Time frame: 1995-1996 (21 months)</p> <p>Duration of the study: During pregnancy until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Combination: prospective cohort and retrospective nested case control <p>Total Study N: 2,50 and 219</p> <p>Group Description: G1: Cohort study G2: Birth weight < 4500 g G3: Birth weight > 4500 g</p> <p>Group N: G1: 2050 G2: 1962 G3: 88</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All pregnant women of norwegian decent receiving care at Aker Hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Pre-gestational diabetes Mltiple pregnancy Peterm births Mssing medical records Mssing information on birth weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal careNR <p>G1: 65.0 (11.2) G2: 64.7 (11.0) G3: 72.2 (13.9)***P, 0.001</p> <p>Pregravid BMI: G1: 23.0 (3.7) G2: 22.9 (3.7) G3: 24.8 (4.3) *** P, 0.001</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce Lan < 20 Nrmal weight 20-25 Ovrweight 25-30 Obse > 30 <p>Age (mean, yrs): G1: 29.9 (4.4) G2: 29.9 (4.5) G3: 30.6 (4.2)</p> <p>Parity: G1: 50.3% nullipara G2: 51% nullipara G3: 34.1% nullipara **P, 0.001</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 22.2% G2: 22.5% G3: 17.0%</p> <p>Diabetes mellitus,%: G1: 2.1% G2: 1.9 G3: 5.7 *P, 0.05,</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 2050 G2: 1962 G3: 88 Total weight gain: G1: 15.4 (9.7) G2: 15.3 (9.8) G3: 18.2 (5.7)**P, 0.001, Categorized: <ul style="list-style-type: none"> Continuous Quartiles Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: G1: 2.1% G2: 1.9 G3: 5.7 *P, 0.05 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Odds ratios (95% CIs) for macrosomia Groups G1: WG, Quartile 1 (Reference) G2: WG, Quartile 2 G3: WG, Quartile 3 G4: WG, Quartile 4 Results G1: 1.0 G2: 2.1 (0.8-5.1) G3: 3.5 (1.5-8.0) G4: 4.3 (1.9-9.8) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, smoking, placental weight, gestational diabetes, first trimester BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 1 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cogswell et al., 1994 Country and setting: USA, Pregnancy Nutrition Surveillance System Enrollment Period: 1990-1991 Funding: NR Study Objective: To determine association between increased gestational weight gain and birth weight outcomes for low income women Time frame: 1990-1991 Duration of the study: Women in WIC but everything is self reported so it is when they were first enrolled in WIC until delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 53,541 Group Description: G1: Average weight G2: Overweight G3: Very overweight Group N: G1: 33,809 G2: 7,661 G3: 12,071 Inclusion criteria: <ul style="list-style-type: none"> White, black and hispanic women who delivered single, liveborn, term infants Exclusion criteria: <ul style="list-style-type: none"> Low or high values for; birth weight, prepregnancy BMI, or weight gain during pregnancy Missing data on one or more study variables Underweight women Only 1 infant was used in analysis for women who delivered more than once during study period 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 11-17 yr: 11.9% 18-34yr: 85.0% 35-54 yr: 3.1% G2: 11-17 yr: 6.9% 18-34yr: 88.7% 35-54 yr: 4.4% G3: 11-17 yr: 4.0% 18-34yr: 90.1% 35-54 yr: 6.0% Parity: NR	Race, %: White G1: 75.1 G2: 72.4 G3: 74.5 Black G1: 13.8 G2: 14.1 G3: 16.1 Hispanic G1: 11.1 G2: 13.5 G3: 9.4 Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.9 G2: 28.3 G3: 25.7 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 33,809 G2: 7,661 G3: 12,071 Total weight gain: G1: < 15 lb: 6.2% 15-19: 5.8% 20-24: 11.2% 25-29: 14.4% 30-34: 17.1% 35-39: 13.9% ≥ 40: 31.4% G2: < 15 lb: 11.4% 15-19: 7.8% 20-24: 13.0% 25-29: 12.7% 30-34: 15.9% 35-39: 11.2% ≥ 40: 28.1% G3: < 15 lb: 25.1% 15-19: 10.1% 20-24: 1 Categorized: <ul style="list-style-type: none"> 4 lbs increments starting at 15 lbs Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: < 2500g: 2.7% 2500-4000g: 87.5% > 4000-4500: 8.5% > 4500g: 1.4% G2: < 2500g: 2.5% 2500-4000g: 83.9% > 4000-4500: 11.7% > 4500g: 2.0% G3: < 2500g: 2.1% 2500-4000g: 81.1% > 4000-4500: 13.2% > 4500g: 3.6% Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratios (95% CIs) for macrosomia by MWG and prepregnancy BMI Groups G1: Normal BMI, MWG 25-29 lbs (Reference for normal BMI) G2: Normal BMI, MWG 35-39 lbs G3: Normal BMI, MWG ≥ 40 lbs G4: Overweight BMI, MWG 15-19 lbs (Reference for overweight BMI) G5: Overweight BMI, MWG ≥ 40 lbs G6: Obese, MWG 15-19 lbs (Reference for obese GMI) G7: Obese BMI, MWG 30-34 lbs G8: Obese BMI, MWG 35-39 lbs G9: Obese BMI, MWG ≥ 40 lbs Results G1: 1.0 G2: 1.5 (1.0-2.3) G3: 3.3 (2.3-4.7) G4: 1.0 G5: 4.0 (1.6-10.1) G6: 1.0 G7: 1.9 (1.3-2.9) G8: 2.1 (1.3-3.2) G9: 2.3 (1.6-3.3) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Height Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Sex of infant 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hedderson et al., 2006</p> <p>Country and setting: USA, Kaiser Permanente Medical Care Program</p> <p>Enrollment Period: January 1, 1996 - June 31, 1998</p> <p>Funding: R01 DK 54834 from National Institute of Diabetes and Digestive and Kidney Diseases, grant from American Diabetes Association and Kaiser Community Benefit research support</p> <p>Study Objective: To examine whether pregnancy weight gains outside IOM recommendations and rates of maternal weight gain are associated with neonatal complications</p> <p>Time frame: January 1, 1996 to June 31, 1998</p> <p>Duration of the study: First prenatal care visit to 30 days post delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 45,245</p> <p>Group Description: G1: Controls G2: Macrosomia G3: Hypoglycemia G4: Hyperbilirubinemia</p> <p>Group N: G1: 652 G2: 391 G3: 328 G4: 432</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton livebirth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No pregestational diabetes or history of gestational diabetes (screened at 24-28 weeks gestation - meeting National Diabetes Data Group criteria for GDM) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported in some cases used measured weight recorded in chart closes to woman's last menstrual period but no more than 12 months before her last menstrual period <p>Pregravid BMI: G1: < 19.8: 13.5% 19.8-24.9: 56.4% 25.0-29.0: 12.4% > 29.0: 17.6% G2: < 19.8: 5.1% 19.8-24.9: 51.2% 25.0-29.0: 16.6% > 29.0: 27.1% G3: < 19.8: 10.1% 19.8-24.9: 50.0% 25.0-29.0: 17.1% > 29.0: 22.9% G4: < 19.8: 13.9% 19.8-24.9: 57.9% 25.0-29.0: 13.2% > 29.0: 57.1%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: < 25 years: 22.1% 25-29: 24.2% 30-34: 33.6% ≥ 35: 20.1% G2: < 25 years: 15.9% 25-29: 28.0% 30-34: 31.7% ≥ 35: 24.3% G3: < 25 years: 24.1% 25-29: 25.3% 30-34: 26.8% ≥ 35: 23.8% G4: < 25 years: 17.1% 25-29: 29.4% 30-34: 32.6% ≥ 35: 20.8%</p> <p>Parity: % primiparous: G1: 56.9 G2: 31.2 G3: 50.0 G4: 59.3</p>	<p>Race, %: White G1: 54.0 G2: 67.8 G3: 47.6 G4: 42.6 Black G1: 10.0 G2: 5.1 G3: 11.3 G4: 4.4 Hispanic G1: 17.2 G2: 15.1 G3: 20.4 G4: 15.5 Asian/Pacific Islander G1: 8.1 G2: 3.6 G3: 6.7 G4: 20.1 Other G1: 10.7 G2: 8.4 G3: 14.0 G4: 17.4</p> <p>Smoking, %: G1: %nonsmoking during pregnancy: 92.0; %smoked but quit: 4.2; %smoked 3.9 G2: %nonsmoking during pregnancy: 90.8; %smoked but quit: 5.3; %smoked 4.0 G3: %nonsmoking during pregnancy: 92.6; %smoked but quit: 1.5; %smoked 5.8 G4: %nonsmoking during pregnancy: 94.2; %smoked but quit: 4.9; %smoked 1.0</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Screening glucose value less than 140: G1: 85.0%: > 140: 15.0% G2: 81.6%: > 140: 18.4% G3: 81.4%: > 140: 18.6% G4: 83.3%: > 140: 16.7%</p>

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity recordsrate of maternal weight gain was calculated as total pregnancy weight gain minus infant birth weight divided by weeks of gestation when last weight was measured; rate of maternal weight gain before the third trimester was calculated using the weight measured at or before the screening test for GDM (24-28 wks of gestation) minus prepregnancy weight divided by weeks of gestation Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight at last prenatal visit (within 2 weeks of delivery date) and prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratio (95% CI) for macrosomia based on rate of weight gain Groups Rate of gain kg/wk: G1: -0.26 to 0.21 G2: 0.22 to 0.31 (Reference) G3: 0.32 to 0.39 G4: 0.40 to 1.03 Results G1: 0.52 (0.34-0.79) G2: 1.00 G3: 0.99 (0.67-1.47) G4: 2.23 (1.54-3.22) Maternal confounders and effect modifiers accounted for in analysis: Age, race/ethnicity, parity, pregravid BMI, screening glucose value Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Jain et al, 2007	Design: <ul style="list-style-type: none"> Cohort Retrospective 	Pregravid weight: <ul style="list-style-type: none"> Self-reported 	Race, %: NR
Country and setting: United States, hospitals	Total Study N: 7661	Pregravid BMI: <ul style="list-style-type: none"> NR 	Smoking, %: NR
Enrollment period: 2002-2005	Group Description: NR	Imputed: <ul style="list-style-type: none"> No 	Diabetes mellitus, %: NR
Funding: Not reported	Group N: NR	Categorized: <ul style="list-style-type: none"> IOM guidelines 	Hypertension, %: NR
Study Objective: To analyze risks of cesarean section, macrosomia, and breastfeeding at 10 weeks postpartum using logistic regression to estimate independent effects of prepregnancy BMI and gestational weight gain	Inclusion criteria: <ul style="list-style-type: none"> Term (> 37 weeks) and singleton for macrosomia and breastfeeding 	Age (mean, yrs): NR	
Time frame: 2002-2005	Exclusion criteria: <ul style="list-style-type: none"> Cesarean analysis limited to women with cephalic presentation-records with missing data excluded 	Parity: NR	
Duration of the study: Entry into prenatal care to 10 weeks postpartum			

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Odds ratios (95% CIs) for macrosomia	Background: Fair
Total weight gain: • NR	Gestational diabetes, %: NR	Groups G1: WG ≤ 15 lbs G2: WG 15-24 lbs G3: WG 25-35 lbs G4: WG ≥ 35 lbs	Sample selection: Poor
Categorized: • ≤ 15 lbs • 15-25 lbs • 25-35 lbs • 35+ lbs	Cesarean delivery, %: NR	Results G1: 0.49 (0.30-0.82) G2: 1.0 G3: 1.17 (0.82-1.65) G4: 2.83 (2.04-3.92)	Definition of maternal weight gain: Poor
Collected from: • Not outlined	Instrumental delivery, %: NR		Definition of outcomes: Fair
Ascertained by: • Birth certificate	Episiotomy, %: NR		Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: NR	Maternal confounders and effect modifiers accounted for in analysis: Maternal age, pregravid BMI, parity, education, race/ethnicity, US/foreign origin	Followup: Fair
	Other infant outcomes: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor
			Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Jensen et al., 2005 Country and setting: Denmark, university hospitals Enrollment Period: Gestation through birth Funding: Many different funds Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women Time frame: Gestation through birth Duration of the study: NR	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 481 Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg Group N: G1: 93 G2: 134 G3: 132 G4: 122 Inclusion criteria: <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included Exclusion criteria: <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n=153) 	Pregravid weight: <ul style="list-style-type: none"> Records Patient report of pregravid BMI Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8) Parity: NR	Race, %: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0. 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratios (95% CIs) for macrosomia Groups G1: MWG < 5.0 kg (Reference) G2: MWG 5.0-9.9 kg G3: MWG 10.0-14.9 kg G4: MWG ≥ 15.0 kg Results G1: 1.0 G2: 1.8 (0.8-3.8) G3: 2.2 (1.0-4.7) G4: 4.0 (1.8-9.0) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pregravid BMI 2h OGTT result Parity Smoking Ethnicity Clinical Center Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Johnson et al., 1992 Country and setting: USA, prenatal clinics Enrollment Period: January 1, 1987-December 31, 1989 Funding: NR Study Objective: To determine influences of increased maternal prepregnancy weight and increased gestational weight gain on pregnancy outcome Time frame: January 1, 1987 to December 31, 1989 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,191 Group Description: G1: BMI < 19.8 G2: 19.8-26.0 G3: 27-29 G4: > 29 G5: All Group N: G1: 755 G2: 1,621 G3: 329 G4: 486 G5: 3191 Inclusion criteria: <ul style="list-style-type: none"> Delivery at or beyond 38 weeks of gestation Singletons Received prenatal care and delivered in Shands Hospital Exclusion criteria: <ul style="list-style-type: none"> Fetal abnormalities Oligohydramnios Polyhydramnios Medical or surgical complications (GI disorders, sickle cell hemoglobinopathy, hepatitis, hematologic disorders, malignant disease, renal disease, neurologic disease, pulmonary disease, psychiatric disorders, tuberculosis) Incomplete risk variable data or outcome variable information 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> National Academy of Sciences Age (mean, yrs): G1: NR <ul style="list-style-type: none"> < 20 years: 36.6% 20-26 years: 44.8% > 26 years: 18.7% G2: NR <ul style="list-style-type: none"> < 20 years: 30.8% 20-26 years: 46.5% > 26 years: 22.6% G3: <ul style="list-style-type: none"> < 20 years: 25.8% 20-26 years: 48.9% > 26 years: 25.2% G4: <ul style="list-style-type: none"> < 20 years: 16.5% 20-26 years: 53.9% > 26 years: 29.6% G5: <ul style="list-style-type: none"> < 20 years: 29.5% 20-26 years: 47.5 % > 26 years: 23.0% Parity: G1: % first: 49.3 G2: 43.1 G3: 37.4 G4: 31.1 G5: 42.1	Race, %: White G1: 64.5 G2: 60.0 G3: 49.8 G4: 51.9 G5: 58.7 Black G1: 33.6 G2: 37.9 G3: 48.9 G4: 47.5 G5: 39.5 Hispanic NR Asian/Pacific Islander NR Other G1: 1.9 G2: 2.1 G3: 1.2 G4: 0.6 G5: 1.7 Smoking, %: NR Diabetes mellitus, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Hypertension, %: G1: 3.4 G2: 4.6 G3: 5.8 G4: 10.7 G5: 5.4 Additional characteristics: G1: % married: 42.6 G2: 46.1 G3: 40.4 G4: 49.4 G5: 45.2 Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 755 G2: 1621 G3: 329 G4: 486 G5: 3191 Total weight gain: G1: <ul style="list-style-type: none"> < 16kg: 7.8% 16-25kg: 18.5% 26-35kg: 35.1% > 35kg: 38.5% G2: <ul style="list-style-type: none"> < 16kg: 11.7% 16-25kg: 18.0% 26-35kg: 28.8% > 35kg: 41.5% G3: <ul style="list-style-type: none"> < 16kg: 19.8% 16-25kg: 19.1% 26-35kg: 28.3% > 35kg: 32.8% G4: <ul style="list-style-type: none"> < 16kg: 32.3% 16-25kg: 22.0%; Categorized: <ul style="list-style-type: none"> Quartiles National Academy of Sciences (below, within, or above recommended range) Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at last prenatal visit (mean 6.1 days prior to delivery) 	Birth weight: G1: <ul style="list-style-type: none"> < 2500g: 4.8% 2500-4000g: 89.1% > 4000g: 6.1% G2: <ul style="list-style-type: none"> < 2500g: 2.0% 2500-4000g: 85.2% > 4000g: 12.8% G3: <ul style="list-style-type: none"> < 2500g: 1.5% 2500-4000g: 83.0% > 4000g: 15.5% G4: <ul style="list-style-type: none"> < 2500g: 0.2% 2500-4000g: 82.5% > 4000g: 17.3% Gestational diabetes, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Cesarean delivery, %: G1: NR G2: NR G3: NR G4: NR G5: 11.9 Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Frequency of macrosomia = 12.2% Frequency of cesarean = 11.9% Frequency of LBW = 2.9% 	Outcomes Description: Odds ratio (95% CI) for macrosomia Groups G1: Net WG < 14.9 lbs (Reference) G2: Net WG 14.9-23.5 lbs G3: Net WG 24-33 lbs G4: Net WG > 33 lbs Results G1: 1.0 G2: 1.20 (0.83-1.75) G3: 1.77 (1.24-2.52) G5: 2.86 (2.02-4.02) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Race Parity Pre-gravid BMI Pregnancy induced hypertension Height Prepregnancy weight Marital status Education Tobacco/alcohol/drug use Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex Macrosomia 	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 9 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Johnson et al., 1992 (continued)			

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<ul style="list-style-type: none"> • Frequency of postdate pregnancy = 9.8% • Frequency of labor abnormalities (40% were unscheduled cesareans) = 7.8% • Frequency of oxytocin induction = 13.7% • Frequency of oxytocin augmentation = 16.1% • Frequency of meconium staining = 21.5% <p>Other infant outcomes: NA</p>		

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kiel et al., 2007 Country and setting: United States, birth registry Enrollment period: 1990 to 2001 Funding: NR Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women Time frame: 1990 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NIH guidelines Age (mean, yrs): G1: <26: 46% 26–35: 47% Older than 35: 8% G2: <26: 44% 26–35: 48% Older than 35: 8% G3: <26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 Black G1: 22 G2: 23 G3: 27 Hispanic NR Asian/Pacific Islander NR Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA:13% ($P < 0.05$)	Outcomes Description: Odds of macrosomia	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	G2: SGA: 7% LGA:16% ($P < 0.05$) G3: SGA: 6% LGA:18% ($P < 0.05$) Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Groups G1: Odds of macrosomia for WG > 2 5lbs G2: OR of macrosomia for WG < 15 lbs G3: Reference WG 15-25 lbs Results G1: higher for women in this group G2: lower for women in this group Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in Medicaid, WIC, food stamp programs) • Smoking • Chronic hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, • and greater than 35 lb gain Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records Ascertained by: NR			

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 to 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kirchengast and Hartmann, 2003</p> <p>Country and setting: Singleton births that took place at University Clinic for Gynecology and Obstetrics in Vienna, Austria</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: Examine impact of biological factors such as young maternal age and maternal somatic characteristics on pregnancy outcome among group of adolescent mothers who gave birth between 39th and 41st week of gestation after period of intensive psychological support</p> <p>Time frame: NR</p> <p>Duration of the study: 1985 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 8,011</p> <p>Group Description: G1: 12 to 16 years G2: 17 to 19 years G3: 20 to 29 years</p> <p>Group N: G1: 215 G2: 1,336 G3: 6,460</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women ages 12 to 29 All prenatal check-ups of mother-child passport were performed Delivery of single infant without congenital malformations Receiving psychosocial support by family and/or specially trained social worker within young adolescent group (12 to 16 years) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Coincident medical diseases such as diabetes mellitus or nephropathy Drug or alcohol abuse Twin birth IVF Registered maternal diseases before and during pregnancy Hypertension (BP < 150/90 mmHG) Protein or glucose in urine Pregnancy related immunization 	<p>Pregravid weight: Estimated by means of retrospective method and first weight determination, which was carried out at first prenatal visit (8th week of gestation)</p> <p>G1: 56.0 G2: 57.2 G3: 59.2</p> <p>Pregravid BMI: G1: 21.45 G2: 21.59 G3: 22.10</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 14.5 G2: 17.8 G3: 24.1</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Age at menarche: G1: 12.2 G2: 12.9 G3: 13.3 Gynecological age: G1: 3.4 G2: 5.3 G3: 10.8</p>

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 215 G2: 1,336 G3: 6,460 Total weight gain: G1: 13.1 G2: 13.1 G3: 13.1 (P = .10) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3237.6 (significantly different from 17-19 and 20-29) G2: 3298.3 (significantly different from < 17 and 20-29) G3: 3368.9 (significantly different from < 17 and 17-19) (F = 24.1, P < .0001) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Chronological age Age at menarche Gynecological age Height Distancia spinarum Distancia christarum Prepregnancy weight Weight at end of pregnancy Other infant outcomes <ul style="list-style-type: none"> Birth length Head circumference Acromial circumference Diameter frontooccipitale 	Outcomes Description: OR and 95% CI, for Macrosomia Groups NA, weight gain as continuous variable Results G1: 1.07 (1.05-1.10) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, age at menarche, pregravid weight, height, distantia cristarum Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Takimoto et al., 2006 Country and setting: Japan, obstetric units Enrollment Period: 2001 to 2002 Funding: Ministry of Health, Labour, and Welfare, Health, and Labour Research Grant, Research on Children and Families Study Objective: To identify adequate weight gain ranges during pregnancy in Japanese women Time frame: 2001 to 2002 Duration of the study: Pregnancy through delivery (all info derived from delivery records)	Design: <ul style="list-style-type: none"> Cross-sectional Total Study N: 112,257 Group Description: G1: Study cohort G2: NR Group N: G1: 46,659 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Vaginal birth Singleton pregnancy Low risk Term Exclusion criteria: <ul style="list-style-type: none"> Cesarean deliveries (n = 30,559) Delivery method unknown (n = 2258) Multiple gestations (n = 8387) Preterm deliveries < 37 weeks (n = 19623) Post-term deliveries > 41 weeks (n = 623) Stillbirths and neonatal deaths (n = 2558) Maternal deaths (n = 11) Congenital anomalies of the infant (n = 2449) 	Pregravid weight: <ul style="list-style-type: none"> Taken from records not stated whether it was self-reported or measured Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: 29.9 (4.8) G2: NR Parity: % primiparous: G1: 53.5 G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 6.3 G2: NR Diabetes mellitus, %: G1: 1.2 G2: NR Hypertension, %: G1: 2.0 G2: NR Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 46,659 G2: NR Total weight gain: G1: 9.9 (4.3) G2: NR Categorized: <ul style="list-style-type: none"> Gestational age specific percentile values of weight gain: under the 25th, 25th-49th, 50th-74th, 75th-89th, ≥ 90th Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated 	Birth weight: G1: 2982 (472) G2: NR Gestational diabetes, %: G1: 1.2 G2: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Macrosomia IUGR 	Outcomes Description: Odds ratio (95% CI) for macrosomia Groups G1: Total MWG < 25th percentile for GA G2: Total MWG 25-49th percentile for GA G3: Total MWG 50-74th percentile for GA (Reference) G4: Total MWG 75-89th percentile for GA G5: Total MWG ≥90th percentile for GA Results G1: 0.31 (0.20,-0.47) G2: 0.49 (0.34-0.70) G3: 1.0 G4: 1.62 (1.24-2.12) G5: 2.41 (1.83-3.17) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-pregnancy weight Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Zhou and Olsen, 1997 Country and setting: Denmark, two communities Enrollment Period: April 1984 to April 1987 Funding: Danish National Research Foundation and Sygekassernes Helsefond Study Objective: To study association between gestational weight gain and different birth weight indicators considering prepregnancy BMI Time frame: April 1984 to April 1987 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 7122 Group Description: G1: Entire study G2: NR Group N: G1: 7122 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Women who provided detailed information on lifestyle during pregnancy Singletons Non-diabetic women who gave birth between weeks 37 and 42 for whom weight gain was reported Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: % < 19.8: 27.2; %19.8-26: 63.7; %26+: 9.1 G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): % < 25: G1: 30.3 G2: NR Parity: %nulliparous: G1: 48.9 G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: %non-smoking: G1: 60.0 G2: NR Diabetes mellitus, %: G1: 0 G2: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 20. Gestational weight gain and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 7122 G2: NR Total weight gain: G1: % < 11kg: 35.2; %12-15: 35.5; %16+: 29.3 G2: NR Categorized: <ul style="list-style-type: none"> ≤ 11, 12-15, ≥ 16 kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between last measured weight prior to delivery and prepregnancy weight 	Birth weight: G1: %LBW: 1.7; %normal: 96.8; %HBW: 1.5 G2: NR Gestational diabetes, %: G1: 0 G2: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Low birth weight (< 2500g) High birth weight (> 4500g) Growth retarded were newborns with a birth weight below 3000g in spite of a placenta weight higher than 66 percentile (491g) 	Outcomes Description: Odds ratios (95% CI) for macrosomia by MWG categories and BMI Groups G1: MWG < 11 kg, underweight (Reference) G2: MWG < 11 kg, normal weight G3: MWG < 11 kg, overweight G4: MWG 12-15 kg, underweight, G5: MWG 12-15 kg, normal weight G6: MWG 12-15 kg, overweight G7: MWG ≥ 16 kg, underweight G8: MWG ≥ 16 kg, normal weight G9: MWG ≥ 16 kg, overweight Results G1: 1.0 G2: 52.8 (0.3-22.9) G3: 9.7 (1.2-81.8) G4: 0.0 (0.0-7x10 ⁵) G5: 6.8 (0.9-51) G6: 27.1 (3.3-220) G7: 6.1 (0.7-52.5) G8: 15.7 (2.2-114) G9: 45.6 (6.0-349) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Alcohol No diabetes Term delivery Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 21. Gestational weight gain and large-for-gestational age

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race,%: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension,%: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Percentage of LGA for MWG Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: > 35 lbs Results G1: 12.0 G2: 11.8 G3: 18.8 G4: 25.8 G5: 23.8 ($P < 0.01$) Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bo et al., 2003</p> <p>Country and setting: Italy, university clinic</p> <p>Enrollment Period: April 1999 to February 2001</p> <p>Funding: NR</p> <p>Study Objective: To evaluate pregnancy outcomes in cohort of caucasian pregnant women in relation to BMI and glucose toleranc status; role of central fat distribution, as indicated by waist to hip circumference ratio also considered</p> <p>Time frame: April 1999 to February 2001</p> <p>Duration of the study: Screened during pregnancy at 24 to 28 weeks, recall data on pregravid weight</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 700</p> <p>Group Description: G1: Normal wieight, normal OGTT G2: Overweight/Obese, normal OGTT G3: Normal Weight, IGT/GDM G4: Overweight/Obese, IGT/GDM</p> <p>Group N: G1: 333 G2: 117 G3: 133 G4: 117</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Caucasian pregnant women attending Gynecological and Obstetrical Department of University of Torino screened with 50g oral glucose test at 24 to 28 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women known to have preexistent diabetes mellitus, a disease affecting glucose metabolism, or hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 21.2 G2: 29.9 G3: 21.5 G4: 29.9</p> <p>Imputed: <ul style="list-style-type: none"> No </p> <p>Categorized: NR</p> <p>Age (mean, yrs): G1: 31.7 G2: 31.1 G3: 32.9 G4: 32.6</p> <p>Parity: G1: Nulliparous (%): 63.7 G2: 53.0 G3: 62.4 G4: 51.3</p>	<p>Race, %: White G1: 100 G2: 100 G3: 100 G4: 100</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: G1: 11.4 G2: 15.4 G3: 15.0 G4: 18.8</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: G1: 1.2 G2: 10.3 G3: 4.5 G4: 11.1</p> <p>Additional characteristics: Waist-to-hip ratio: G1: 0.86 G2: 0.87 G3: 0.89 G4: 0.90</p> <p>Additional characteristics: Preterm delivery (%): G1: 6.9 G2: 6.7 G3: 9.2 G4: 8.5</p> <p>Additional characteristics: LGA (%): G1: 13.1 G2: 27.6 G3: 13.3 G4: 27.4</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 333 G2: 117 G3: 133 G4: 117 Total weight gain: G1: 13.2+/-4.1 (<i>P</i> < 0.01 vs. G2) G2: 10.5+/-6.1 G3: 11.8+/-5.7 (<i>P</i> < 0.05 vs. G2, <i>P</i> < 0.05 vs. G4) G4: 9.5+/-6.8 (<i>P</i> < 0.01 vs. G1) (overall <i>P</i> < 0.0001) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Gains during pregnancy not collected Ascertained by: <ul style="list-style-type: none"> Not explained by researchers, may be difference between prepregnancy weight and weight measured at 24 to 28 weeks gestation 	Birth weight: G1: 3271+/-446 (<i>P</i> < 0.05 vs. G2) G2: 3413+/-589 (<i>P</i> < 0.01 vs. G3) G3: 3186+/-578 (<i>P</i> < 0.01 vs. G4) G4: 3389+/-447 (<i>P</i> < 0.05 vs. G1) (overall <i>P</i> = 0.001) Gestational diabetes,%: NR Cesarean delivery,%: G1: 30.5 G2: 38.1 G3: 39.2 G4: 44.3 (<i>P</i> < 0.01 vs. G1) (overall <i>P</i> = 0.044) Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: <ul style="list-style-type: none"> Height Parental diabetes Waist Systolic bp Diastolic bp Hypertension Triglycerides HDL Other infant outcomes: <ul style="list-style-type: none"> Weeks of delivery SGA Neonatal pathologies 	Outcomes Description: Odds ratio (95% CI) for LGA Groups G1: for each 1 kg increase in MWG Results G1: 1.08 (1.03-1.12) Maternal confounders and effect modifiers accounted for in analysis: Age, pregravid BMI, smoking, gestational hyperglycaemia Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 7 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Caulfield et al., 1998 Country and setting: USA, hospital obstetric database Enrollment Period: 1987 to 1989 Funding: NR Study Objective: To examine relation between gestational weight gain and risk of delivering a small for gestational age infant by race Time frame: 1987-1989 Duration of the study: Entry into pn care until delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,870 Group Description: G1: BMI < 19.8 Black G2: BMI < 19.8 White G3: BMI 19.8 to 26.0 Black G4: BMI 19.8 to 26.0 White G5: BMI > 26.0 Black G6: BMI > 26.0 White Group N: G1: 523 G2: 267 G3: 1,479 G4: 796 G5: 615 G6: 190 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies White or black ethnicity At least 28 weeks' gestation One delivery per woman (randomly chosen) Information on anthropometric data Exclusion criteria: <ul style="list-style-type: none"> Missing data Improbable data Non-black or non-white ethnicity 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3) Pregravid BMI: G1: 18.4 (1.0) G2: 18.5 (1.0) G3: 22.7 (1.8) G4: 22.1 (1.8) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 21.7 (4.8) G2: 27.1 (6.6) G3: 22.7 (5.3) G4: 29.8 (5.8) G5: 24.9 (6.0) G6: 28.2 (5.5) Parity: G1: % primiparous: 52.4 G2: 55.4 G3: 50.1 G4: 48.0 G5: 36.9 G6: 46.9	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 32.8 G2: 20.6 G3: 35.4 G4: 20.0 G5: 28.8 G6: 25.4 Diabetes mellitus, %: NR Hypertension, %: G1: 4.3 G2: 3.0 G3: 6.0 G4: 5.7 G5: 11.9 G6: 17.0 Additional characteristics: NR

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: ORs and 95% CIs for LGA per 50g/wk increase in rate of weight gain by BMI	Background: Good
Total weight gain: G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3)	Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	G1: Underweight G2: Normal weight G3: Overweight G1: 1.25 (1.11-1.41) G2: 1.14 (1.08,-1.20) G3: 1.13 (1.07-1.20) Maternal age, race, parity, pregravid BMI, height, hypertension, provider type, smoking, infant sex Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Pre-gravid BMI • Height • Hypertension • Provider type • Smoking Infant and child confounders and effect modifiers accounted for in analysis: Female infant	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good
Categorized: <ul style="list-style-type: none"> • According to IOM 			
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 			
Ascertained by: <ul style="list-style-type: none"> • Based on last clinically measured weight prior to delivery: difference between selfreport pre-pregnancy weight and last recorded weight 			

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cedergren, 2006 Country and setting: Sweden, Medical Birth Registry Enrollment Period: January 1, 1994 - December 31, 2002 Funding: Ostergotland County Council Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes Time frame: January 1, 1994 to December 31, 2002 Duration of the study: First visit to maternity health care center to delivery	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 245,526 Group Description: BMI G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35 Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Inclusion criteria: <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 Age (mean, yrs): G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1% G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9% G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5% G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4% G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%	Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: • < 8kg, 8-16, > 16 Collected from: • Routine pre-natal care or maternity records Ascertained by: • Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratio (95% CIs) for LGA (> 2 SD above the mean) Groups Weight gain < 8 kg G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI ≥ 35 Weight gain > 16 kg G6: BMI < 20 G7: BMI 20-24.9 G8: BMI 25-29.9 G9: BMI 30-34.9 G10: BMI ≥ 35 Weight gain 8-16 kg (Reference) Results G1: 0.43 (0.24-0.75) G2: 0.53 (0.47-0.61) G3: 0.48 (0.43-0.53) G4: 0.66 (0.59-0.75) G5: 0.54 (0.46-0.63) G6: 3.26 (2.76-3.86) G7: 2.73 (2.60-2.88) G8: 2.14 (2.01-2.28) G9: 2.24 (2.00-2.51) G10: 1.54 (1.24-1.90) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Parity • Smoking Infant and child confounders and effect modifiers accounted for in analysis: Year of birth	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Ekblad and Grenman, 1992 Country and setting: Finland, hospital Enrollment Period: July 1, 1985 - December 31, 1985 (6 months) Funding: NR Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome Time frame: July 1, 1985 to December 31, 1985 (6 months) Duration of the study: Pregnancy to delivery	Design: <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery Total Study N: Total n = 357 <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6 Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Inclusion criteria: <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control Exclusion criteria: <ul style="list-style-type: none"> Not stated 	Pregravid weight: <ul style="list-style-type: none"> Records - not stated if self reported G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5) Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4) Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) <i>P</i> < 0.05 compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) <i>P</i> < 0.0005 compared to controls G4: 23.2 (22.8) <i>P</i> < 0.0005 compared to controls G5: 13.2 (3.4) Categorized: <ul style="list-style-type: none"> ≤ 5kg or ≥ 20kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3712 g (614) <i>P</i> < 0.05 compared to controls G2: 3293 (362) <i>P</i> < 0.05 compared to controls G3: 3284 (880) G4: 3803 (538) <i>P</i> < 0.005 compared to controls G5: 3538 (535) Gestational diabetes, %: NR Cesarean delivery, %: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percentage of Infant BW by maternal weight gain groups Groups Infant weight percentile for mothers with normal pregravid weight and normal weight gain G1: < 2.5% G2: 2.5-10% G3: 10-50% G4: 50-90% G5: 90-97.5% G6: > 97.5% Infant weight percentile for mothers with weight gain ≤5 kg G7: < 2.5% G8: 2.5-10% G9: 10-50% G10: 50-90% G11: 90-97.5% G12: > 97.5% Infant weight percentile for mothers with weight gain ≥20 kg G13: < 2.5% G14: 2.5-10% G15: 10-50% G16: 50-90% G17: 90-97.5% G18: > 97.5% Results G1: 1% G2: 6% G3: 35% G4: 43% G5: 13% G6: 2% G7: 3% G8: 14% G9: 32% G10: 34% G11: 14% G12: 3% G13: 0% G14: 2% G15: 42% G16: 29% G17: 20% G18: 7%	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis: NA</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NAR</p>	

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Jensen et al., 2005 Country and setting: Denmark, university hospitals Enrollment Period: Gestation through birth Funding: Many different funds Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women Time frame: Gestation through birth Duration of the study: NR	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 481 Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg Group N: G1: 93 G2: 134 G3: 132 G4: 122 Inclusion criteria: <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included Exclusion criteria: <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n-153) 	Pregravid weight: <ul style="list-style-type: none"> Records Patient report of pregravid BMI Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8) Parity: NR	Race, %: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0, 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratios (95% CIs) for LGA Groups G1: MWG < 5.0 kg (Reference) G2: MWG 5.0-9.9 kg G3: MWG 10.0-14.9 kg G4: MWG ≥ 15.0 kg Results G1: 1.0 G2: 2.4 (1.1-5.3) G3: 2.1 (1.1-4.8) G4: 4.7 (2-11) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pregravid BMI 2h OGTT result Parity Smoking Ethnicity Clinical Center Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kiel et al., 2007 Country and setting: United States, birth registry Enrollment period: 1990 to 2001 Funding: NR Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women Time frame: 1990 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NIH guidelines Age (mean, yrs): G1: < 26: 46% 26–35: 47% Older than 35: 8% G2: < 26: 44% 26–35: 48% Older than 35: 8% G3: < 26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 Black G1: 22 G2: 23 G3: 27 Hispanic NR Asian/Pacific Islander NR Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA:13% ($P < 0.05$) G2: SGA: 7% LGA:16% ($P < 0.05$) G3: SGA: 6% LGA:18% ($P < 0.05$)	Outcomes Description: Odds of LGA by maternal weight gain groups	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb)Less than 2: 15%	Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Groups G1: Odds of LGA for weight gain > 25lbs G2: OR of LGA for weight gain < 15lbs G3: Reference weight gain 15-25 lbs Results G1: Odds of LGA are higher for women in this group G2: Odds of LGA are lower for women in this group Numerical value for ORs not reported in study Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in Medicaid, WIC, food stamp programs) • Smoking • Chronic hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss 2 to 9 lbs loss, no weight change, 2 to 9 lbs gain, 10 to 14 lbs gain, 15–25 lb gain, 26–35 lb gain, and greater than 35 lb gain 			
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 			
Ascertained by: NR			Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 to 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kitajima et al., 2001</p> <p>Country and setting: Japan, university hospital</p> <p>Enrollment period: 1992 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To determine whether elevated midpregnancy maternal serum lipid levels predict newborn weight at term and risk of LGA infants in women with positive diabetic screen but normal glucose tolerance test</p> <p>Time frame: 1992 to 1999</p> <p>Duration of the study: Entry of pn care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 146</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 146 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Japanese pregnant women who had positive diabetic screen test results (at least 135 mg/dL of plasma glucose level at 1 hour after 50-g oral glucose challenge) and a normal 75-g oral GTT at 24 to 32 weeks' gestation at Nagasaki University Hospital between November 1992 and October 1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with pregestational or gestational diabetes mellitus to eliminate therapeutic biases in association between maternal metabolic variables and fetal growth Women with hypertensive disorder, thyroid disorder, lupus, and antiphospholipid syndrome, because those conditions are associated with fetal growth restriction due to placental insufficiency rather than metabolic factors Subjects who delivered before 37 weeks' gestation and cases of fetal congenital malformation or multifetal gestation 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 21.2 +/-2.7 G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 32+/-1 4 G2: NR</p> <p>Parity: G1: Nulliparous 44% G2: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 9.6+/- 3.3 kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3012g+/- 359 G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Odds ratio (95% CI) for LGA Groups G1: for each 1 kg increase in MWG Results G1: 1.08 (0.81-1.44) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Maternal plasma glucose levels Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex 	Background: Good Sample selection: Good Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 1 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kramer et al., 1990</p> <p>Country and setting: Canada, university hospital</p> <p>Enrollment Period: 1980 to 1986</p> <p>Funding: National Health Research and Development Program, Health and Welfare Canada</p> <p>Study Objective: (1) Which maternal and fetal variables appear to have independent causal impacts on intrauterine growth? (2) For a given fetal growth status, which maternal and fetal variables affect proportionality?</p> <p>Time frame: 1980 to 1986</p> <p>Duration of the study: Entry in to prenatal care up to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 8,719</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 8715 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Live-born, singleton infants without evidence of congenital intrauterine infection, chromosomal anomalies, or other major malformations and for whom gestational age calculated from last normal menstrual period agreed within ± 7 days with an early second-trimester (usually 16 to 18 weeks) Ultrasonographic estimate based on fetal biparietal diameter <p>Exclusion criteria:</p> <ul style="list-style-type: none"> See above 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>G1: 57.8 kg (10.8) G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> They used prepregnancy wt and ht separately NR <p>Age (mean, yrs): G1: 28.6 (4.7) G2: NR</p> <p>Parity: G1: 0.72 (0.86) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: Cigarettes/d: G1: 3.2 (7.5) G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: Pg related HTN: G1: 7.7% G2: NR</p> <p>Additional characteristics: Education, y completed: G1: 13.0 (3.3) G2: NR</p> <p>Marital status: G1: 90.6% G2: NR</p> <p>Parity % primiparas: G1: 48.0 G2: NR</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 8715 G2: NR Total weight gain: G1: 14.2kg (5.5) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery, using net weight gain (total weight minus wt of infant) 	Birth weight: G1: 3385g (547) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Bivariate associations between selected maternal and fetal variables and fetal growth and proportionality: Correlation coefficient for net gestational weight gain (kg) and fetal growth ratio = 0.12 ($P < 0.001$); for prepregnancy weight (kg) 0.21 ($P < 0.001$) Other infant outcomes: <ul style="list-style-type: none"> Correlation coefficients for Net prepregnancy weight gain (kg) and length = -0.04 ($P < 0.01$) Head circumference = -0.01 (NS); BMI 0.04 ($P < 0.001$); Ponderal index = 0.04 ($P < 0.001$) Weight/height circumference = 0.01 (NS) 	Outcomes Description: Odds ratio (95% CI) for LGA Groups G1: for each 5 kg decrease in net gestational WG Results G1: 0.73 (0.68-0.79) Maternal confounders and effect modifiers accounted for in analysis: Pregravid weight, smoking, parity, maternal diabetes, height, previous LBW infant, severe pregnancy-induced hypertension Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Sex of the infant 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Muscati et al., 1996</p> <p>Country and setting: Canada, public health department</p> <p>Enrollment Period: 1979 to 1989</p> <p>Funding: NR</p> <p>Study Objective: To examine association of extent and timing of pregnancy weight gain with infant birth weight and postpartum weight retention</p> <p>Time frame: 1979 to 1989</p> <p>Duration of the study: Pregnancy through 6 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 371</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 371 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, low income, non-smoking women Pregnant women <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Prematurity < 37 weeks Adolescents < 16 years Women > 40 years Maternal health problems Women who consume alcohol or drugs Pregnancy complications such as proteinuria, hypertension, diabetes, negative weight gain, missing values 	<p>Pregravid weight: Family physicians' records G1: 62.8 +/- 16.0 kg G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Pregravid weight status categorized into 3 groups as a percentage of standard weight: underweight < 90%, normal 90-120%, and overweight > 120% <p>Age (mean, yrs): G1: 24.5 +/- 5.6 G2: NR</p> <p>Parity: G1: Primiparous 52% G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: G1: PPWR: 5.3 +/- 5.7 kg G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 16.1 +/- 6.4 kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: From Table 1: Pearson's Correlation Coefficient and determination coefficient of maternal weight gain with PP weight retention and Infant BW. Maternal PP weight retention and Preg weight gain: [Total amount $r = 0.808$, R square 65.3%, $P < 0.001$], [Up to week 20 $r = 0.682$, R square 46.5%, $P < 0.001$], [Weeks 21-30 $r = 0.411$, R square 16.9%, $P < 0.001$], [Week 31 - term $r = 0.414$, R square 17.1%, $P < 0.001$] Other infant outcomes: Pregnancy Weight Gain and Infant Birth Weight (from Table 1): [Total amount $r = 0.216$, R square 4.7%, $P < 0.001$], [Up to week 20 $r = 0.114$, R-square 1.3%, $P < 0.05$], [Weeks 21-30 $r = 0.157$, R square 2.5%, $P < 0.01$], [Week 31 - term $r = 0.160$, R square 2.6%, $P < 0.01$]	Outcomes Description: Odds ratio for LGA per weight gain increase Groups G1: OR for LGA per 1 kg increase in WG up to week 20 G2: OR for LGA per 1 kg increase in WG from weeks 21 to 30 G3: OR for LGA per 1 kg increase in WG from weeks 31 to term Results G1: 1.17 ($P < 0.001$) G2: 1.16 ($P < 0.01$) G3: 1.02 ($P = NS$) Maternal confounders and effect modifiers accounted for in analysis: Parity, pregravid standard weight, pregravid excess weight Infant and child confounders and effect modifiers accounted for in analysis: Birth length, infant sex	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Parker and Abrams, 1992</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Sept 1980 to Dec 1988</p> <p>Funding: UC Committee on Research & MCH and Resources Development, Health Resources and Services Administration</p> <p>Study Objective: To test whether gains outside IOM reference ranges were associated with increased risks of suboptimal pregnancy outcome (SGA, LGA, cesarean delivery) and to determine whether locally developed ranges were more applicable to study population</p> <p>Time frame: Sept 1980 to Dec 1988</p> <p>Duration of the study: From entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 6,690</p> <p>Group Description: G1: Overall G2: NR</p> <p>Group N: G1: 6,690 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutive live singleton births at Moffitt Hospital between September 1980 and December 1988 with gestational ages of 37 to 42 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Maternal transfers or transports and deliveries complicated by fetal malformations, maternal diabetes, or maternal hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 56.8 kg(SD 11.0) G2: NR</p> <p>Pregravid BMI: G1: Underweight: 27.7%, Normal weight 61.8%, Overweight: 5.6%, Obese 4.9% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 27.7 (5.5) G2: NR</p> <p>Parity: Primiparous: G1: 58.8% G2: NR</p>	<p>Race, %: White G1: 44.0 G2: NR</p> <p>Black G1: 8.3 G2: NR</p> <p>Hispanic G1: 9.4 G2: NR</p> <p>Asian/Pacific Islander G1: 21.4 G2: NR</p> <p>Other G1: 12.0 G2: NR</p> <p>Smoking, %: G1: 12.0 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 6690 G2: NR Total weight gain: G1: 15.2kg (5.2) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Weight gain ranges based on percentiles from previous study of UC population with good pregnancy outcomes: 25th - 75th, 10-90th percentiles. For 25-75th, weight gain range = 12-17kg for underweight women (BMI < 19.8); Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3408g (462) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Odds ratios (95% CIs) of LGA by weight gain Groups G1: Compared to UCSF Cohort 25-75 th percentile of WG G2: Compared to UCSF 10-90 th percentile of WG Results G1: 1.89 (1.51-2.37) G2: 1.87 (1.39-2.52) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Height Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Pezzarossa et al., 1996 Country and setting: Italy, not stated Enrollment Period: Not stated Funding: NR Study Objective: To evaluate effects of gestational weight gain on neonatal birthweight in women who were diagnosed with gestational diabetes after 3second week gestation Time frame: Not stated Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 192 Group Description: G1: Normal G2: GDM Group N: G1: 132 G2: 60 Inclusion criteria: <ul style="list-style-type: none"> Caucasian women who had 1 or more risk factors for GDM: BMI > 28.6, gestational weight gain > 12kg, previous GDM, or previous neonatal macrosomia and underwent a diagnostic oral glucose tolerance test for GDM after 3second week of gestation - women with positive tests formed GDM group while women with negative test results formed normal singleton Exclusion criteria: <ul style="list-style-type: none"> Smoking Hypertension Underweight (BMI < 19.6) Previous metabolic treatment Diabetic counseling 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 25.7 (0.5) G2: 25.4 (0.8) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.1 (0.4) G2: 28.07 (0.6) Parity: NR	Race, %: White G1: 100 G2: 100 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 132 G2: 60 Total weight gain: G1: 13.4 (0.5) G2: 12.2 (0.6) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: used weight at last prenatal visit 	Birth weight: G1: 3576.8 (41.3) G2: 3678.7 (69.3) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: macrosomia	Outcomes Description: Relative risks for LGA Groups G1: MWG < 9 kg G2: MWG 9-14 kg Results G1: similar between non-diabetic and GDM groups G2: GDM group has 2 times higher risk that non-diabetics Numerical results not reported Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Fasting plasma glucose Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Suneahag et al., 1991</p> <p>Country and setting: Sweden, prenatal clinics</p> <p>Enrollment Period: October 1994 to December 1987</p> <p>Funding: Grants from Gillberg Foundation, Swedish Diabetes Association, and Family Ernfors Foundation</p> <p>Study Objective: To assess perinatal morbidity in clinic with policy of liberal insulin treatment in pregnancies complicated by diabetes and to find predictive factors for adverse perinatal outcome</p> <p>Time frame: October 1994 to December 1987</p> <p>Duration of the study: Initiation of prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 133 women confirmed to have GDM</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 133 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women at risk for GDM <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Twin pregnancies Incomplete case records 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Not stated - records? <p>Pregravid BMI: G1: 25.6 (4.7) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous > 23.9 <p>Age (mean, yrs): G1: 32 (range 19-43) G2: NR</p> <p>Parity: % primiparous: G1: 30.8% G2: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: G1: 30.8 G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 133 G2: NR Total weight gain: G1: 12.5 (6.3) kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Not stated - records? Ascertained by: <ul style="list-style-type: none"> Not stated 	Birth weight: G1: 3.7 (0.6) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: G1: 27 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Association between LGA and MWG Groups G1: LGA vs MWG > 18 kg Results G1: $\chi^2 = 8.2$ ($P < 0.005$) Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 21. Maternal weight and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Wataba et al., 2006</p> <p>Country and setting: Japan, academic medical center</p> <p>Enrollment Period: 1981 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To analyze association of pregnancy complications with prepregnant body mass index and weight gain during pregnancy in Japanese women</p> <p>Time frame: 1981 to 1999</p> <p>Duration of the study: Entry into PNC up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base and look at medical records retrospectively Retrospective <p>Total Study N: 21,718</p> <p>Group Description: G1: Nulliparous G2: Parous women</p> <p>Group N: G1: 10413 G2: 11305</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy delivering term baby at Osaka Med Center and Research Institute for Maternal and Child Health in 1981-1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> None reported 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> In data base, but don't know if self reported <p>Pregravid BMI: G1: 20.5 (2.6) G2: 21.1 (3.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in 2 kg/m² point intervals from prepregnancy weight; categorical into low, medium, high BMI groups (< 18, 18-23.9, > 24) <p>Age (mean, yrs): G1: 27.8 (4.1) G2: 30.45 (3.9)</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 21. Maternal weight and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 10413 G2: 11305</p> <p>Total weight gain: G1: kg/wk: 0.25 (SD 0.09) G2: kg/wk: 0.24 (0.09) $P < 0.01$</p> <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in kg/wk using prepregnancy weight and weight at delivery divided by gestational age of infant at birth <p>Collected from:</p> <ul style="list-style-type: none"> Rate of weight gain determined by: total weight gain divided by weeks ga <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: and subtracting prepregnancy weight 	<p>Birth weight: G1: SGA: 5.4% LGA 5.2% G2: SGA 6.5% LGA 5.2%</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <ul style="list-style-type: none"> NR <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Odds ratio for LGA (95% CIs)</p> <p>Groups Nulliparous G1: Low BMI (< 18), WG > 0.40 kg/wk G2: Medium BMI (18-23.9), WG 0.20-0.25 kg/wk G3: WG 0.25-0.30 kg/wk (Reference) G4: Medium BMI, WG 0.30-0.35 kg/wk G5: Medium BMI, WG 0.35-0.40 kg/wk G6: Medium BMI, WG > 0.40 kg/wk</p> <p>Parous G7: Low BMI (< 18), WG > 0.40 kg/wk G8: WG 0.20-0.25 kg/wk (Reference for low/med BMI) G9: Medium BMI (18-23.9), WG 0.25-0.30 kg/wk G10: Medium BMI, WG 0.30-0.35 kg/wk G11: Medium BMI, WG 0.35-0.40 kg/wk G12: Medium BMI, WG > 0.40 kg/wk G13: High BMI (≥ 24), WG 0.15-0.20 kg/wk G14: WG ≥ 0.30 kg/wk (Reference for high BMI)</p> <p>Results G1: 2.25 (1.03-4.94) G2: 1.41 (1.31-1.76) G3: 1.0 G4: 1.76 (1.38-2.23) G5: 2.34 (1.77-3.10) G6: 2.58 (1.71-3.89) G7: 2.16 (0.63- 7.44) G8: 1.0 G9: 1.48 (1.15-2.33) G10: 1.64 (1.18-2.27) G11: 2.23 (1.51-3.31) G12: 3.94 (2.56-6.03) G13: 2.27 (1.31-3.95) G14: 1.0</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Preeclampsia, C-section, 1-minute Apgar score < 4</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor</p> <p>Final Quality Score: Poor</p>

Evidence Table 22. Gestational weight gain and small-for-gestational age

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 22. Gestational weight gain and small-for-gestational age(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: SGA (%) Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 4 G2: 3.9 G3: 5.6 G4: 3.1 G5: 3.8 Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Caulfield et al., 1998 Country and setting: USA, hospital obstetric database Enrollment Period: 1987 to 1989 Funding: NR Study Objective: To examine relation between gestational weight gain and risk of delivering a small for gestational age infant by race Time frame: 1987-1989 Duration of the study: Entry into pn care until delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,870 Group Description: G1: BMI < 19.8 Black G2: BMI < 19.8 White G3: BMI 19.8 to 26.0 Black G4: BMI 19.8 to 26.0 White G5: BMI > 26.0 Black G6: BMI > 26.0 White Group N: G1: 523 G2: 267 G3: 1,479 G4: 796 G5: 615 G6: 190 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies White or black ethnicity At least 28 weeks' gestation One delivery per woman (randomly chosen) Information on anthropometric data Exclusion criteria: <ul style="list-style-type: none"> Missing data Improbable data Non-black or non-white ethnicity 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3) Pregravid BMI: G1: 18.4 (1.0) G2: 18.5 (1.0) G3: 22.7 (1.8) G4: 22.1 (1.8) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 21.7 (4.8) G2: 27.1 (6.6) G3: 22.7 (5.3) G4: 29.8 (5.8) G5: 24.9 (6.0) G6: 28.2 (5.5) Parity: G1: % primiparous: 52.4 G2: 55.4 G3: 50.1 G4: 48.0 G5: 36.9 G6: 46.9	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 32.8 G2: 20.6 G3: 35.4 G4: 20.0 G5: 28.8 G6: 25.4 Diabetes mellitus, %: NR Hypertension, %: G1: 4.3 G2: 3.0 G3: 6.0 G4: 5.7 G5: 11.9 G6: 17.0 Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Odds ratio (95% CI) for SGA per 50g/wk increase in rate of weight gain by BMI	Background: Good
Total weight gain: G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3)	Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Groups G1: Underweight G2: Normal weight G3: Overweight Results G1: 0.87 (0.78-0.97) G2: 0.90 (0.84-0.96) G3: 0.93 (0.86-1.01) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Pregravid BMI • Height • Hypertension • Provider type • Smoking Infant and child confounders and effect modifiers accounted for in analysis: Infant sex	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good
Categorized: <ul style="list-style-type: none"> • According to IOM Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> • Based on last clinically measured weight prior to delivery: difference between selfreport prepregnancy weight and last recorded weight 			

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cedergren, 2006 Country and setting: Sweden, Medical Birth Registry Enrollment Period: January 1, 1994 - December 31, 2002 Funding: Ostergotland County Council Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes Time frame: January 1, 1994 to December 31, 2002 Duration of the study: First visit to maternity health care center to delivery	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 245,526 Group Description: BMI G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35 Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Inclusion criteria: <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 Age (mean, yrs): G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1% G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9% G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5% G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4% G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%	Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: • < 8kg, 8-16, > 16 Collected from: • Routine pre-natal care or maternity records Ascertained by: • Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratios (95% CIs) for SGA (< 2 SD below the mean) Groups Weight gain < 8 kg G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI ≥ 35 Weight gain > 16 kg G6: BMI < 20 G7: BMI 20-24.9 G8: BMI 25-29.9 G9: BMI 30-34.9 G10: BMI ≥ 35 Weight gain 8-16 kg (Reference) Results G1: 2.35 (1.92-2.88) G2: 1.99 (1.77-2.23) G3: 1.75 (1.48-2.07) G4: 1.68 (1.26-2.25) G5: 1.71 (1.03-2.85) G6: 0.50 (0.41-0.61) G7: 0.50 (0.45-0.56) G8: 0.57 (0.47-0.68) G9: 0.61 (0.40-0.93) G10: 0.50 (0.20-1.24) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Parity • Smoking Infant and child confounders and effect modifiers accounted for in analysis: Year of birth	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cheng et al., 2004 Country and setting: Missouri - birth certificate data Enrollment period: Funding: NR Study Objective: To estimate whether maternal weight changes between pregnancy influence risk for small for gestational age births Time frame: NR Duration of the study: 1989 to 1997	Design: <ul style="list-style-type: none"> Case-control Retrospective Total Study N: <ul style="list-style-type: none"> Cases: 6,973 (8,062 used but percentages based on those with information) Controls: 7,141 (8,062 used but percentages based on those with information) Group Description: G1: Cases G2: Controls Group N: G1: 8,062 G2: 8,062 Inclusion criteria: <ul style="list-style-type: none"> Second born infants: cases had second born SGA infants (less than the 10th percentile of birth weight) Controls were randomly selected by year of birth from remaining cohort of mothers with 2 live births during study period Exclusion criteria: <ul style="list-style-type: none"> Missing data 	Pregravid weight: <ul style="list-style-type: none"> Self-reported NR Pregravid BMI: G1: < 19.8: 26% 19.8 to 26.0: 47% >26: 22% G2: < 19.8: 14% 19.8 to 26.0: 51% >26: 30% Imputed: <ul style="list-style-type: none"> No Categorized: IOM Guidelines Age (mean, yrs): G1: < 20: 15% 20 to 34: 80% ≥ 35: 5% G2: < 20: 10 % 20 to 34: 83% ≥ 35: 6% Parity: NR	Race, %: White G1: 86 G2: 85 Black G1: 13 G2: 13 Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 40 G2: 17 Diabetes mellitus, %: G1: 2 G2: 2 Hypertension, %: NR Additional characteristics: % married: G1: 67% G2: 77%

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 8,062 G2: 8,062 Total weight gain: G1: < 0.2kg/wk: 17% ≥ 0.2kg/wk: 78% G2: < 0.2kg/wk: 11% ≥ 0.2kg/wk: 86% <i>P</i> < 0.001 cases vs. controls Categorized: Rate - kg/wk Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Birth certificate Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: G1: 2 G2: 2 Group 3 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> NA Other infant outcomes <ul style="list-style-type: none"> NA 	Outcomes Description: Odds ratio (95% CI) for SGA by weight gain categories Groups SGA G1: WG < 0.2 kg/wk G2: WG ≥ 0.2 kg/wk (Reference) SGA for low weight gain (< 0.2 kg/wk) by BMI G1: Underweight G2: Normal weight G3: Overweight G4: Obese Results SGA G1: 1.9 (1.8-2.2) G2: 1.022% SGA by BMI G1: (1.2-2.4) G2: (1.9-2.7) G3: (1.6-2.9) G4: (1.4-2.1) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, education, Medicaid status, pregravid BMI, smoking, previous SGA, adequacy of prenatal care, maternal cardiac disease, preeclampsia, year of birth of second infant Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 2 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cherry et al., 1993 Country and setting: USA, hospital Enrollment Period: NR Funding: NR Study Objective: NR-to examine effect of zinc on birth outcomes Time frame: NR Duration of the study: 9 months-from time of enrollment in to prenatal care up to delivery	Design: <ul style="list-style-type: none"> RCT Total Study N: 599 Group Description: G1: Total G2: NR Group N: G1: 599 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Adolescents in prenatal clinic at Charity Hospital of New Orleans Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Measured by study investigators G1: 53% were 90-110% Expected Weight (EW); 26% < 90% EW; 21% were > 110% EW G2: NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Calculated weight for age and height Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Grams gained per week per cm height Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Table 1 provided data above-LBW, wt for length of infant, % of infants in high risk nursery Other infant outcomes: NA	Outcomes Description: Percentage SGA for each shifting of EW category. Groups Light: < 90% EW Normal: 90 to 110% of EW Heavy: > 110% EW G1: Normal to Heavy G2: Light to Normal G3: Heavy to Heavy G4: Normal to Normal G5: Light to Light G6: Heavy to Normal G7: Normal to Light Results G1: 22% G2: 39% G3: 38% G4: 41% G5: 62% G6: 60% G7: 65% Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Poor Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 3 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cnattingius et al., 1998 Country and setting: Sweden, Medical birth register Enrollment Period: 1992-1993 Funding: NR Study Objective: To examine effect of prepregnancy BMI on risk of late fetal death, early neonatal death, preterm delivery, and delivery of an infant who was SGA Time frame: 1992-1993 Duration of the study: Immediately after birth (from birth register)	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 167,750 Group Description: G1: Total sample G2: NR Group N: G1: 167750 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Singleton births Registered on Swedish Birth Registry Women with information on prepregnancy BMI info Women born in Sweden, Denmark, Norway, Finland, or Iceland Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: < 20: 13.5% 20-24.9: 60.4% 25-29.9: 19.9% ≥ 30: 6.2% G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> < 20.0 20-24.9 25-29.9 ≥ 30.0 Age (mean, yrs): G1: ≤ 19: 2.3% 20-24: 20.3% 25-29: 39.9% 30-34: 25.9% ≥ 35: 11.7% G2: NR Parity: G1: Nulliparous: 40.6% G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: Nonsmoking: 77.4% G2: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 91,484 G2: NR Total weight gain: G1: < 0.25 kg/wk: 9.3%; 0.25-0.34 kg/wk: 32.9%; 0.35-0.44: 29.4%; ≥ 0.45: 20.6% G2: NR Categorized: <ul style="list-style-type: none"> Rate: kg/wk Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between prepregnancy weight and weight at delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: <ul style="list-style-type: none"> % late fetal death: 0.28% % early neonatal death: 0.18% 	Outcomes Description: Odds ratios (95% CIs) for SGA Groups G1: WG < 0.25 kg/wk G2: WG 0.25-0.34 kg/wk G3: WG 0.35-0.44 kg/wk G4: ≥ 0.45 kg/wk (Reference) Results G1: 3.0 (2.5-3.5) G2: 1.9 (1.6-2.2) G3: 1.3 (1.1-1.5) G4: 1.0 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Height Education Mother living with father Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Dawes and Grudzinskas, 1991 Country and setting: UK, hospital Enrollment Period: 12 months Funding: Grant from Royal College of General Practitioners Study Objective: To examine patterns of maternal weight gain in relation to sociodemographic factors and pregnancy outcome Time frame: 12 months Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 988 Group Description: G1: Total cohort G2: NR Group N: G1: 988 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Alternate women who delivered at Radcliffe Hospital within 12 month period Exclusion criteria: <ul style="list-style-type: none"> Not stated 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal careweight measured at first visit G1: 62.7 (11.15) G2: NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 26.6 (5.1) G2: NR Parity:	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 988 G2: NR Total weight gain: G1: 10.71 (4.3) average weekly weight gain: 0.38 (0.16) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3.32 (0.54) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Average weekly weight gain < 0.20 kg as a predictor of SGA Groups G1: Sensitivity G2: Specificity Results G1: 12.9% G2: 91.3% Maternal confounders and effect modifiers accounted for in analysis: Maternal age, parity, pre-gravid BMI, weight, smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Ekblad and Grenman, 1992 Country and setting: Finland, hospital Enrollment Period: July 1, 1985 - December 31, 1985 (6 months) Funding: NR Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome Time frame: July 1, 1985 to December 31, 1985 (6 months) Duration of the study: Prepregnancy to delivery	Design: <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery Total Study N: Total n = 357 <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6 Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Inclusion criteria: <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control Exclusion criteria: <ul style="list-style-type: none"> Not stated 	Pregravid weight: <ul style="list-style-type: none"> Records - not stated if self reported G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5) Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4) Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) <i>P</i> < 0.05 compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) <i>P</i> < 0.0005 compared to controls G4: 23.2 (22.8) <i>P</i> < 0.0005 compared to controls G5: 13.2 (3.4) Categorized: • ≤ 5kg or ≥ 20kg Collected from: • Routine pre-natal care or maternity records Ascertained by: • Based on last clinically measured weight prior to delivery	Birth weight: G1: 3712 g (614) <i>P</i> < 0.05 compared to controls G2: 3293 (362) <i>P</i> < 0.05 compared to controls G3: 3284 (880) G4: 3803 (538) <i>P</i> < 0.005 compared to controls G5: 3538 (535) Gestational diabetes,%: NR Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Infant birthweight by maternal weight gain group Groups Infant weight percentile for mothers with normal prepregnancy weight and normal weight gain G1: < 2.5% G2: 2.5-10% G3: 10-50% G4: 50-90% G5: 90-97.5% G6: > 97.5% Infant weight percentile for mothers with weight gain ≤5 kg G7: < 2.5% G8: 2.5-10% G9: 10-50% G10: 50-90% G11: 90-97.5% G12: > 97.5% Infant weight percentile for mothers with weight gain ≥20 kg G13: < 2.5% G14: 2.5-10% G15: 10-50% G16: 50-90% G17: 90-97.5% G18: > 97.5% Results G1: 1% G2: 6% G3: 35% G4: 43% G5: 13% G6: 2% G7: 3% G8: 14% G9: 32% G10: 34% G11: 14% G12: 3% G13: 0% G14: 2% G15: 42% G16: 29% G17: 20% G18: 7%	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Ekblad and Grenman, 1992 (continued)			

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		Maternal confounders and effect modifiers accounted for in analysis: NA	
		Infant and child confounders and effect modifiers accounted for in analysis: NA	

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Jensen et al., 2005 Country and setting: Denmark, university hospitals Enrollment Period: Gestation through birth Funding: Many different funds Study Objective: To investigate effect of gestational weight gain in obese glucose tolerant women Time frame: Gestation through birth Duration of the study: NR	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 481 Group Description: G1: GWG < 5.0 kg G2: GWG 5.0-9.9kg G3: GWG 10.0-14.9 kg G4: GWG ≥ 15.0kg Group N: G1: 93 G2: 134 G3: 132 G4: 122 Inclusion criteria: <ul style="list-style-type: none"> Prepregnancy BMI ≥ 30 Normal 2h 75g oral glucose tolerance test (OGTT) during third trimester (according to WHO criteria) Only first pregnancy during study period included Exclusion criteria: <ul style="list-style-type: none"> Well defined chronic disease Twin pregnancies Women with GDM (n = 323) Known diet treatment (n = 10) Incomplete data on weight gain during pregnancy (n-153) 	Pregravid weight: <ul style="list-style-type: none"> Records Patient report of pregravid BMI Pregravid BMI: G1: 34.3 (32.2-39.9) G2: 33.9 (31.5-36.5) G3: 32.9 (31.2-35.6) G4: 32.7 (31.3-34.7) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 29.8 (26.4-33.1) G2: 29.1 (26.3-33.1) G3: 30.0 (26.6-33.2) G4: 27.9 (24.8-31.8) Parity: NR	Race, %: White G1: 84.4 G2: 85.8 G3: 82.7 G4: 89.9 Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.7 G2: 25.8 G3: 30.2 G4: 26.8 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 93 G2: 134 G3: 132 G4: 122 Total weight gain: Categorized: <ul style="list-style-type: none"> < 5.0, 5.0-9.9, 10.0-14.9, ≥ 15.0 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated by authors 	Birth weight: G1: 3500 (3200-3840) G2: 3645 (3200-4000) G3: 3750 (3390-4125) G4: 3762 (3400-4120) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Rates of SGA by weight gain groups Groups G1: MWG < 5.0 kg (Reference) G2: MWG 5.0-9.9 kg G3: MWG 10.0-14.9 kg G4: MWG ≥ 15.0 kg Results No significant difference in rates of SGA by maternal weight gain group. Numerical results not reported in article Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pregravid BMI 2h OGTT result Parity Smoking Ethnicity Clinical Center Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kabiru and Raynor, 2004 Country and setting: USA, hospital Enrollment Period: 1999 to 2002 Funding: NR Study Objective: To investigate effect of increase in body mass index category on obstetric outcomes Time frame: 1999 to 2002 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 5,131 Group Description: G1: No change in BMI between first prenatal visit and delivery G2: 1 category increase in BMI between first prenatal visit and delivery G3: > 1 category increase in BMI between first prenatal visit and delivery Group N: G1: 2,556 G2: 2,252 G3: 323 Inclusion criteria: <ul style="list-style-type: none"> Singleton pregnancies Exclusion criteria: <ul style="list-style-type: none"> Multiple pregnancies BMI < 20 Missing BMI data 	Pregravid weight: <ul style="list-style-type: none"> Measured at first prenatal visit Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> 20-24.9, 25-29.9, 30-34.9, 35-39.9, ≥ 40 Age (mean, yrs): G1: 24.7 (6.1) G2: 24.4 (5.7) G3: 25.2 (5.9) $P < 0.001$ Parity: G1: Gravidity (mean): 1.9 (1.9) G2: 1.5 (1.7) G3: 1.2 (1.7) $P < 0.001$	Race, %: White G1: 1.9 G2: 2.6 G3: 2.8 Black G1: 84.1 G2: 82.8 G3: 88.2 Hispanic G1: 13.9 G2: 14.6 G3: 9.0 Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean weight gain: G1: 8.6 pounds (8.4) G2: 22.2 pounds (10.2) G3: 55.3 pounds (23.8) Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 579 G2: 942 G3: 189 G4: 819 G5: 790 G6: 104 Total weight gain: Categorized: <ul style="list-style-type: none"> > 35 pounds for normal BMI, > 25 pounds for overweight BMI, > 15 pounds for obese BMI Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated, most likely difference between weight at first prenatal visit and weight at delivery 	Birth weight: G1: 2886.0 (756) G2: 3174.9 (600) G3: 3099.5 (673) <i>P</i> < 0.001 G4: 3116 (713) G5: 3269 (698) G6: 3371 (733) <i>P</i> = 0.015 Gestational diabetes,%: NR Cesarean delivery,%: G1: 8.2 G2: 12.6 G3: 21.0 <i>P</i> < 0.001 G4: 13.0 G5: 14.3 G6: 19.3 <i>P</i> = 0.256 Instrumental delivery,%: Episiotomy,%: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percentage SGA by BMI category Groups G1: No change in BMI category G2: 1 category increase in BMI G3: > 1 category increase in BMI % SGA among overweight G4: No change in BMI category G5: 1 category increase in BMI G6: > 1 category increase in BMI Results G1: 19.5% G2: 13.5% G3: 9.5% G4: 14.2% G5: 9.9% G6: 11.5% Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kiel et al., 2007 Country and setting: United States, birth registry Enrollment period: 1990 to 2001 Funding: NR Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women Time frame: 1990 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NIH guidelines Age (mean, yrs): G1: <26: 46% 26–35: 47% Older than 35: 8% G2: <26: 44% 26–35: 48% Older than 35: 8% G3: <26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 Black G1: 22 G2: 23 G3: 27 Hispanic NR Asian/Pacific Islander NR Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% ($P < 0.05$) G2: SGA: 7% LGA: 16% ($P < 0.05$) G3: SGA: 6% LGA: 18% ($P < 0.05$)	Outcomes Description: Odds of SGA for weight gain groups	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Groups G1: Odds of SGA for weight gain > 25lbs G2: OR of SGA for weight gain < 15lbs G3: Reference Weight gain 15-25 lbs Results G1: lower for women in this group G2: higher for women in this group Numerical value for ORs not reported in study Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in Medicaid, WIC, food stamp programs) • Smoking • Chronic hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, and • greater than 35 lb gain 			
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 			
Ascertained by: NR			

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 to 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kramer et al., 1990</p> <p>Country and setting: Canada, university hospital</p> <p>Enrollment Period: 1980 to 1986</p> <p>Funding: National Health Research and Development Program, Health and Welfare Canada</p> <p>Study Objective: (1) Which maternal and fetal variables appear to have independent causal impacts on intrauterine growth? (2) For a given fetal growth status, which maternal and fetal variables affect proportionality?</p> <p>Time frame: 1980 to 1986</p> <p>Duration of the study: Entry in to prenatal care up to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 8,719</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 8715 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Live-born, singleton infants without evidence of congenital intrauterine infection, chromosomal anomalies, or other major malformations and for whom gestational age calculated from last normal menstrual period agreed within ± 7 days with an early second-trimester (usually 16 to 18 weeks) Ultrasonographic estimate based on fetal biparietal diameter <p>Exclusion criteria:</p> <ul style="list-style-type: none"> See above 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>G1: 57.8 kg (10.8) G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> They used prepregnancy wt and ht separately NR <p>Age (mean, yrs): G1: 28.6 (4.7) G2: NR</p> <p>Parity: G1: 0.72 (0.86) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: Cigarettes/d: G1: 3.2 (7.5) G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: Pg related HTN: G1: 7.7% G2: NR</p> <p>Additional characteristics: Education, y completed: G1: 13.0 (3.3) G2: NR</p> <p>Marital status: G1: 90.6% G2: NR</p> <p>Parity % primiparas: G1: 48.0 G2: NR</p>

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 8715 G2: NR Total weight gain: G1: 14.2kg (5.5) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery, using net weight gain (total weight minus wt of infant) 	Birth weight: G1: 3385g (547) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Bivariate associations between selected maternal and fetal variables and fetal growth and proportionality: Correlation coefficient for net gestational weight gain (kg) and fetal growth ratio = 0.12 ($P < 0.001$); for prepregnancy weight (kg) 0.21 ($P < 0.001$) Other infant outcomes: <ul style="list-style-type: none"> Correlation coefficients for Net prepregnancy weight gain (kg) and length = -0.04 ($P < 0.01$) Head circumference = -0.01 (NS); BMI 0.04 ($P < 0.001$); Ponderal index = 0.04 ($P < 0.001$) Weight/height circumference = 0.01 (NS) 	Outcomes Description: Odds ratio (95% CI) for SGA for weight gain groups Groups G1: OR and 95% CI, for SGA for each 5 kg decrease in net gestational WG Results G1: 1.32 (1.20-1.44) Maternal confounders and effect modifiers accounted for in analysis: Pregravid weight, infant sex, smoking, parity, maternal diabetes, height, previous LBW infant, severe pregnancy-induced hypertension Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Sex of the infant 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Lang et al., 1996 Country and setting: USA, hospital Enrollment period: August 1977-March 1980 Funding: NR Study Objective: To estimate effects of 23 factors on prevalence of premature labor and fetal growth retardation across birthweight spectrum Time frame: August 1977 to March 1980 Duration of the study: Pregnancy through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 11,505 Group Description: G1: Prevalence of preterm labor G2: Prevalence of SGA Group N: Inclusion criteria: <ul style="list-style-type: none"> Singleton Livebirths Had data on birthweight, gestational age, and sex Infants with gestational age from 22 to 45 weeks Birthweights no more than 50% higher than 90th percentile for sex and gestational age Exclusion criteria: <ul style="list-style-type: none"> Women with menstrual abnormalities for whom gestational dating was problematic Stillbirths Incomplete data Preterm delivery Women with preexisting diabetes mellitus, hypertension, epilepsy, asthma 	Pregravid weight: <ul style="list-style-type: none"> Not stated by authors G1: NR <ul style="list-style-type: none"> < 100 pounds: 11.2 100-125: 5.9 126-160: 5.1 161-180: 7.3 > 180: 4.4 G2: NR <ul style="list-style-type: none"> < 100 pounds: 24.9 100-125: 12.6 126-160: 7.7 161-180: 6.5 > 180: 5.9 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: <ul style="list-style-type: none"> < 15: 14.8 16-19: 11.2 20-24: 8.2 25-34: 4.6 ≥ 35: 5.5 G2: <ul style="list-style-type: none"> < 15: 25.0 16-19: 17.6 20-24: 14.3 25-34: 9.4 ≥ 35: 7.2 Parity: G1: 6.4 G2: 12.3	Race, %: White G1: 5.3 G2: 9.1 Black G1: 9.6 G2: 17.7 Hispanic NR Asian/Pacific Islander NR Other G1: 5.0 G2: 14.0 Smoking, %: % smoked throughout pregnancy: G1: 8.3 G2: 17.9 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Weekly rate of weight gain Collected from: <ul style="list-style-type: none"> Not stated by authors Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Odds ratios (95% CIs) for SGA be weight gain groups Groups G1: WG ≤ 0.40 lbs/wk G2: WG 0.40-0.65 lbs/wk G3: WG 0.65-0.90 lbs/wk (Reference) G4: WG > 0.90 lbs/wk Results G1: 2.8 (2.2-3.6) G2: 1.6 (1.4-1.9) G3: 1.0 (Reference) G4: 0.6 (0.5-0.7) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Maternal height Prepregnancy weight Maternal education Health insurance Planned pregnancy Previous induced abortion Previous spontaneous abortion Previous still birth Maternal morbidity Caffeine intake Marijuana prenatal care smoking Infant and child confounders and effect modifiers accounted for in analysis: Infant sex	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Good Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 3 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Muscati et al., 1996 Country and setting: Canada, public health department Enrollment Period: 1979 to 1989 Funding: NR Study Objective: To examine association of extent and timing of pregnancy weight gain with infant birth weight and postpartum weight retention Time frame: 1979 to 1989 Duration of the study: Pregnancy through 6 weeks postpartum	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 371 Group Description: G1: Total G2: NR Group N: G1: 371 G2: NR Inclusion criteria: <ul style="list-style-type: none"> White, low income, non-smoking women Pregnant women Exclusion criteria: <ul style="list-style-type: none"> Prematurity < 37 weeks Adolescents < 16 years Women > 40 years Maternal health problems Women who consume alcohol or drugs Pregnancy complications such as proteinuria, hypertension, diabetes, negative weight gain, missing values 	Pregravid weight: Family physicians' records G1: 62.8 +/- 16.0 kg G2: NR Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Pregravid weight status categorized into 3 groups as a percentage of standard weight: underweight < 90%, normal 90-120%, and overweight > 120% Age (mean, yrs): G1: 24.5 +/- 5.6 G2: NR Parity: G1: Primiparous 52% G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: G1: PPWR: 5.3 +/- 5.7 kg G2: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 16.1 +/- 6.4 kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: From Table 1: Pearson's Correlation Coefficient and determination coefficient of maternal weight gain with PP weight retention and Infant BW. Maternal PP weight retention and Preg weight gain: [Total amount $r = 0.808$, R square 65.3%, $P < 0.001$], [Up to week 20 $r = 0.682$, R square 46.5%, $P < 0.001$], [Weeks 21-30 $r = 0.411$, R square 16.9%, $P < 0.001$], [Week 31 - term $r = 0.414$, R square 17.1%, $P < 0.001$] Other infant outcomes: Pregnancy Weight Gain and Infant Birth Weight (from Table 1): [Total amount $r = 0.216$, R square 4.7%, $P < 0.001$], [Up to week 20 $r = 0.114$, R-square 1.3%, $P < 0.05$], [Weeks 21-30 $r = 0.157$, R square 2.5%, $P < 0.01$], [Week 31 - term $r = 0.160$, R square 2.6%, $P < 0.01$]	Outcomes Description: Odds ratios for SGA by weight gain groups Groups G1: per 1 kg increase in WG up to week 20 G2: per 1 kg increase in WG from weeks 21 to 30 G3: per 1 kg increase in WG from weeks 31 to term Results G1: 0.93 ($P = NS$) G2: 0.85 ($P < 0.01$) G3: 0.89 ($P < 0.01$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Pregravid standard weight Pregravid excess weight, Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Birth length Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Parker and Abrams, 1992</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Sept 1980 to Dec 1988</p> <p>Funding: UC Committee on Research & MCH and Resources Development, Health Resources and Services Administration</p> <p>Study Objective: To test whether gains outside IOM reference ranges were associated with increased risks of suboptimal pregnancy outcome (SGA, LGA, cesarean delivery) and to determine whether locally developed ranges were more applicable to study population</p> <p>Time frame: Sept 1980 to Dec 1988</p> <p>Duration of the study: From entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 6,690</p> <p>Group Description: G1: Overall G2: NR</p> <p>Group N: G1: 6,690 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutive live singleton births at Moffitt Hospital between September 1980 and December 1988 with gestational ages of 37 to 42 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Maternal transfers or transports and deliveries complicated by fetal malformations, maternal diabetes, or maternal hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 56.8 kg(SD 11.0) G2: NR</p> <p>Pregravid BMI: G1: Underweight: 27.7%, Normal weight 61.8%, Overweight: 5.6%, Obese 4.9% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 27.7 (5.5) G2: NR</p> <p>Parity: Primiparous: G1: 58.8% G2: NR</p>	<p>Race, %: White G1: 44.0 G2: NR</p> <p>Black G1: 8.3 G2: NR</p> <p>Hispanic G1: 9.4 G2: NR</p> <p>Asian/Pacific Islander G1: 21.4 G2: NR</p> <p>Other G1: 12.0 G2: NR</p> <p>Smoking, %: G1: 12.0 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 6690 G2: NR Total weight gain: G1: 15.2kg (5.2) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Weight gain ranges based on percentiles from previous study of UC population with good pregnancy outcomes: 25th - 75th, 10-90th percentiles. For 25-75th, weight gain range = 12-17kg for underweight women (BMI < 19.8); Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3408g (462) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Odds ratios (95% CIs) of SGA for low WG Groups G1: Compared to UCSF Cohort 25-75 th percentile of WG G2: Compared to UCSF 10-90 th percentile of WG Results G1: 2.06 (1.62-2.63) G2: 1.82 (1.35-2.47) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pregravid BMI Height Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Steward and Moser, 2004 Country and setting: USA, vital statistics data Enrollment Period: 1993 Funding: Ohio State University Graduate School and College of Nursing Study Objective: To determine prevalence of IUGR in full term infants and to identify sociodemographic and maternal characteristics associated with IUGR Time frame: 1993 Duration of the study: Prenatal to birth	Design: <ul style="list-style-type: none"> Cross-sectional Retrospective Total Study N: 2,933 (from 14,463 births in county in 1993) Group Description: G1: Normal birth weight G2: IUGR Group N: G1: 1569 G2: 1364 Inclusion criteria: <ul style="list-style-type: none"> Birth weight > 2500g Reported gestational age ≥ 38 weeks Singleton birth Exclusion criteria: <ul style="list-style-type: none"> Chromosomal abnormality Congenital anomaly 	Pregravid weight: <ul style="list-style-type: none"> Birth statistics G1: 144.4 (33.3) G2: 134.4 (31.0) Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 27.0 (5.8) G2: 25.4 (5.9) Parity: NR	Race, %: White G1: 77.9 G2: 61.0 $P < 0.001$ Black G1: 18.4 G2: 33.7 Hispanic NR Asian/Pacific Islander G1: 3.6 G2: 5.3 Other NR Smoking, %: G1: 19.6 G2: 34.5 $P < 0.001$ Diabetes mellitus, %: NR Hypertension, %: G1: 1.7 G2: 1.5 Additional characteristics: Adequate PNC G1: 53% G2: 45.9% ($P < 0.001$) Prev LBW G1: 0.7 G2: 1.0 Prenatal risk G1: 24.4 G2: 26.9

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 32.3 pounds G2: 29.2 $P < 0.001$ Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Self-reported Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Self-reported Birth certificate data 	Birth weight: G1: 3484.9 (414.9) G2: 2781.4 (131.9) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: IUGR in full term newborn infants with birth weights > 2500g	Outcomes Description: Odds ratio (95% CI) for SGA Groups SGA defined as FGR < 0.85 Results G1: 0.98 (0.97-0.98) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Maternal education Marital status Prepregnancy weight Adequacy of prenatal care Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Takimoto et al., 2006 Country and setting: Japan, obstetric units Enrollment Period: 2001 to 2002 Funding: Ministry of Health, Labour, and Welfare, Health, and Labour Research Grant, Research on Children and Families Study Objective: To identify adequate weight gain ranges during pregnancy in Japanese women Time frame: 2001 to 2002 Duration of the study: Pregnancy through delivery (all info derived from delivery records)	Design: <ul style="list-style-type: none"> Cross-sectional Total Study N: 112,257 Group Description: G1: Study cohort G2: NR Group N: G1: 46,659 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Vaginal birth Singleton pregnancy Low risk Term Exclusion criteria: <ul style="list-style-type: none"> Cesarean deliveries (n = 30,559) Delivery method unknown (n = 2258) Multiple gestations (n = 8387) Preterm deliveries < 37 weeks (n = 19623) Post-term deliveries > 41 weeks (n = 623) Stillbirths and neonatal deaths (n = 2558) Maternal deaths (n = 11) Congenital anomalies of the infant (n = 2449) 	Pregravid weight: <ul style="list-style-type: none"> Taken from records not stated whether it was self-reported or measured Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: 29.9 (4.8) G2: NR Parity: % primiparous: G1: 53.5 G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 6.3 G2: NR Diabetes mellitus, %: G1: 1.2 G2: NR Hypertension, %: G1: 2.0 G2: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 46,659 G2: NR Total weight gain: G1: 9.9 (4.3) G2: NR Categorized: <ul style="list-style-type: none"> Gestational age specific percentile values of weight gain: under the 25th, 25th-49th, 50th-74th, 75th-89th, ≥ 90th Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: not stated 	Birth weight: G1: 2982 (472) G2: NR Gestational diabetes, %: G1: 1.2 G2: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Macrosomia IUGR 	Outcomes Description: Odds ratios (95% CI) for SGA by weight gain groups Groups G1: Total MWG < 25 th percentile for GA G2: Total MWG 25-49 th percentile for GA G3: Total MWG 50-74 th percentile for GA (Reference) G4: Total MWG 75-89 th percentile for GA G5: Total MWG ≥90 th percentile for GA Results G1: 2.87 (2.56-3.21) G2: 1.49 (1.35-1.66) G3: 1.0 G4: 0.55 (0.55-0.72) G5: 0.45 (0.45-0.63) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-pregnancy weight Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Wataba et al., 2006</p> <p>Country and setting: Japan, academic medical center</p> <p>Enrollment Period: 1981 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To analyze association of pregnancy complications with prepregnant body mass index and weight gain during pregnancy in Japanese women</p> <p>Time frame: 1981 to 1999</p> <p>Duration of the study: Entry into PNC up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base and look at medical records retrospectively Retrospective <p>Total Study N: 21,718</p> <p>Group Description: G1: Nulliparous G2: Parous women</p> <p>Group N: G1: 10413 G2: 11305</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy delivering term baby at Osaka Med Center and Research Institute for Maternal and Child Health in 1981-1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> None reported 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> In data base but don't know if self reported <p>Pregravid BMI: G1: 20.5 (2.6) G2: 21.1 (3.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in 2 kg/m² point intervals from prepregnancy weight; categorical into low, medium, high BMI groups (< 18, 18-23.9, > 24) <p>Age (mean, yrs): G1: 27.8 (4.1) G2: 30.45 (3.9)</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 10413 G2: 11305 Total weight gain: G1: kg/wk: 0.25 (SD 0.09) G2: kg/wk: 0.24 (0.09) $P < 0.01$ Categorized: <ul style="list-style-type: none"> Categorical in kg/wk using prepregnancy weight and weight at delivery divided by gestational age of infant at birth Collected from: <ul style="list-style-type: none"> Rate of weight gain determined by: total weight gain divided by weeks ga Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: and subtracting prepregnancy weight 	Birth weight: G1: SGA: 5.4% LGA 5.2% G2: SGA 6.5% LGA 5.2% Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> NR Other infant outcomes: NR	Outcomes Description: Odds ratios (95% CIs) for SGA by weight gain categories Groups Parous, Low BMI (< 18) G1: WG < 0.15 kg/wk G2: WG 0.15-0.20 kg/wk G3: WG 0.20-0.25 kg/wk G4: WG 0.25-0.30 kg/wk (Reference) Parous, Medium BMI (18-23.9) G5: WG < 0.15 kg/wk G6: WG 0.15-0.20 kg/wk G7: WG 0.20-0.25 kg/wk (Reference) Parous, High BMI (> 24) G8: WG < 0.15 kg/wk G9: WG 0.15-0.20 kg/wk (Reference) Nulliparous, Low BMI (< 18) G10: WG < 0.15 kg/wk G11: WG 0.15-0.20 kg/wk G12: WG 0.20-0.25 kg/wk G13: WG 0.25-0.30 kg/wk (Reference) Nulliparous, Medium BMI (18-23.9) G14: WG < 0.15 kg/wk G15: WG 0.15-0.20 kg/wk G16: WG 0.20-0.25 kg/wk G17: WG 0.25-0.30 (Reference) Nulliparous, High BMI (> 24) G18: WG < 0.05 kg/wk G19: WG 0.15-0.20 kg/wk (Reference) Results G1: 5.42 (2.86-10.27) G2: 2.78 (1.53-5.06) G3: 1.39 (0.82-2.42) G4: 1.0 G5: 2.21 (1.67-2.93) G6: 1.68 (1.23-2.07) G7: 1.0 G8: 2.82 (1.17-6.78) G9: 1.0 G10: 6.20 (2.72-14.09) G11: 2.58 (1.14-5.87) G12: 2.46 (1.19-5.08) G13: 1.0	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Wataba et al., 2006 (continued)			

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		G14: 2.64 (1.88-3.71) G15: 1.60 (1.15-2.23) G16: 1.39 (1.03-1.87) G17: 1.0	
		G18: 7.06 (2.11-23.61) G19: 1.0	
		Maternal confounders and effect modifiers accounted for in analysis: Preeclampsia, C-section	
		Infant and child confounders and effect modifiers accounted for in analysis: 1-minute Apgar score < 4	

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Wen et al., 1990 Country and setting: USA, hospital Enrollment Period: January 1983 to December 1987 Funding: NIH contract N01-HD-4-2811 Study Objective: To determine effect of factors related to LBW on IUGR and preterm delivery Time frame: January 1983 to December 1987 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 17,149 Group Description: G1: Total G2: IUGR G3: Preterm delivery Group N: G1: 100% G2: 7.4% G3: 12.6% Inclusion criteria: <ul style="list-style-type: none"> Women seen for prenatal care and delivered of infants at study location Exclusion criteria: <ul style="list-style-type: none"> Diabetes Pregnancies involving multiple births Fetal death Congenital malformation 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal careweight at first prenatal visit was used G1: Prepregnancy weight (kg) < 50: 10.6%, 50-60: 32.6%, 61-72: 28.7%, 73-84: 14.5%, > 85: 13.6% G2: (Pregpregnancy?) Maternal weight (kg) < 50: 12.9%, 50-60: 8.5%, 61-72: 6.4%, 73-84: 5.5%, > 85: 4.8% G3: (Pregpregnancy?) Maternal wei Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NR Age (mean, yrs): G1: < 17: 7.5%, 17-19: 22.7%, 20-25: 43.1%, 26-30: 17.5%, 31-35: 7.0%, > 36: 2.3% G2: < 17: 8.0%, 17-19: 6.6%, 20-25: 7.4%, 26-30: 7.6%, 31-35: 8.2%, > 36: 8.6% G3: < 17: 15.4%, 17-19: 13.0%, 20-25: 11.6%, 26-30: 12.9%, 31-35: 14.3%, > 36: 13.4% Parity: G1: Parity 0: 44.1, 1: 29.9, > 1: 26.0 G2: Parity 0: 8.4, 1: 6.3, > 1: 6.6 G3: Parity 0: 12.5, 1: 12.3, > 1: 12.8	Race, %: White G1: 29.7 G2: NR Black G1: 70.3 G2: NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 29.4 G2: 10.3 G3: 13.3 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: G1: Married: 38.0% G2: Married: 6.6% G3: Married: 10.6% Additional characteristics: Education: G1: < 12: 41.1%, 12: 41.6%, > 12: 15.8% G2: < 12: 7.7%, 12: 7.3%, > 12: 7.6% G3: < 12: 12.8%, 12: 12.1%, > 12: 12.2% Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: Weight gain/week (after the 20th week) in kg: < 0.24: 12.2%, 0.24-0.57: 54.4%, 0.58-0.74: 19.2%, ≥ 0.75: 14.3% G2: Weight gain/week (after the 20th week) in kg: < 0.24: 9.9%, 0.24-0.57: 7.9%, 0.58-0.74: 5.2%, ≥ 0.75: 5.7% G3: Weight gain/ Categorized: <ul style="list-style-type: none"> Ave weight gain per week after 20th week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Maternal weight at delivery not available, so total weight gain not calculated 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Odds ratios for SGA by weight gain groups Groups G1: MWG < 0.24 kg/wk G2: MWG 0.24-0.57 kg/wk G3: MWG 0.58-0.74 kg/wk (Reference) G4: MWG ≥ 0.75 kg/wk Results G1: 2.24 ($P < 0.05$) G2: 1.55 ($P < 0.05$) G3: 1.0 G4: 1.25 (NS) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Marital status Education Previous preterm delivery Alcohol use Drug use Maternal height Maternal weight Smoking Infant and child confounders and effect modifiers accounted for in analysis: Infant sex	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Zhou and Olsen, 1997 Country and setting: Denmark, two communities Enrollment Period: April 1984 to April 1987 Funding: Danish National Research Foundation and Sygekassernes Helsefond Study Objective: To study association between gestational weight gain and different birth weight indicators considering prepregnancy BMI Time frame: April 1984 to April 1987 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 7122 Group Description: G1: Entire study G2: NR Group N: G1: 7122 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Women who provided detailed information on lifestyle during pregnancy Singletons Non-diabetic women who gave birth between weeks 37 and 42 for whom weight gain was reported Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: % < 19.8: 27.2; %19.8-26: 63.7; %26+: 9.1 G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): % < 25: G1: 30.3 G2: NR Parity: %nulliparous: G1: 48.9 G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: %non-smoking: G1: 60.0 G2: NR Diabetes mellitus, %: G1: 0 G2: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 22. Gestational weight gain and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 7122 G2: NR Total weight gain: G1: % < 11kg: 35.2; %12-15: 35.5; %16+: 29.3 G2: NR Categorized: <ul style="list-style-type: none"> ≤ 11, 12-15, ≥ 16 kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between last measured weight prior to delivery and prepregnancy weight 	Birth weight: G1: %LBW: 1.7; %normal: 96.8; %HBW: 1.5 G2: NR Gestational diabetes, %: G1: 0 G2: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Low birth weight (< 2500g) High birth weight (> 4500g) Growth retarded were newborns with a birth weight below 3000g in spite of a placenta weight higher than 66 percentile (491g) 	Outcomes Description: Percentage growth retardation (birth weight < 3,000g and placental weight > 490g) by weight gain category and BMI Groups Weight gain < 11 kg G1: Underweight (Reference) G2: Normal G3: Overweight Weight gain 12-15 kg G4: Underweight G5: Normal G6: Overweight Weight gain > 16 kg G7: Underweight G8: Normal G9: Overweight Results G1: 1.0 G2: 0.6 (0.4-0.8) G3: 0.6 (0.4-1.1) G4: 0.3 (0.2-0.5) G5: 0.4 (0.3-0.6) G6: 0.4 (0.1-1.0) G7: 0.3 (0.2-0.5) G8: 0.2 (0.1-0.3) G9: 0.2 (0.1-0.6) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Alcohol Diabetes Term delivery Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex 	Background: Fair Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 23. Gestational weight gain and Apgar Scores

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Cedergren, 2006 Country and setting: Sweden, Medical Birth Registry Enrollment Period: January 1, 1994 - December 31, 2002 Funding: Ostergotland County Council Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes Time frame: January 1, 1994 to December 31, 2002 Duration of the study: First visit to maternity health care center to delivery	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 245,526 Group Description: BMI G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35 Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Inclusion criteria: <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 Age (mean, yrs): G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1% G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9% G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5% G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4% G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%	Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: <ul style="list-style-type: none"> < 8kg, 8-16, > 16 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Association of weight gain and Apgar scores Groups 5 minute Apgar Score < 7 Weight gain < 8 kg, 8-16 kg, and > 16 kg for each BMI class below G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI ≥ 35 Results No association between low weight gain and Apgar score, despite BMI of mother Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> BMI Age Parity Smoking in early pregnancy Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Year of birth 	Background: Fair Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Johnson et al., 1992 Country and setting: USA, prenatal clinics Enrollment Period: January 1, 1987- December 31, 1989 Funding: NR Study Objective: To determine influences of increased maternal prepregnancy weight and increased gestational weight gain on pregnancy outcome Time frame: January 1, 1987 to December 31, 1989 Duration of the study: Initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 3,191 Group Description: G1: BMI < 19.8 G2: 19.8-26.0 G3: 27-29 G4: > 29 G5: All Group N: G1: 755 G2: 1,621 G3: 329 G4: 486 G5: 3191 Inclusion criteria: <ul style="list-style-type: none"> Delivery at or beyond 38 weeks of gestation Singletons Received prenatal care and delivered in Shands Hospital Exclusion criteria: <ul style="list-style-type: none"> Fetal abnormalities Oligohydramnios Polyhydramnios Medical or surgical complications (GI disorders, sickle cell hemoglobinopathy, hepatitis, hematologic disorders, malignant disease, renal disease, neurologic disease, pulmonary disease, psychiatric disorders, tuberculosis) Incomplete risk variable data or outcome variable information 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> National Academy of Sciences Age (mean, yrs): G1: NR <ul style="list-style-type: none"> < 20 years: 36.6% 20-26 years: 44.8% > 26 years: 18.7% G2: NR <ul style="list-style-type: none"> < 20 years: 30.8% 20-26 years: 46.5% > 26 years: 22.6% G3: <ul style="list-style-type: none"> < 20 years: 25.8% 20-26 years: 48.9% > 26 years: 25.2% G4: <ul style="list-style-type: none"> < 20 years: 16.5% 20-26 years: 53.9% > 26 years: 29.6% G5: <ul style="list-style-type: none"> < 20 years: 29.5% 20-26 years: 47.5 % > 26 years: 23.0% Parity: G1: % first: 49.3 G2: 43.1 G3: 37.4 G4: 31.1 G5: 42.1	Race, %: White G1: 64.5 G2: 60.0 G3: 49.8 G4: 51.9 G5: 58.7 Black G1: 33.6 G2: 37.9 G3: 48.9 G4: 47.5 G5: 39.5 Hispanic NR Asian/Pacific Islander NR Other G1: 1.9 G2: 2.1 G3: 1.2 G4: 0.6 G5: 1.7 Smoking, %: NR Diabetes mellitus, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1 Hypertension, %: G1: 3.4 G2: 4.6 G3: 5.8 G4: 10.7 G5: 5.4 Additional characteristics: G1: % married: 42.6 G2: 46.1 G3: 40.4 G4: 49.4 G5: 45.2 Additional characteristics: NR

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 755 G2: 1621 G3: 329 G4: 486 G5: 3191</p> <p>Total weight gain: G1: <ul style="list-style-type: none"> < 16kg: 7.8% 16-25kg: 18.5% 26-35kg: 35.1% > 35kg: 38.5% G2: <ul style="list-style-type: none"> < 16kg: 11.7% 16-25kg: 18.0% 26-35kg: 28.8% > 35kg: 41.5% G3: <ul style="list-style-type: none"> < 16kg: 19.8% 16-25kg: 19.1% 26-35kg: 28.3% > 35kg: 32.8% G4: <ul style="list-style-type: none"> < 16kg: 32.3% 16-25kg: 22.0%; </p> <p>Categorized: <ul style="list-style-type: none"> Quartiles National Academy of Sciences (below, within, or above recommended range) </p> <p>Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records </p> <p>Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and weight at last prenatal visit (mean 6.1 days prior to delivery) </p>	<p>Birth weight: G1: <ul style="list-style-type: none"> < 2500g: 4.8% 2500-4000g: 89.1% > 4000g: 6.1% G2: <ul style="list-style-type: none"> < 2500g: 2.0% 2500-4000g: 85.2% > 4000g: 12.8% G3: <ul style="list-style-type: none"> < 2500g: 1.5% 2500-4000g: 83.0% > 4000g: 15.5% G4: <ul style="list-style-type: none"> < 2500g: 0.2% 2500-4000g: 82.5% > 4000g: 17.3% </p> <p>Gestational diabetes, %: G1: 1.9 G2: 2.3 G3: 6.1 G4: 5.3 G5: 3.1</p> <p>Cesarean delivery, %: G1: NR G2: NR G3: NR G4: NR G5: 11.9</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: <ul style="list-style-type: none"> Frequency of macrosomia = 12.2% Frequency of cesarean = 11.9% Frequency of LBW = 2.9% </p>	<p>Outcomes Description: Rate of 1-minute and 5-minute Apgar Scores \leq 7 by weight gain categories</p> <p>Groups 1-minute and 5-minute Apgar score \leq 7 G1: total weight gain < 16lb G2: total weight gain 16 - 25lb G3: total weight gain 26-35lb G4: total weight gain >35lb</p> <p>Results Increased OR for gestational weight gain, persists after adjusting (no further details provided)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Race Parity BMI category GDM Hypertension Height (tertile) Prepregnancy weight quartile Other variables entered by stepwise regression model </p> <p>Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NR </p>	<p>Background: Fair</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Fair</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 0 Good, 9 Fair, 0 Poor</p> <p>Final Quality Score: Fair</p>

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Johnson et al., 1992
(continued)

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
	<ul style="list-style-type: none"> • Frequency of postdate pregnancy = 9.8% • Frequency of labor abnormalities (40% were unscheduled cesareans) = 7.8% • Frequency of oxytocin induction = 13.7% • Frequency of oxytocin augmentation = 16.1% • Frequency of meconium staining = 21.5% 	
	<p>Other infant outcomes: NA</p>	

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nixon et al., 1998</p> <p>Country and setting: USA, county nurse-midwifery services</p> <p>Enrollment Period: January 1991 to December 1994</p> <p>Funding: American College of Nurse Midwives</p> <p>Study Objective: To compare outcomes of term infants of average birth weight with outcomes of large infants using computer database</p> <p>Time frame: January 1991 to December 1994</p> <p>Duration of the study: First prenatal visit through birth collected retrospectively</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 2,228</p> <p>Group Description: G1: 2500 - 3999g G2: ≥ 4000g</p> <p>Group N: G1: 1906 G2: 322</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Gestational age ≥ 37 weeks Birth weight ≥ 2500g Live infant at onset of labor Birth occurred in hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with gestational diabetes that required insulin therapy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 138 (31) G2: 158 (36) ($P < 0.0001$)</p> <p>Pregravid BMI: G1: 24 (5) G2: 26 (5.8) ($P < 0.0001$)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous IOM guidelines <p>Age (mean, yrs): G1: 25 (6) G2: 27.5 (6) ($P < 0.0001$)</p> <p>Parity: % parous: G1: 56.3 G2: 69.9 ($P < 0.00001$)</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: % shoulder dystocia: G1: 0.6 G2: 5.9 ($P < 0.001$) % NICU: G1: 4.3 G2: 6.6 ($P = \text{ns}$)</p>

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1906 G2: 322 Total weight gain: G1: 30.7+/-15 G2: 37.2+/-15 (P < 0.0001) Categorized: <ul style="list-style-type: none"> Continuous According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Apgar scores 	Outcomes Description: Apgar scores less than 7 Groups 1-minute Apgar score < 7 Continuous weight gain measure Results Gestational weight gain not a predictor of Apgar scores < 7 (details NR) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Wataba et al., 2006</p> <p>Country and setting: Japan, academic medical center</p> <p>Enrollment Period: 1981 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To analyze association of pregnancy complications with prepregnant body mass index and weight gain during pregnancy in Japanese women</p> <p>Time frame: 1981 to 1999</p> <p>Duration of the study: Entry into PNC up til delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base and look at medical records retrospectively Retrospective <p>Total Study N: 21,718</p> <p>Group Description: G1: Nulliparous G2: Parous women</p> <p>Group N: G1: 10413 G2: 11305</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy delivering term baby at Osaka Med Center and Research Institute for Maternal and Child Health in 1981-1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> None reported 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> In data base, on't know if self reported <p>Pregravid BMI: G1: 20.5 (2.6) G2: 21.1 (3.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in 2 kg/m² point intervals from prepregnancy weight; categorical into low, medium, high BMI groups (< 18, 18-23.9, > 24) <p>Age (mean, yrs): G1: 27.8 (4.1) G2: 30.45 (3.9)</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 23. Gestational weight gain and Apgar Scores (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 10413 G2: 11305</p> <p>Total weight gain: G1: kg/wk: 0.25 (SD 0.09) G2: kg/wk: 0.24 (0.09) P < 0.01</p> <p>Categorized:</p> <ul style="list-style-type: none"> Categorical in kg/wk using prepregnancy weight and weight at delivery divided by gestational age of infant at birth <p>Collected from:</p> <ul style="list-style-type: none"> Rate of weight gain determined by: total weight gain divided by weeks ga <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: and subtracting prepregnancy weight 	<p>Birth weight: G1: SGA: 5.4% LGA 5.2% G2: SGA 6.5% LGA 5.2%</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: <ul style="list-style-type: none"> NR </p> <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Rate of 1 minute Apgar scores <4 by weight gain categories</p> <p>Groups 1 minute Apgar score < 4 Rate of weight gain, categorized differently across different BMI groups</p> <p>Results AOR for nulliparous women with low BMI with weekly weight gain of < 15kg/wk versus women with weight gain of 0.25-0.3kg/wk: 12.24 (2.04 - 73.43)</p> <p>AOR for parous women with medium BMI, with weekly weight gain of 0.35-0.4kg/wk versus women with weight gain 0.2-0.25kg/wk: 2.21 (1.08-4.53)</p> <p>No other relationships were significant</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Parity Baseline BMI <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 1 Good, 4 Fair, 4 Poor</p> <p>Final Quality Score: Poor</p>

Evidence Table 24. Gestational weight gain and perinatal mortality

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bracero and Byrne, 1997</p> <p>Country and setting: Hospital charts - Maimonides Medical Center, Brooklyn, NY</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To determine optimal weight gain in singleton pregnancy and evaluate current recommendations</p> <p>Time frame:</p> <p>Duration of the study: Jan 1, 1987 to Jan 1, 1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 20,971</p> <p>Group Description: G1: Total population G2: NR</p> <p>Group N: G1: 20,971 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Delivery at Maimonides Medical Center Singleton pregnancy No documentation of congenital anomaly, pregnancy was not terminated by abortion Documentation on chart of prepregnancy maternal weight, amount of maternal weight gain during pregnancy, and gender of infant <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Infants with any type of congenital anomaly (international classification of diseases (ICD-9-CM) codes 740.0-759.9 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: median BMI = 23.19 (range 14.46-40.07) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: % < 15 years: < 0.1; 15-19 yrs: 4.8; 20-24: 25.1; 25-29: 31.1; 30-34: 24.3; 35-39: 11.8; 40-44: 2.8; 45-49: 0.1; > 50: < 0.1 G2: NR</p> <p>Parity: % primigravida: G1: 25.1 G2: NR</p>	<p>Race, %: White G1: 92.1 G2: NR</p> <p>Black G1: 4.2 G2: NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander G1: 0.9 G2: NR</p> <p>Other G1: 2.1 G2: NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: % married: G1: 12.4 G2: NR</p> <p>Additional characteristics: Type of service: G1: Ward, 22.5% Private: 77.5% G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 24. Gestational weight gain and perinatal mortality (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain:</p> <p>G1: % weight gain: lost weight, 0.4; 1 to 5lbs, 0.9; 6 to 10, 2.3; 11 to 15, 5.4; 16 to 20, 12.0; 21 to 25, 17.2; 26 to 30, 21.1; 31 to 35, 14.8; 36 to 40, 11.5; 41 to 45, 6.1; ≥ 46, 8.3</p> <p>G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> According to IOM ordinal categories in 5 pound intervals <p>Collected from:</p> <ul style="list-style-type: none"> Routine prenatal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: using last measurement obtained as an outpatient 	<p>Birth weight:</p> <p>G1: $r = .210$ correlation with maternal weight gain</p> <p>G2: NR</p> <p>Gestational diabetes, %:</p> <p>NR</p> <p>Cesarean delivery, %:</p> <p>NR</p> <p>Instrumental delivery, %:</p> <p>NR</p> <p>Episiotomy, %:</p> <p>NR</p> <p>Other maternal outcomes:</p> <p>Optimal weight gain defined as 36 to 40 pounds for underweight women, 31 to 40 pounds for women of ideal prepregnancy weight, 26 to 30 pounds for overweight women</p> <p>Other infant outcomes:</p> <p>Adverse outcomes:</p> <ul style="list-style-type: none"> Still birth Neonatal death Preterm delivery/low birth weight Perinatal morbidity 	<p>Outcomes Description:</p> <p>Perinatal mortality %</p> <p>Groups:</p> <p>G1: Suboptimal weight gain</p> <p>G2: Optimal weight gain</p> <p>Results:</p> <p>G1: 0.6</p> <p>G2: 0.2</p> <p>$P < 0.0001$</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <p>NA</p> <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NA</p>	<p>Background:</p> <p>Fair</p> <p>Sample selection:</p> <p>Fair</p> <p>Definition of maternal weight gain:</p> <p>Fair</p> <p>Definition of outcomes:</p> <p>Good</p> <p>Source of information on exposure, outcomes, and confounders:</p> <p>Fair</p> <p>Followup:</p> <p>Fair</p> <p>Analysis comparability:</p> <p>Fair</p> <p>Analysis of outcomes:</p> <p>Fair</p> <p>Interpretation:</p> <p>Fair</p> <p>Sum of Good/Fair/Poor:</p> <p>1 Good, 8 Fair, 0 Poor</p> <p>Final Quality Score:</p> <p>Fair</p>

Evidence Table 24. Gestational weight gain and perinatal mortality (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Naeye, 1990</p> <p>Country and setting: USA, hospitals affiliated with medical schools</p> <p>Enrollment Period: 1959 to 1966</p> <p>Funding: NR</p> <p>Study Objective: To evaluate relationship of maternal pregravid BMI to pregnancy outcome</p> <p>Time frame: 1959 to 1966</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 56,857</p> <p>Group Description: G1: BMI < 20 G2: BMI 20-24 G3: BMI 25-30 G4: BMI > 30</p> <p>Group N: G1: 12,669 G2: 28,810 G3: 10,160 G4: 5,218</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Data from Collaborative Perinatal Study <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Deliveries taking place outside of CPS hospitals 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> < 20, 20-24, 25-30, > 30 <p>Age (mean, yrs): G1: 10-18: 19.3% 35-50: 2.4% G2: 10-18: 17.8% 35-50: 5.9% G3: 10-18: 9.8% 35-50: 12.9% G4: 10-18: 7.8% 35-50: 16.3%</p> <p>Parity: NR</p>	<p>Race, %: White NR Black G1: 34.7 G2: 45.8 G3: 55.3 G4: 54.1 Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 49.1 G2: 44.9 G3: 40.0 G4: 39.8</p> <p>Diabetes mellitus, %: G1: (GDM and preexisting DM) 0.6 G2: 1.0 G3: 1.1 G4: 5.0</p> <p>Hypertension, %: G1: 7.2 G2: 7.4 G3: 8.9 G4: 8.8</p> <p>Additional characteristics: NR</p>

Evidence Table 24. Gestational weight gain and perinatal mortality (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Low weight gain defined as < 0.8 kg/month after first trimester Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: G1: (GDM and preexisting DM) 0.6 G2: 1.0 G3: 1.1 G4: 5.0 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: % preterm births: BMI < 20: 20.8%, BMI 20-24: 19.6% ($P < 0.01$ compared to BMI < 20), BMI 25-30: 22.5% ($P < 0.005$ compared to BMI < 20), BMI > 30: 30.7% ($P < 0.001$ compared to BMI < 20)	Outcomes Description: Attributable risk estimates for perinatal death for low pregnancy weight gain Groups: Low weight gain defined as < 0.8 kg/week after the first trimester for pregravid BMI groups below: G1: BMI < 20 G2: BMI 20-24 G3: BMI 25-30 G4: BMI > 30 Results: G1: 0.03 (95% CI, 0.02-0.05) G2: 0.02 (95% CI, 0.01-0.03) G3: 0.01 (95% CI, 0.00-0.02) G4: 0.00 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age 35-40 Diabetes mellitus Hypertensive disorders Black Preterm birth Major congenital malformations Twins Neonatal respiratory distress syndrome Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 2 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 24. Gestational weight gain and perinatal mortality (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nohr et al., 2005</p> <p>Country and setting: Denmark, National Birth Cohort</p> <p>Enrollment Period: May, 1998 to April, 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine association between high prepregnancy BMI and fetal death, allowing for the effects of gestational age, weight gain, and maternal diseases in pregnancy</p> <p>Time frame: May, 1998 to April, 2001</p> <p>Duration of the study: Approximately 16 weeks gestational age through end of pregnancy</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 55432</p> <p>Group Description:</p> <p>G1: < 18.5 G2: 18.5-24.9 G3: 25-29.9 G4: ≥ 30</p> <p>Group N:</p> <p>G1: 2458 G2: 36986 G3: 10650 G4: 4411</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who had participated in first telephone interview <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing information on BMI (n = 886) Missing information on gestational age (n = 30) Termination of pregnancy after first telephone interview or at an estimated gestational age less than 28 days (n = 11) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs):</p> <p>G1: < 25 years: 19.0% 25-29: 42.2% 30-34: 29.5% ≥ 35: 9.3%</p> <p>G2: < 25 years: 11.9% 25-29: 41.2% 30-34: 34.9% ≥ 35: 12.0%</p> <p>G3: < 25 years: 13.9% 25-29: 41.8% 30-34: 33.3% ≥ 35: 10.9%</p> <p>G4: < 25 years: 16.8% 25-29: 40.9% 30-34: 32.3% ≥ 35: 10.0%</p> <p>Parity:</p> <p>G1: %primiparous: 46.8 G2: 46.7 G3: 43.6 G4: 42.7</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %:</p> <p>G1: % non-smoking: 72.5 G2: 84.1 G3: 83.3 G4: 82.1</p> <p>Diabetes mellitus, %:</p> <p>G1: 0.3 G2: 0.6 G3: 1.6 G4: 5.0</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 24. Gestational weight gain and perinatal mortality (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 2,458 G2: 36,986 G3: 10,650 G4: 4,411 Total weight gain: G1: 459 g/wk G2: 487 g/wk G3: 462 g/wk G4: 347 g/wk Categorized: <ul style="list-style-type: none"> Weight gain was defined as average weekly increase between self reported weights in first and second pregnancy interviews for women who provided a first interview between 9-24 weeks, those who provided a second interview between 26 and 38 completed weeks of gestation, and those who had at least 6 weeks between 2 interviews Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: G1: 0.3 G2: 0.6 G3: 1.6 G4: 5.0 Cesarean delivery, %: Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Adjusted odds ratio for perinatal mortality Groups: Weight per week for BMI groups: G1: Underweight <18.5 G2: 18.5 ≤ normal weight < 25 G3: 25 ≤ overweight < 30 G4: Obese ≥ 30 Results: Weight gain in pregnancy was not significantly associated with the risk of stillbirth for any BMI groups Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Height Parity Socio-occupational status Physical exercise Smoking Alcohol and coffee consumption Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 7 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 25. Gestational weight gain and neonatal distress

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Cedergren, 2006</p> <p>Country and setting: Sweden, Medical Birth Registry</p> <p>Enrollment Period: January 1, 1994 - December 31, 2002</p> <p>Funding: Ostergotland County Council</p> <p>Study Objective: To estimate effects of high and low gestational weight gain in different maternal BMI classes on obstetric and neonatal outcomes</p> <p>Time frame: January 1, 1994 to December 31, 2002</p> <p>Duration of the study: First visit to maternity health care center to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 245,526</p> <p>Group Description: BMI</p> <p>G1: < 20 G2: 20 to 24.9 G3: 25 to 29.9 G4: 30 to 34.9 G5: ≥ 35</p> <p>Group N: G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton, term pregnancies Information on maternal height, maternal weight in early pregnancy, and gestational weight gain <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported If unknown, standardized measurement is made during first visit to maternity health care center <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> < 20, 20.0-24.9, 25.0-29.9, 30-34.9, ≥ 35 <p>Age (mean, yrs): G1: 15 to 19 years: 3.8% 20 to 24: 23.0% 25 to 29: 38.7% 30 to 34: 25.7% 35 to 39: 7.7% ≥ 40: 1.1% G2: 15 to 19 years: 1.9% 20 to 24: 15.9% 25 to 29: 37.7% 30 to 34: 31.1% 35 to 39: 11.3% ≥ 40: 1.9% G3: 15 to 19 years: 1.5% 20 to 24: 15.7% 25 to 29: 36.1% 30 to 34: 31.2% 35 to 39: 12.9% ≥ 40: 2.5% G4: 15 to 19 years: 1.5% 20 to 24: 17.4% 25 to 29: 35.6% 30 to 34: 30.0% 35 to 39: 13.0% ≥ 40: 2.4% G5: 15 to 19 years: 1.1% 20 to 24: 17.3% 25 to 29: 38.0% 30 to 34: 29.6% 35 to 39: 11.7% ≥ 40: 2.3%</p>	<p>Race, %: White G1: 96.6 G2: NR Black NR Hispanic NR Asian/Pacific Islander G1: 1.4 G2: NR Other G1: 2.0 G2: NR</p> <p>Smoking, %: G1: % nonsmoking: 81.6 G2: 85.2 G3: 83.1 G4: 79.9 G5: 78.4 Group 6</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 25. Gestational weight gain and neonatal distress (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28,186 G2: 143,365 G3: 60,626 G4: 17,248 G5: 6,296 Total weight gain: G1: < 8kg: 6.9% 8-15.9kg: 65.2% ≥ 16kg: 28.0% G2: < 8kg: 8.4% 8-15.9kg: 67.1% ≥ 16kg: 30.4% G3: < 8kg: 15.7% 8-15.9kg: 54.4% ≥ 16kg: 29.9% G4: < 8kg: 30.2% 8-15.9kg: 48.7% ≥ 16kg: 21.1% G5: < 8kg: 44.6% 8-15.9kg: 40.9% ≥ 16kg: Categorized: <ul style="list-style-type: none"> < 8kg, 8-16, > 16 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between maternal weights measured when woman attended delivery unit and maternal weight recorded at first visit to maternity health care center 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> AOR for fetal distress (95% CI) Groups GWG<8 g, 8-15.9 kg, ≥ 16kg for BMI groups (8.-15.9 ref) G1: BMI < 20 G2: BMI 20-24.9 G3: BMI 25-29.9 G4: BMI 30-34.9 G5: BMI ≥ 35 Results GWG<8kg G1: 1.05 (0.54-2.03) G2: 1.06 (0.81-1.40) G3: 0.96 (0.70-1.32) G4: 1.21 (0.79-1.85) G5: 0.59 (0.28-1.25) GWG≥ 16kg G1: 0.86 (0.57-1.29) G2: 1.08 (0.92-1.26) G3: 1.31 (1.05-1.53) G4: 1.02 (0.65-1.62) G5: 2.15 (1.10-4.20) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Smoking Infant and child confounders and effect modifiers accounted for in analysis: Year of birth	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 26. Gestational weight gain and neonatal hypoglycemia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hedderson et al., 2006</p> <p>Country and setting: USA, Kaiser Permanente Medical Care Program</p> <p>Enrollment Period: January 1, 1996 - June 31, 1998</p> <p>Funding: R01 DK 54834 from National Institute of Diabetes and Digestive and Kidney Diseases, grant from American Diabetes Association and Kaiser Community Benefit research support</p> <p>Study Objective: To examine whether pregnancy weight gains outside IOM recommendations and rates of maternal weight gain are associated with neonatal complications</p> <p>Time frame: January 1, 1996 to June 31, 1998</p> <p>Duration of the study: First prenatal care visit to 30 days post delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 45,245</p> <p>Group Description: G1: Controls G2: Macrosomia G3: Hypoglycemia G4: Hyperbilirubinemia</p> <p>Group N: G1: 652 G2: 391 G3: 328 G4: 432</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton livebirth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No pregestational diabetes or history of gestational diabetes (screened at 24-28 weeks gestation - meeting National Diabetes Data Group criteria for GDM) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported in some cases used measured weight recorded in chart closes to woman's last menstrual period but no more than 12 months before her last menstrual period <p>Pregravid BMI: G1: < 19.8: 13.5% 19.8-24.9: 56.4% 25.0-29.0: 12.4% > 29.0: 17.6% G2: < 19.8: 5.1% 19.8-24.9: 51.2% 25.0-29.0: 16.6% > 29.0: 27.1% G3: < 19.8: 10.1% 19.8-24.9: 50.0% 25.0-29.0: 17.1% > 29.0: 22.9% G4: < 19.8: 13.9% 19.8-24.9: 57.9% 25.0-29.0: 13.2% > 29.0: 57.1%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: < 25 years: 22.1% 25-29: 24.2% 30-34: 33.6% ≥ 35: 20.1% G2: < 25 years: 15.9% 25-29: 28.0% 30-34: 31.7% ≥ 35: 24.3% G3: < 25 years: 24.1% 25-29: 25.3% 30-34: 26.8% ≥ 35: 23.8% G4: < 25 years: 17.1% 25-29: 29.4% 30-34: 32.6% ≥ 35: 20.8%</p> <p>Parity: % primiparous: G1: 56.9 G2: 31.2 G3: 50.0 G4: 59.3</p>	<p>Race, %: White G1: 54.0 G2: 67.8 G3: 47.6 G4: 42.6 Black G1: 10.0 G2: 5.1 G3: 11.3 G4: 4.4 Hispanic G1: 17.2 G2: 15.1 G3: 20.4 G4: 15.5 Asian/Pacific Islander G1: 8.1 G2: 3.6 G3: 6.7 G4: 20.1 Other G1: 10.7 G2: 8.4 G3: 14.0 G4: 17.4</p> <p>Smoking, %: G1: %nonsmoking during pregnancy: 92.0; %smoked but quit: 4.2; %smoked 3.9 G2: %nonsmoking during pregnancy: 90.8; %smoked but quit: 5.3; %smoked 4.0 G3: %nonsmoking during pregnancy: 92.6; %smoked but quit: 1.5; %smoked 5.8 G4: %nonsmoking during pregnancy: 94.2; %smoked but quit: 4.9; %smoked 1.0</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Screening glucose value less than 140: G1: 85.0%: > 140: 15.0% G2: 81.6%: > 140: 18.4% G3: 81.4%: > 140: 18.6% G4: 83.3%: > 140: 16.7%</p>

Evidence Table 26. Gestational weight gain and neonatal hypoglycemia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity recordsrate of maternal weight gain was calculated as total pregnancy weight gain minus infant birth weight divided by weeks of gestation when last weight was measured; rate of maternal weight gain before the third trimester was calculated using the weight measured at or before the screening test for GDM (24-28 wks of gestation) minus prepregnancy weight divided by weeks of gestation Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight at last prenatal visit (within 2 weeks of delivery date) and prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> AOR for neonatal hypoglycemia (95% CI) Groups: G1: Rate of maternal weight gain (kg/wk): -0.26-0.21 G2: Rate of maternal weight gain (kg/wk): 0.22-0.31 G3: Rate of maternal weight gain (kg/wk): 0.32-0.39 G4: Rate of maternal weight gain (kg/wk): 0.40-1.03 Results: G1: 0.87 (0.57-1.32) G2: 1.00 G3: 0.74 (0.49-1.14) G4: 1.91 (1.33-2.82) Below IOM recommendations 0.91 (0.59-1.41) Within IOM recommendations 1.00 Above IOM recommendations 1.39 (1.02-1.90) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Screening glucose value from 1 hour after 50g oral glucose challenge test Difference between age at delivery and gestational age at last weight measured Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 26. Gestational weight gain and neonatal hypoglycemia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Stotland et al., 2006 Country and setting: USA, university hospital Enrollment Period: 1980 to 2001 Funding: NR Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more) Time frame: 1980 to 2001 Duration of the study: Entry into PN care up till delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 20465 Group Description: G1: Gain below IOM recommendations G2: Gain within IOM recommendations G3: Gain above IOM recommendations Group N: G1: 4,114 G2: 7,490 G3: 8,861 Inclusion criteria: <ul style="list-style-type: none"> Singleton Exclusion criteria: <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: < 19.8: 25.8% 19.8-26.0: 19.4% 26.1-29.0: 9.2% > 29.0: 20.6% G2: < 19.8: 49.1% 19.8-26.0: 34.8% 26.1-29.0: 23.3% > 29.0: 25.5% G3: < 19.8: 25.0% 19.8-26.0: 45.8% 26.1-29.0: 67.5% > 29.0: 53.9% $P < 0.001$ Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: < 20 years: 23.4% 20-29 years: 19.3% 30-39 years: 19.9% > 40 years: 25.3% G2: < 20 years: 31.3% 20-29 years: 36.6% 30-39 years: 37.6% > 40 years: 36.3% G3: < 20 years: 45.4% 20-29 years: 44.0% 30-39 years: 42.5% > 40 years: 38.4% $P < 0.001$ Parity: % Nulliparous: G1: 17.3 G2: 36.2 G3: 46.6 $P < 0.001$	Race, %: White G1: 16.2 G2: 35.8 G3: 48.0 Black G1: 25.5 G2: 29.4 G3: 45.1 Hispanic G1: 19.2 G2: 34.8 G3: 46.0 Asian/Pacific Islander G1: 24.3 G2: 43.3 G3: 32.4 Other G1: 21.7 G2: 37.9 G3: 40.4 P for all race categories < 0.001 Smoking, %: G1: 23.5 G2: 30.8 G3: 45.8 $P < 0.001$ Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 26. Gestational weight gain and neonatal hypoglycemia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOMpercentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 <i>P</i> < 0.001 Gestational diabetes,%: NR Cesarean delivery,%: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery,%: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 Assisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: AOR for neonatal hypoglycemia (95% CI) Groups: G1: GWG > 7 kg G2: GWG 11.5-16 kg G3: GWG >18 kg Results Hypoglycemia G1: 1.86 (0.91-3.81) G2: 1.0 G3: 1.67 (1.13-2.46) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 27. Gestational weight gain and hyperbilirubinemia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hedderson et al., 2006</p> <p>Country and setting: USA, Kaiser Permanente Medical Care Program</p> <p>Enrollment Period: January 1, 1996 - June 31, 1998</p> <p>Funding: R01 DK 54834 from National Institute of Diabetes and Digestive and Kidney Diseases, grant from American Diabetes Association and Kaiser Community Benefit research support</p> <p>Study Objective: To examine whether pregnancy weight gains outside IOM recommendations and rates of maternal weight gain are associated with neonatal complications</p> <p>Time frame: January 1, 1996 to June 31, 1998</p> <p>Duration of the study: First prenatal care visit to 30 days post delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 45,245</p> <p>Group Description: G1: Controls G2: Macrosomia G3: Hypoglycemia G4: Hyperbilirubinemia</p> <p>Group N: G1: 652 G2: 391 G3: 328 G4: 432</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton livebirth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No pregestational diabetes or history of gestational diabetes (screened at 24-28 weeks gestation - meeting National Diabetes Data Group criteria for GDM) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported in some cases used measured weight recorded in chart closes to woman's last menstrual period but no more than 12 months before her last menstrual period <p>Pregravid BMI: G1: < 19.8: 13.5% 19.8-24.9: 56.4% 25.0-29.0: 12.4% > 29.0: 17.6% G2: < 19.8: 5.1% 19.8-24.9: 51.2% 25.0-29.0: 16.6% > 29.0: 27.1% G3: < 19.8: 10.1% 19.8-24.9: 50.0% 25.0-29.0: 17.1% > 29.0: 22.9% G4: < 19.8: 13.9% 19.8-24.9: 57.9% 25.0-29.0: 13.2% > 29.0: 57.1%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: < 25 years: 22.1% 25-29: 24.2% 30-34: 33.6% ≥ 35: 20.1% G2: < 25 years: 15.9% 25-29: 28.0% 30-34: 31.7% ≥ 35: 24.3% G3: < 25 years: 24.1% 25-29: 25.3% 30-34: 26.8% ≥ 35: 23.8% G4: < 25 years: 17.1% 25-29: 29.4% 30-34: 32.6% ≥ 35: 20.8%</p> <p>Parity: % primiparous: G1: 56.9 G2: 31.2 G3: 50.0 G4: 59.3</p>	<p>Race, %: White G1: 54.0 G2: 67.8 G3: 47.6 G4: 42.6 Black G1: 10.0 G2: 5.1 G3: 11.3 G4: 4.4 Hispanic G1: 17.2 G2: 15.1 G3: 20.4 G4: 15.5 Asian/Pacific Islander G1: 8.1 G2: 3.6 G3: 6.7 G4: 20.1 Other G1: 10.7 G2: 8.4 G3: 14.0 G4: 17.4</p> <p>Smoking, %: G1: %nonsmoking during pregnancy: 92.0; %smoked but quit: 4.2; %smoked 3.9 G2: %nonsmoking during pregnancy: 90.8; %smoked but quit: 5.3; %smoked 4.0 G3: %nonsmoking during pregnancy: 92.6; %smoked but quit: 1.5; %smoked 5.8 G4: %nonsmoking during pregnancy: 94.2; %smoked but quit: 4.9; %smoked 1.0</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Screening glucose value less than 140: G1: 85.0%: > 140: 15.0% G2: 81.6%: > 140: 18.4% G3: 81.4%: > 140: 18.6% G4: 83.3%: > 140: 16.7%</p>

Evidence Table 27. Gestational weight gain and hyperbilirubinemia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity recordsrate of maternal weight gain was calculated as total pregnancy weight gain minus infant birth weight divided by weeks of gestation when last weight was measured; rate of maternal weight gain before the third trimester was calculated using the weight measured at or before the screening test for GDM (24-28 wks of gestation) minus prepregnancy weight divided by weeks of gestation Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight at last prenatal visit (within 2 weeks of delivery date) and prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> AOR for hyperbilirubinemia (95% CI) Groups: G1: Rate of maternal weight gain (kg/wk): -0.26-0.21 G2: Rate of maternal weight gain (kg/wk): 0.22-0.31 G3: Rate of maternal weight gain (kg/wk): 0.32-0.39 G4: Rate of maternal weight gain (kg/wk): 0.40-1.03 Results: G1: 0.74 (0.49-1.11) G2: 1.00 G3: 0.91 (0.62-1.34) G4: 1.58 (1.10-2.28) Below IOM recommendations 0.98 (0.65-1.47) Within IOM recommendations 1.00 Above IOM recommendations 1.43 (1.06-1.93) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Screening glucose value from 1 hour after 50g oral glucose challenge test Difference between age at delivery and gestational age at last weight measured Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 28. Gestational weight gain and neonatal hospitalization

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Murakami et al., 2004 Country and setting: Japan, hospital Enrollment Period: 2001 Funding: NR Study Objective: To estimate risk of perinatal morbidity of mother and infant with respect to maternal prepregnancy BMI and weight gain in Japanese women Time frame: 2001 Duration of the study: Prenatal through birth	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 633 Group Description: G1: Total cohort G2: NR Group N: G1: 633 G2: NR Inclusion criteria: <ul style="list-style-type: none"> Live, singletons delivered between 24 to 42 weeks gestation Exclusion criteria:	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 20.9 (2.8) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> WHO International Taskforce Age (mean, yrs): G1: 29.1 (4.5) G2: NR Parity: G1: 0.6 (0.7) G2: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 8.5 G2: NR Diabetes mellitus, %: G1: 2.1 G2: NR Hypertension, %: NR Additional characteristics: G1: Preeclampsia Mild: 5.4% Severe: 4.1% G2: NR Additional characteristics: NR

Evidence Table 28. Gestational weight gain and neonatal hospitalization (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 633 G2: NR Total weight gain: G1: 10.5 (3.4) G2: NR Categorized: <ul style="list-style-type: none"> < 8.5kg, 8.5-12.5, > 12.5 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: last measurement was taken at hospitalization prior to delivery 	Birth weight: G1: 3,052.6 (483.8) G2: NR Gestational diabetes, %: G1: 2.1 G2: NR Cesarean delivery, %: G1: 10.3 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Adjusted ORs of hospitalization of infant (95% CI) Groups: Gesational weight gain G1: < 8.5 kg G2: 8.5-12.5 kg G3: > 12.5 kg Hospitalization of infant G1: 1.60 (0.88-2.88) G2: 1.00 G3: 0.93 (0.46-1.88) Outcomes Set 2: NR Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 29. Gestational weight gain and other infant morbidity

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Spector et al., 2007</p> <p>Country and setting: United States, hospital</p> <p>Enrollment period: January 1, 1996 and August 20, 2002</p> <p>Funding: National Cancer Institute grant R01CA79940. University of Minnesota supported by Children's Cancer Research Fund (Minneapolis, MN) and grants U10CA13539 and U10CA98543</p> <p>Study Objective: Report association between birth characteristics and maternal reproductive history with infant leukemia</p> <p>Time frame: January 1, 1996 and August 20, 2002</p> <p>Duration of the study: Entry to prenatal care until child's first birthday</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 495</p> <p>Group Description: G1: Cases G2: Controls G3: P value</p> <p>Group N: G1: 240 G2: 255</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Infants diagnosed with leukemia at < 1 year of age. <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No telephone Down syndrome Biological mother not available for interview in English 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 25.2 (5.07) G2: 25.1 (5.52) G3: 0.83</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs): G1: 29 (5.54) G2: 30 (5.58) G3: 0.06</p> <p>Parity: NR</p>	<p>Race,%: White G1: 79.5 G2: 85.5 G3: 0.003</p> <p>Black G1: 2.1 G2: 5.5</p> <p>Hispanic G1: 10.5 G2: 3.5</p> <p>Asian/Pacific Islander G1: 8.0 G2: 5.5</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 29. Gestational weight gain and other infant morbidity (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 240 G2: 255 Total weight gain: G1: 15.3 (7.52) G2: 14.6 (7.62) G3: 0.31 Categorized: <ul style="list-style-type: none"> Quartiles Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Finally, no observation observed between infant leukemia and maternal prepregnancy BMI or weight gain during pregnancy Other infant outcomes: NR	Outcomes Description: AORs for acute lymphoblastic leukemia (95% CI) Groups: G1: GWG≤ 9.07 kg G2: GWG 9.53-13.61 kg G3: GWG: 13.61-18.14 kg G4: GWG: > 18.14 kg Results: G1: 1.0 G2: 1.16 (0.68-1.99) G3: 1.25 (0.71-2.21) G4: 1.50 (0.84-2.68) P for trend=0.23 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal education Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 29. Gestational weight gain and other infant morbidity (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Stotland et al., 2006 Country and setting: USA, university hospital Enrollment Period: 1980 to 2001 Funding: NR Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more) Time frame: 1980 to 2001 Duration of the study: Entry into PN care up till delivery Quality: Fair	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 20465 Group Description: G1: Gain below IOM recommendations G2: Gain within IOM recommendations G3: Gain above IOM recommendations Group N: G1: 4,114 G2: 7,490 G3: 8,861 Inclusion criteria: <ul style="list-style-type: none"> Singleton Exclusion criteria: <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: < 19.8: 25.8% 19.8-26.0: 19.4% 26.1-29.0: 9.2% > 29.0: 20.6% G2: < 19.8: 49.1% 19.8-26.0: 34.8% 26.1-29.0: 23.3% > 29.0: 25.5% G3: < 19.8: 25.0% 19.8-26.0: 45.8% 26.1-29.0: 67.5% > 29.0: 53.9% $P < 0.001$ Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: < 20 years: 23.4% 20-29 years: 19.3% 30-39 years: 19.9% > 40 years: 25.3% G2: < 20 years: 31.3% 20-29 years: 36.6% 30-39 years: 37.6% > 40 years: 36.3% G3: < 20 years: 45.4% 20-29 years: 44.0% 30-39 years: 42.5% > 40 years: 38.4% $P < 0.001$ Parity: % Nulliparous: G1: 17.3 G2: 36.2 G3: 46.6 $P < 0.001$	Race, %: White G1: 16.2 G2: 35.8 G3: 48.0 Black G1: 25.5 G2: 29.4 G3: 45.1 Hispanic G1: 19.2 G2: 34.8 G3: 46.0 Asian/Pacific Islander G1: 24.3 G2: 43.3 G3: 32.4 Other G1: 21.7 G2: 37.9 G3: 40.4 P for all race categories < 0.001 Smoking, %: G1: 23.5 G2: 30.8 G3: 45.8 $P < 0.001$ Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 29. Gestational weight gain and other infant morbidity (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOMpercentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 <i>P</i> < 0.001 Gestational diabetes,%: NR Cesarean delivery,%: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery,%: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 , Aassisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: AOR for morbidity (95% CI) Groups: G1: GWG > 7 kg G2: GWG 11.5-16 kg G3: GWG >18 kg Results Seizure G1: 10.66 (2.17-52.36) G3: 6.19 (1.32-28.96) Polycythemia G1: 1.32 (0.66-2.62) G3: 1.59 (1.13-2.22) MAS (meconium aspiration syndrome)/ RDS (respiratory distress syndrome) or tachypnea G1: 1.93 (0.82-4.53) G3: 1.86 (1.13-3.05) RDS (respiratory distress syndrome) or tachypnea G1: 0.56 (0.29-1.06) G3: 1.04 (0.79-1.38) Hospital stay more than 5 days/ Hospital stay more than 10 days G1: 1.44 (1.02-2.04) G3: 1.07 (0.90-1.28) Hospital stay more than 10 days G1: 1.13 (0.51-2.53) G3: 1.22 (0.81-1.84) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 30. Gestational weight gain and infant BMI

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kramer et al., 1990</p> <p>Country and setting: Canada, university hospital</p> <p>Enrollment Period: 1980 to 1986</p> <p>Funding: National Health Research and Development Program, Health and Welfare Canada</p> <p>Study Objective: (1) Which maternal and fetal variables appear to have independent causal impacts on intrauterine growth? (2) For a given fetal growth status, which maternal and fetal variables affect proportionality?</p> <p>Time frame: 1980 to 1986</p> <p>Duration of the study: Entry in to prenatal care up to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 8,719</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 8715 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Live-born, singleton infants without evidence of congenital intrauterine infection, chromosomal anomalies, or other major malformations and for whom gestational age calculated from last normal menstrual period agreed within ± 7 days with an early second-trimester (usually 16 to 18 weeks) Ultrasonographic estimate based on fetal biparietal diameter <p>Exclusion criteria:</p> <ul style="list-style-type: none"> See above 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>G1: 57.8 kg (10.8) G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> They used prepregnancy wt and ht separately NR <p>Age (mean, yrs): G1: 28.6 (4.7) G2: NR</p> <p>Parity: G1: 0.72 (0.86) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: Cigarettes/d: G1: 3.2 (7.5) G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: Pg related HTN: G1: 7.7% G2: NR</p> <p>Additional characteristics: Education, y completed: G1: 13.0 (3.3) G2: NR</p> <p>Marital status: G1: 90.6% G2: NR</p> <p>Parity % primiparas: G1: 48.0 G2: NR</p>

Evidence Table 30. Gestational weight gain and infant BMI (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 8715 G2: NR Total weight gain: G1: 14.2kg (5.5) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery, using net weight gain (total weight minus wt of infant) 	Birth weight: G1: 3385g (547) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Bivariate associations between selected maternal and fetal variables and fetal growth and proportionality: Correlation coefficient for net gestational weight gain (kg) and fetal growth ratio = 0.12 ($P < 0.001$); for prepregnancy weight (kg) 0.21 ($P < 0.001$) Other infant outcomes: <ul style="list-style-type: none"> Correlation coefficients for Net prepregnancy weight gain (kg) and length = -0.04 ($P < 0.01$) Head circumference = -0.01 (NS); BMI 0.04 ($P < 0.001$); Ponderal index = 0.04 ($P < 0.001$) Weight/height circumference = 0.01 (NS) 	Outcomes Description: <ul style="list-style-type: none"> Infant BMI (kg/m^2) Groups: NA, net gestational weight (total weight gain minus weight of infant) as continuous variable Results: Correlation of net gestational weight gain with infant BMI $R=0.037$, $P<0.01$ Net gestational weight gain did not meet criterion threshold for stepwise regression Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NA Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NA 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 30. Gestational weight gain and infant BMI (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Vohr et. al, 1995 Country and setting: USA, hospital Enrollment period: Funding: National Institute of Child Health and Human Development Grant 2P50-HD11343 Study Objective: To determine effects of maternal factors, including prepregnancy maternal adiposity, weight gain during pregnancy, degree of abnormality of oral glucose tolerance test, glycemia during pregnancy, and treatment with insulin vs. diet therapy, on neonatal body weight, adiposity, and blood pressure on IGDM and control infants Time frame: NR Duration of the study: 21 months	Design: <ul style="list-style-type: none"> Case-control Prospective Total Study N: 262 Group Description: G1: Controls - LGA G2: Controls - AGA G3: GDM mothers- LGA G4: GDM mothers - AGA Group 5Group 6 Group N: G1: 74 G2: 69 G3: 57 G4: 62 Group 5Group 6 Inclusion criteria: <ul style="list-style-type: none"> GDM criteria based on screen at 24-28 weeks of gestation. Women were diagnosed with GDM if an initial 1-hour 50 - g glucose screen value > 130 mg/dl followed by two abnormal values in a 100-g oral glucose tolerance test. An equal number of infants were selected based on mother's GDM status and LGA/AGA status at birth. All mothers of LGA babies were recruited for participation, and both GDM and control mothers of AGA infants were approached at random Exclusion criteria: <ul style="list-style-type: none"> Infants with anomalies or requiring intensive care 	Pregravid weight: Self-reported G1: 67 kg (14) G2: 61 kg (12) G3: 71 kg (17) G4: 71 kg (18) Pregravid BMI: G1: 25 (5) G2: 23 (4) G3: 27 (6) G4: 28 (7) Imputed: No Categorized: Continuous Age (mean, yrs): G1: 29 (5) G2: 27 (6) G3: 30 (6) G4: 31 (5) Parity: NR	Race, %: Black G1: 5.7% of total study population Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR

Evidence Table 30. Gestational weight gain and infant BMI (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 74 G2: 69 G3: 57 G4: 62 Total weight gain: G1: 18 kg (7) <i>P</i> < 0.05 G2: 15 kg (6) G3: 15 kg (7) <i>P</i> < 0.05 G4: 11 kg (7) <i>P</i> < 0.05 Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Does not state Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> Infant BMI (kg/m²) Groups: Weight gain as a continuous variable for G1: GDM mothers G2: Control mothers Results: Estimates of 1-kg increase in gestational weight on infant BMI G1: 0.06, <i>P</i> =0.001 G2: 0.05, <i>P</i> =0.003 Correlation between weight gain and infant BMI overall: .022, <i>P</i> =0.01 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NR Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NR 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 31. Gestational weight gain and other infant growth characteristics

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Brown et al., 2002</p> <p>Country and setting: USA, primary care clinics</p> <p>Enrollment Period: 1989 to 1993</p> <p>Funding: NIH</p> <p>Study Objective: To identify effects of maternal weight change by trimester of pregnancy on weight, length, head circumference, and ponderal index (PI; in kg/m³) of newborns</p> <p>Time frame: 1989 - 1993</p> <p>Duration of the study: From preconception or entry into prenatal care through 6 to 8 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 389</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 389 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women aged 22-35 years enrolled in Group Health managed care organization Intended to become pg within enrollment period Had not been attempting pg for > 3 mo Had delivered last infant > 12 mo before enrollment Did not intend to use contraceptives during study Delivery of live, singleton infants Pg lasting > 241 days from conception <p>Exclusion criteria:</p> <ul style="list-style-type: none"> History of hypertension, renal disease, DM, heart disease, infertility No data on preconceptional weight and height within 6 months of conception or 2 weeks after conception Missing data on weight with 25 days of end of each trimester 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured by study investigators Weight was measured < 6 months before conception for 364 women by study investigators <p>G1: 61.2 ± 9.4 (50.7, 73.2) G2: NR</p> <p>Pregravid BMI: G1: 22.5 ± 3.2 (19.2, 26.9) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.4 ± 3.1 (25.3, 33.7) G2: NR</p> <p>Parity: G1: 0.5 ± 0.7 (0, 1) G2: NR</p>	<p>Race, %: White G1: 97 G2: NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 389 G2: NR</p> <p>Total weight gain: G1: 15.6 ± 4.1 (10.5–21.4)² G2: NR</p> <p>Categorized: <ul style="list-style-type: none"> Continuous </p> <p>Collected from: <ul style="list-style-type: none"> Collected by investigatorsRoutine pre-natal care or maternity records </p> <p>Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery </p>	<p>Birth weight: G1: 3575g ± 448 (3033–4167) G2: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NR</p> <p>Other infant outcomes: Although nonsignificant, a trend was noted that suggested, among women with lower preconception weight, an increased effect of first-trimester weight gain on weight of their newborns (51 kg preconception weight, 51 g/kg weight gain; 62 kg preconception weight, 62 g/kg weight gain)</p>	<p>Outcomes Description: <ul style="list-style-type: none"> Ponderal index, beta coefficients </p> <p>Groups: G1: Increase in Ponderal Index per 1 kg increase in first trimester weight gain G2: Increase in Ponderal Index per 1 kg increase in second trimester weight gain G3: Increase in Ponderal Index per 1 kg increase in third trimester weight gain</p> <p>Results: G1: $\beta = 0.21$ ($P < 0.0003$) G2: $\beta = 0.05$ PI ($P < 0.4$) G3: $\beta = 0.12$ ($P < 0.03$)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Mother's height </p> <p>Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Sex (female) </p>	<p>Background: Good</p> <p>Sample selection: Good</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Good</p> <p>Followup: Good</p> <p>Analysis comparability: Good</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Good</p> <p>Sum of Good/Fair/Poor: 8 Good, 1 Fair, 0 Poor</p> <p>Final Quality Score: Good</p>

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Ekblad and Grenman, 1992 Country and setting: Finland, hospital Enrollment Period: July 1, 1985 - December 31, 1985 (6 months) Funding: NR Study Objective: To evaluate effects of abnormal maternal weight or weight gain on pregnancy outcome Time frame: July 1, 1985 to December 31, 1985 (6 months) Duration of the study: Prepregnancy to delivery	Design: <ul style="list-style-type: none"> Cohort Combination: retrospective data from records, prospective weight and height at delivery Total Study N: Total n = 357 <ul style="list-style-type: none"> 191 women with abnormal prepregnant weight ($\geq 20\%$ under or over ideal weight for height) or abnormal pregnancy weight gain ($\geq 20\text{kg}$ or $\leq 5\text{kg}$) 166 controls Group Description: G1: $\geq 20\%$ over normal weight for height G2: $\geq 20\%$ under normal weight for height G3: weight gain $\leq 5\text{kg}$ G4: weight gain $\geq 20\text{kg}$ G5: control Group 6 Group N: G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Inclusion criteria: <ul style="list-style-type: none"> Birth at hospital within study period selected those with abnormal maternal prepregnancy weight or abnormal weight gain during pregnancy, as well as next mother in sequential order with normal prepregnancy weight and weight gain during pregnancy to serve as a control Exclusion criteria: <ul style="list-style-type: none"> Not stated 	Pregravid weight: <ul style="list-style-type: none"> Records - not stated if self reported G1: 83.9 (10.1) G2: 46.7 (3.4) G3: 73.1 (16.5) G4: 65.0 (12.2) G5: 58.3 (6.5) Pregravid BMI: G1: 39.5 (3.4) G2: 17.2 (0.9) G3: 26.1 (6.1) G4: 23.6 (4.1) G5: 21.6 (2.0) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous $\geq 20\%$ over or under normal weight for height Age (mean, yrs): G1: 28 (5.1) G2: 25.5 (5.1) G3: 29.5 (5.1) G4: 28.7 (4.7) G5: 28.7 (4.4) Parity: G1: prior deliveries: 1.0 (1.0) G2: 0.8 (0.8) G3: 1.2 (1.1) G4: 0.8 (1.0) G5: 0.9 (1.0)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 28 G3: 30 G4: 56 G5: 166 Total weight gain: G1: 11.8 (6.2) <i>P</i> < 0.05 compared to controls G2: 13.4 (4.5) G3: 3.0 (3.5) <i>P</i> < 0.0005 compared to controls G4: 23.2 (22.8) <i>P</i> < 0.0005 compared to controls G5: 13.2 (3.4) Categorized: • ≤ 5kg or ≥ 20kg Collected from: • Routine pre-natal care or maternity records Ascertained by: • Based on last clinically measured weight prior to delivery	Birth weight: G1: 3712 g (614) <i>P</i> < 0.05 compared to controls G2: 3293 (362) <i>P</i> < 0.05 compared to controls G3: 3284 (880) G4: 3803 (538) <i>P</i> < 0.005 compared to controls G5: 3538 (535) Gestational diabetes,%: NR Cesarean delivery,%: G1: Elective 7% Emergency 14% Total 21% G2: Elective 4% Emergency 4% Total 8% G3: Elective 3% Emergency 3% Total 6% G4: Elective 5% Emergency 18% Total 23% G5: Elective 13% Emergency 9% Total 22% Instrumental delivery,%: NR Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Mean symphysis-fundus height: Group: G1: weight gain ≤ 5kg G2: weight gain ≥ 20kg G3: control: 5-20 kg Results G1: 30.8 cm ± 4.0 G2: 32.8 cm ± 3.4 G3: 35.0 cm ± 3.9 Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Poor Definition of maternal weight gain: Poor Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Guihard-Costa et al., 2004</p> <p>Country and setting: France, hospital database</p> <p>Enrollment Period: 1980-1990</p> <p>Funding: NR</p> <p>Study Objective: To determine relative influences of maternal factors on infant skinfold thickness and other outcomes</p> <p>Time frame: 1980-1990</p> <p>Duration of the study: Pregnancy to birth</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 13,972</p> <p>Group Description:</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Liveborn singletons Term infants (37 to 41 weeks) Both parents born in France No maternal smoking during gestation All data available, specifically subscapular skinfold thickness French metropolitan mothers <p>Exclusion criteria:</p> <ul style="list-style-type: none"> French mothers born in French Caribbean Islands or outside of France 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from database 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Crown-heel length, head circumference, subscapular skinfold thickness Groups: NA, weight gain continuous variable, results reported in standardized coefficients (SC). SCs are regression coefficients calculated as if all of the independent variables had a variance of 1 Results: G1: SC for effect of MWG on crown-heel length G2: SC for effect of MWG on head circumference G3: SC for effect of MWG on subscapular skinfold thickness G1: SC 0.142 G2: SC 0.120 G3: SC 0.146 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI Height Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kirchengast and Hartmann, 2003</p> <p>Country and setting: Singleton births that took place at University Clinic for Gynecology and Obstetrics in Vienna, Austria</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: Examine impact of biological factors such as young maternal age and maternal somatic characteristics on pregnancy outcome among group of adolescent mothers who gave birth between 39th and 41st week of gestation after period of intensive psychological support</p> <p>Time frame: NR</p> <p>Duration of the study: 1985 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 8,011</p> <p>Group Description: G1: 12 to 16 years G2: 17 to 19 years G3: 20 to 29 years</p> <p>Group N: G1: 215 G2: 1,336 G3: 6,460</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women ages 12 to 29 All prenatal check-ups of mother-child passport were performed Delivery of single infant without congenital malformations Receiving psychosocial support by family and/or specially trained social worker within young adolescent group (12 to 16 years) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Coincident medical diseases such as diabetes mellitus or nephropathy Drug or alcohol abuse Twin birth IVF Registered maternal diseases before and during pregnancy Hypertension (BP < 150/90 mmHG) Protein or glucose in urine Pregnancy related immunization 	<p>Pregravid weight: Estimated by means of retrospective method and first weight determination, which was carried out at first prenatal visit (8th week of gestation)</p> <p>G1: 56.0 G2: 57.2 G3: 59.2</p> <p>Pregravid BMI: G1: 21.45 G2: 21.59 G3: 22.10</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 14.5 G2: 17.8 G3: 24.1</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Age at menarche: G1: 12.2 G2: 12.9 G3: 13.3 Gynecological age: G1: 3.4 G2: 5.3 G3: 10.8</p>

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 215 G2: 1,336 G3: 6,460 Total weight gain: G1: 13.1 G2: 13.1 G3: 13.1 (P = .10) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3237.6 (significantly different from 17-19 and 20-29) G2: 3298.3 (significantly different from < 17 and 20-29) G3: 3368.9 (significantly different from < 17 and 17-19) (F = 24.1, P < .0001) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Chronological age Age at menarche Gynecological age Height Distancia spinarum Distancia chrstarum Prepregnancy weight Weight at end of pregnancy Other infant outcomes <ul style="list-style-type: none"> Birth length Head circumference Acromial circumference Diameter frontooccipitale 	Outcomes Description: Change in infant size characteristics per 1 kg increase in MWG Groups NA, weight gain as continuous variable Results G1: Birth length (cm) G2: Head circumference (cm) G3: Acromial circumference (cm) G4: Diameter frontooccipitalis (cm) G1: $\beta = 0.55$ (0.43-0.68) G2: $\beta = 0.33$ (0.23-0.42) G3: $\beta = 0.47$ (0.39-0.55) G4: $\beta = 0.12$ (0.07-0.18) Maternal confounders and effect modifiers accounted for in analysis: Maternal age, age at menarche, pregravid weight, height, distantia cristarum Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kramer et al., 1990</p> <p>Country and setting: Canada, university hospital</p> <p>Enrollment Period: 1980 to 1986</p> <p>Funding: National Health Research and Development Program, Health and Welfare Canada</p> <p>Study Objective: (1) Which maternal and fetal variables appear to have independent causal impacts on intrauterine growth? (2) For a given fetal growth status, which maternal and fetal variables affect proportionality?</p> <p>Time frame: 1980 to 1986</p> <p>Duration of the study: Entry in to prenatal care up to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 8,719</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 8715 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Live-born, singleton infants without evidence of congenital intrauterine infection, chromosomal anomalies, or other major malformations and for whom gestational age calculated from last normal menstrual period agreed within ± 7 days with an early second-trimester (usually 16 to 18 weeks) Ultrasonographic estimate based on fetal biparietal diameter <p>Exclusion criteria:</p> <ul style="list-style-type: none"> See above 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>G1: 57.8 kg (10.8) G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> They used prepregnancy wt and ht separately NR <p>Age (mean, yrs): G1: 28.6 (4.7) G2: NR</p> <p>Parity: G1: 0.72 (0.86) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: Cigarettes/d: G1: 3.2 (7.5) G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: Pg related HTN: G1: 7.7% G2: NR</p> <p>Additional characteristics: Education, y completed: G1: 13.0 (3.3) G2: NR</p> <p>Marital status: G1: 90.6% G2: NR</p> <p>Parity % primiparas: G1: 48.0 G2: NR</p>

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 8715 G2: NR Total weight gain: G1: 14.2kg (5.5) G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery, using net weight gain (total weight minus wt of infant) 	Birth weight: G1: 3385g (547) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Bivariate associations between selected maternal and fetal variables and fetal growth and proportionality: Correlation coefficient for net gestational weight gain (kg) and fetal growth ratio = 0.12 ($P < 0.001$); for prepregnancy weight (kg) 0.21 ($P < 0.001$) Other infant outcomes: <ul style="list-style-type: none"> Correlation coefficients for Net prepregnancy weight gain (kg) and length = -0.04 ($P < 0.01$) Head circumference = -0.01 (NS); BMI 0.04 ($P < 0.001$); Ponderal index = 0.04 ($P < 0.001$) Weight/height circumference = 0.01 (NS) 	Outcomes Description: Length, head circumference, BMI, Ponderal Index, weight/head circumference Groups: NA, weight gain continuous variable Results: Correlation coefficients between MWG and: G1: Length G2: Head circumference G3: BMI G4: Ponderal Index G5: Weight/Head circumference G1: -0.04 ($P < 0.01$) G2: -0.01 ($P < 0.01$) G3: 0.04 ($P < 0.01$) G4: 0.04 ($P < 0.01$) G5: 0.01 Net gestational weight gain was associated with correlation coefficients of -0.04 for length, -0.01 for head circumference, 0.04 for BMI, 0.04 for Ponderal Index, and 0.01 for weight/head circumference. Results were significant ($P < 0.01$) for length, BMI, and Ponderal Index Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity GDM Pregnancy induced hypertension Obesity (How defined or categorized?) previous lbw, Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Birth weight Sex of the infant 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Shepard et al., 1996</p> <p>Country and setting: Norway and Sweden, multicenter study</p> <p>Enrollment Period: January 1, 1986 to March 31, 1988</p> <p>Funding: NICHD</p> <p>Study Objective: To examine impact of BMI, proportional weight gain, and other variables on fetal growth</p> <p>Time frame: January 1, 1986 to March 31, 1988</p> <p>Duration of the study: Early pregnancy (before 17 wks gestation) through 37 wks gestation</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: Retrospective records for pregravid weight, prospective for fetal growth <p>Total Study N: 369</p> <p>Group Description: G1: Low BMI, ≤ 19.9 G2: Average BMI, 20-23.3 G3: High BMI, > 23.3</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Random 10% sample of NICHD SGA study cohort (n = 571) of women with data on prepregnant weight and weight gain and ultrasound measurements <p>Exclusion criteria: NR</p>	<p>Pregravid weight:</p> <ul style="list-style-type: none"> records <p>G1: 53.1 (0.6) G2: 59.8 (0.5) G3: 72.3 (0.7) $P = 0.0001$</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Quetelet's Index: ≤ 19.9; 20-23.3; > 23.3 <p>Age (mean, yrs): G1: 29.1 (0.3) G2: 29.9 (0.4) G3: 30.0 (0.4) $P = 0.14$</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: # daily cigarette, 17 weeks: 3.7 (0.5) G2: 2.5 (0.4) G3: 3.3 (0.1) $P = 0.17$</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 31. Gestational weight gain and other infant growth characteristics (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: Overall proportional weight gain (%): 23.1 G2: 20.3 G3: 16.7 $P = 0.0001$ Categorized: <ul style="list-style-type: none"> Measured at 3 study time periods - expressed as a proportion of prepregnant weight gained during that time Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Overall proportional weight gain 	Birth weight: G1: 3517.1 (50.9) G2: 3677.9 (37.5) G3: 3837.1 (52.0) $P = 0.0001$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Estimates of fetal growth rate in 3 time periods, model for weeks 17 to 25 adjusted for maternal BMI; model for weeks 25 to 33 adjusted for maternal BMI, maternal age, previous SGA, and male infant; model for 33-37 weeks adjusted for maternal BMI and female infant Groups: NA, continuous weight gain measure Results: Increase in mean abdominal fetal growth rate (mm/day) per 5% increase in proportional weight gain in this period: <ul style="list-style-type: none"> Weeks 17-25, $\beta = 0.35$ ($P = 0.49$) Weeks 25-33, $\beta = 0.88$ ($P = 0.02$) Weeks 33-37, $\beta = 1.53$ ($P = 0.02$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pre-gravid BMI Previous SGA Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 32. Gestational weight gain and childhood weight status

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Li, 2007</p> <p>Country and setting: USA, national survey</p> <p>Enrollment Period: 1959 to 1966</p> <p>Funding: NR</p> <p>Study Objective: To evaluate developmental trajectories of overweight in children and assess early life influences</p> <p>Time frame: 1986 to 2000</p> <p>Duration of the study: 20 years</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1739</p> <p>Group Description: G1: Early overweight G2: Late overweight G3: Never overweight</p> <p>Group N: G1: 10.9% G2: 5.2% G3: 83.9%</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Data from National Longitudinal Survey of Youth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Mother reported high blood pressure or diabetes, gestational week less than 28 weeks or birthweight less than < 0.5 or equal or more than 6 kg. 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> < 25, 25-29, > 29 <p>Age (mean, yrs): Age at birth <25: 40.9%% 25 to 29: 50.5% 30 or more: 8.6%</p> <p>Parity: Birth order 1: 41.1% 2: 36.9% 3 or more: 22.0%</p>	<p>Race, %: White 77.8 Black 15.3 Hispanic 6.9</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NA</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: <ul style="list-style-type: none"> NR 	Birth weight: <2500 : 3.5% 2500-3999: 81.6% 4000 or more: 12.9% Gestational diabetes, %: 0% Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Overweight status for children for upto 12 years Groups: Maternal weight gain categories (kg): G1: < 15 lbs G2: 15-24 lbs G3: 25-34 lbs G4: 35-44 lbs G5: > 45 lbs Results: AOR (95% CI) for early onset overweight (early onset of overweight that persisted throughout childhood) compared with normal (low probability of overweight throughout childhood and was characterized as the never overweight class) G5: 1.7 (1.0-2.9) G3: 1.0 (reference) Other AOR for weight gain categories for early onset overweight not significant compared with weight gain 25-34 lbs No association between maternal weight gain and risk of late onset overweight (moderately high probability of overweight at age 2 years, low probability of overweight at age 4 and 6 years, but growing probability of overweight after age 8 years) Maternal confounders and effect modifiers accounted for in analysis: Breastfeeding Education Time between last pregnancy weight and delivery Household income Marital status Paternal BMI Smoking Infant and child confounders and effect modifiers accounted for in analysis: Birth length Sex Child diet Child television viewing	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Oken et al., 2007</p> <p>Country and setting: Reported elsewhere</p> <p>Enrollment period: NR</p> <p>Funding: Supported by grants from US National Institutes of Health (HD 34568, HL 64925, HL68041, HD 44807), the Robert Wood Johnson Foundation, Harvard Medical School, and Harvard Pilgrim Health Care Foundation</p> <p>Study Objective: Purpose of study to examine associations of gestational weight gain with child adiposity</p> <p>Time frame: NR</p> <p>Duration of the study: Entry to prenatal care thru delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1,044</p> <p>Group Description: G1: Total</p> <p>Group N: G1: 1,044</p> <p>Inclusion criteria: Women delivering live singleton infant and enrolled for continuation of study beyond 6 months after delivery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing information on prepregnancy weight, parental BMI, or infant birthweight, or who did not have a weight recorded within 4 weeks preceding delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 24.6 (SD 5.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 15-24: 6% 25-34: 62% 35-44: 32%</p> <p>Parity: G1: Nulliparous: 48% Parous: 52%</p>	<p>Race, %: White G1: 74%</p> <p>Black G1: 11%</p> <p>Hispanic G1: 6%</p> <p>Other G1: 10%</p> <p>Smoking, %: G1: Never: 67% Quit before pregnancy 20% Smoked in early pregnancy 10%</p> <p>Diabetes mellitus, %: G1: 4%</p>

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: <ul style="list-style-type: none"> Association of MWG with child adiposity-related outcomes at age 3 years, before and after adjustment for potential confounding and pathway variables. Effect increments are for a 5 kg increment in total weight gain. 	Background: Good
Total weight gain: G1: 15.6 kg (5.4)	Gestational diabetes, %: G1: 4%		Sample selection: Fair
Categorized: <ul style="list-style-type: none"> Continuous According to IOM 	Cesarean delivery, %: G1: 23% G2: 12% G3: 35% G4: 53%		Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 		Groups: MWG for 5 kg increments	Definition of outcomes: Good
Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Instrumental delivery, %: NR	Results: AOR (95%CI) BMI \geq 95th percentile vs BMI<50th percentile associated with a 5 kg increase in gestational weight gain: 1.52 (1.19-1.94)	Source of information on exposure, outcomes, and confounders: Good
	Episiotomy, %: NR		Followup: Fair
	Other maternal outcomes: NR	Child BMI z-score at age 3 years for AOR listed above (95% CI): 0.11 (0.05, 0.17)	Analysis comparability: Fair
	Other infant outcomes: NR	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Breastfeeding Education Time between last pregnancy weight and delivery Household income Marital status Paternal BMI Smoking 	Analysis of outcomes: Fair
		Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Birth length Sex Child diet Child television viewing 	Interpretation: Good
			Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor
			Final Quality Score: Fair

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ong et al., 2000</p> <p>Country and setting: UK, Avon longitudinal study of pregnancy and childhood</p> <p>Enrollment Period: Births from April 1991-December 1992 followed to age 5 years</p> <p>Funding: Medical Research Council, Wellcome Trust, Department of Health, Department of the Environment</p> <p>Study Objective: To identify predictors of postnatal catch up growth from birth to 2 years and its relation to size and obesity at 5 years</p> <p>Time frame: Births from April 1991-December 1992 followed to age 5 years</p> <p>Duration of the study: Birth to 5 years, maternal data collected retrospectively</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: Maternal data retrospective, infant prospective <p>Total Study N: 848</p> <p>Group Description:</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 10% sample of births in longitudinal study cohort with information on weight measurements <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Obstetric records, not stated whether it was self reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: obstetric records - not stated 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Catch-up and catch-down growth Groups: Maternal weight gain, continuous measure Result: Children were grouped into three growth categories (catch-up, no change, and catch-down) based on a gain in weight (SD score > 0.67 for catch-up; SD score < 0.67 for catch-down). Maternal weight gain was not a significant predictor of catch-up growth between 0 and 2 years Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 7 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Sowan and Stember, 2000 Country and setting: USA, sample from Infant Growth Study Database Enrollment Period: NR Funding: AAUW, NRSA, NIH, NINR Study Objective: To facilitate an understanding of influence of parental characteristics on development of infant obesity Time frame: NR Duration of the study: Birth through 15 months postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 630 Group Description: NR Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Normal infant at birth (i.e. no organic etiology) Mother able to communicate in English Exclusion criteria: <ul style="list-style-type: none"> Infants weighing less than 2500g at birth Preterm infants (< 37 weeks) 	Pregavid weight: <ul style="list-style-type: none"> Self-reported Pregavid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 32. Gestational weight gain and childhood weight status (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous, 5 pound increments Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Infant obesity (BMI > gender and age specific 84th percentile based on Infant Growth Study population) Groups: Maternal weight gain in 5 pound increments Results: Model AOR (95%CI) for infant obesity (BMI > gender and age specific 84 th percentile based on Infant Growth Study population norms) at 1, 4, 7, and 10 months: NS AOR (95%CI) for obesity at 14 months: .8 (0.7-1.0) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Pre-gravid BMI Marital status Psychosocial factors Sociocultural factors Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Infant gender Birth BMI BMI at previous month 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 33. Gestational weight gain and childhood hospitalization

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Yuan et al., 2001</p> <p>Country and setting: Denmark, birth cohort from midwife centers</p> <p>Enrollment Period: April 1984 to April 1987</p> <p>Funding: Grant from Medical Research Council</p> <p>Study Objective: To examine whether maternal prenatal lifestyle factors were associated with risk of hospitalization with infectious disease during early childhood and whether a possible association was modified by fetal growth reduction</p> <p>Time frame: April 1984 to April 1987</p> <p>Duration of the study: Prenatal period through early childhood (6 to 12 yrs)</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 10,440</p> <p>Group Description: G1: Cohort G2: NR</p> <p>Group N: G1: 10,400 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Children born to mothers attending midwife centers at approximately 36th week gestation in 2 study areas in Denmark <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Stillbirths Multiple births Children with congenital malformations 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported, may be from hospital records - not specifically stated <p>Pregravid BMI: G1: < 18: 5.8%; 18-20: 42.8%; 21-23: 33.5%; ≥ 24: 17.9% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> < 18, 18-20, 21-23, > 24 <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 44.3 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 33. Gestational weight gain and childhood hospitalization (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 7550 G2: NR Total weight gain: G1: < 10kg: 19.1%; 10-12: 24.6%; 13-15: 26.0%; ≥ 16: 30.3% G2: NR Categorized: <ul style="list-style-type: none"> < 10, 10-12, 13-15, ≥ 16 kg Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> Adjusted incidence rate ratio (IRR) of hospitalization with infectious disease (95% CI) Groups: G1: < 13kg G2: ≥ 13kg Results: G1: 1.05 (0.76-1.47) G2: 1.42 (1.09-1.86) All gestational weight gain 1.29 (1.05-1.59) Stratification of analyses by either prepregnancy BMI or gestational weight gain did not show any difference in associations between maternal smoking, alcohol, tea, and fruit intake and hospitalization with infectious disease (of child from 6 months to 12 years) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Paternal age Social group Maternal cohabitation status Number of siblings at birth for infant Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 3 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 34. Gestational weight gain and postpartum weight retention

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Callaway et al., 2007</p> <p>Country and setting: Australia, hospital</p> <p>Enrollment period: Received antenatal care between 1981 and 1984, then followed 21 years later</p> <p>Funding: Authors thank National Health and Medical Research Council and Queensland Health for funding this project. L. K. C. was supported by a National Health and Medical Research Council Postgraduate Medical Scholarship at commencement of this work. D. A. L. is funded by a United Kingdom Department of Health Career Scientist Award</p> <p>Study Objective: To assess changes in body mass index (BMI; weight (kg)/height (m)²) over time in women with and without HDP</p> <p>Time frame: Received antenatal care between 1981 and 1984, then followed 21 years later</p> <p>Duration of the study: From prepregnancy to 21 years after index pregnancy</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 3,572</p> <p>Group Description: G1: Included G2: Excluded G3: <i>P</i> value</p> <p>Group N: G1: 3,572 G2: 3,651</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women delivered live singleton baby, who neither died nor was adopted prior to leaving hospital, and completed both initial phases of data collection <p>Exclusion criteria: NR</p>	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Correlated with first prenatal visit weight $r = 0.95$ <p>Pregravid BMI: G1: 21.9 (3.8) G2: 22.0 (4.1) G3: 0.1</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 25.0 (5.1) G2: 24.1 (5.2) G3: < 0.001</p> <p>Parity: G1: nulliparous 35.7% G2: nulliparous 30.8% G3: < 0.001</p>	<p>Race, %: White G1: 94.9% G2: 89.8% G3: < 0.001</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: G1: 46.9% G2: 53.0% G3: < 0.001</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 3,572 G2: 3,651 Total weight gain: G1: 14.8 (6.03? vs 14.6) G2: 14.9 (14.7) G3: 0.3 Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: NR	Birth weight: G1: 3,388 (518) G2: 3,382 (523) G3: 0.7 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Univariable association of MWG with mean change in BMI over 21 years: MWG < = 15: 5.06 (4.85, 5.27), MWG >15: 6.4 (6.19, 6.61) < 0.001. Women with HDP gained on average 2.01 kg (95% CI, 1.41 kg, 2.61 kg) more than women without HDP Other infant outcomes: NR	Outcomes Description: Postpartum weight retention Groups G1: Maternal weight gain <=15kg G2: Maternal weight gain >15kg Results G1: Mean change (95%CI) in BMI at 21 years postpartum: 5.06 kg/m ² (4.85-5.27) G2: Mean change (95%CI) in BMI at 21 years postpartum: 6.40 kg/m ² (6.19-6.61) <i>P</i> < 0.001 G2 was associated with a mean change in BMI over 21 years of 0.19 kg/m ² (95%CI: 0.16-0.22) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Baseline income Secondary school completion Ethnicity Maternal age at birth Parity Birth weight Gestational age Infant sex Maternal smoking during pregnancy Smoking at 21 years Sedentary lifestyle at 21 years Baseline maternal BMI Hypertensive disorders during pregnancy Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Infant sex 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 1 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Harris et al., 1999</p> <p>Country and setting: UK, antenatal care project</p> <p>Enrollment Period: Not stated</p> <p>Funding: DevR fund of University of Greenwich; NHS Executive, South Thames</p> <p>Study Objective: To assess relative importance of heritable characteristics and lifestyle in development of maternal obesity after pregnancy</p> <p>Time frame: Not stated</p> <p>Duration of the study: First antenatal visit to 2.5 years post delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 74</p> <p>Group Description:</p> <p>G1: Women with long-term weight gains < 0.4kg</p> <p>G2: Women with long-term weight gains > 0.4kg</p> <p>G3: Total sample</p> <p>Group N:</p> <p>G1: 37</p> <p>G2: 37</p> <p>G3: 74</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who had been enrolled in Antenatal Care Project who had been weighed during first trimester of pregnancy and had not become pregnant since birth of child carried during ANC project <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with missing data 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured during first trimester of pregnancy at prenatal visit <p>G1: NR</p> <p>G2: NR</p> <p>G3: 66.23 (1.25)</p> <p>Pregravid BMI:</p> <p>G1: 25.0 (0.6)</p> <p>G2: 24.2 (0.7)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs):</p> <p>G1: 33.4 (0.8)</p> <p>G2: 33.7 (0.8)</p> <p>G3: 33.54 (0.56)</p> <p>Parity:</p> <p>G1: NR</p> <p>G2: NR</p> <p>G3: % nulliparous: 37.8</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %:</p> <p>G1: % continual smokers: 18.9</p> <p>G2: % continual smokers: 18.9</p> <p>G3: % smokers at first antenatal visit: 43.2</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics:</p> <p>G1: % married: 54.1</p> <p>G2: 56.8</p> <p>G3: 55.4</p> <p>Additional characteristics:</p> <p>G1: Duration of followup (days): 1141.2 (20.0)</p> <p>G2: 1181.8 (20.6)</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 37 G2: 37 G3: 74 Total weight gain: G1: 13.14 (1.07) kg G2: 12.73 (0.82) G3: 12.93 (0.67) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Mean long term weight gain in association with pregnancy was 0.50 (0.71)kg, overall the mothers in sample not significantly heavier after pregnancy than were before (95%CI: -0.89-1.89); however, these long term weight gains were very variable ranging from 13.6kg in weight loss to 17.7 kg in weight gain Other infant outcomes: NR	Outcomes Description: Postpartum weight retention Groups Continuous maternal weight gain, kg Results ANCOVA model with weight (kg) at 2.5 years postpartum as dependent variable and maternal weight gain (kg) as independent variable: $B = -0.031$ $\beta = -0.029$ $SEM = 0.120$ $P = 0.796$ Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Marital status Increased dissatisfaction with body Increased access to food increased energy intake Decreased activity Smoking status Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Harris et al., 1997</p> <p>Country and setting: UK, city hospital</p> <p>Enrollment Period: 1992-1993</p> <p>Funding: DevR fund of University of Greenwich</p> <p>Study Objective: Investigated independent associations between parity and maternal body mass index and between parity and maternal weight gain</p> <p>Time frame: 1992 to 1993</p> <p>Duration of the study: Previous pregnancy through current pregnancy and birth</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,637 (523 included and 694 excluded)</p> <p>Group Description: G1: Included women G2: Excluded women</p> <p>Group N: G1: 523 G2: 694</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who had singleton births at hospital between 1992 and 1993 with obstetric notes available for their previous pregnancy Women who were weighed regularly during pregnancy Parity of 1,2,3,4 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Pre-existing hypertension or diabetes (n = 3) Parity 5 (n = 2) or parity 6 (n = 2) 1992/1993 pregnancy began less than 12 months after birth of their previous child (n = 243) Missing data for 1 or more variables (n = 444) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Abstracted from each mother's obstetric notes <p>Pregravid BMI: G1: 23.45 (0.17) G2: 23.59 (0.18)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 29.6 (0.2) G2: 28.9 (0.2)</p> <p>Parity: G1: % parity = 1: 73.4% G2: 54.5%</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 22.4 G2: 27.0</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: G1: 0 G2: 0</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 523 G2: 694</p> <p>Total weight gain: G1: Rate of weight gain: 0.47 (0.01) G2: 0.44 (0.1)</p> <p>Categorized: <ul style="list-style-type: none"> Continuous </p> <p>Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records </p> <p>Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: based on difference between first antenatal weight measurement and last antenatal measurement usually recorded within 1 week of delivery </p>	<p>Birth weight: G1: 3384.1 (21.2) G2: 3338.8 (20.2)</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NA</p> <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Postpartum weight retention</p> <p>Groups G1: Maternal weight gain during previous pregnancy(kg), continuous G2: Interpregnancy weight change (kg), defined as the difference between weight at start of index pregnancy and weight at start of previous pregnancy</p> <p>Results ANCOVA model with G2 as dependent variable and G1 as independent variable: $B = 0.262$ $\beta = 0.227$, $SEM = 0.52$ $P < 0.001$</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Marital status Smoking status Alcohol Parity Age Socioeconomic status Nulliparous BMI Birth weight Gestational age at start of previous pregnancy Gestational age at start of index pregnancy Gestational age at start of first pregnancy Interpregnancy interval <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Gestational age 	<p>Background: Poor</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Good</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Harris et al., 1997</p> <p>Country and setting: UK, hospital</p> <p>Enrollment Period: 1990-1993</p> <p>Funding: DevR Fund of University of Greenwich</p> <p>Study Objective: To investigate impact of pregnancy on long term weight gain of primiparous mothers and to identify potential risk factors for maternal obesity</p> <p>Time frame: 1990 to 1993</p> <p>Duration of the study: Initiation of prenatal care during first pregnancy to beginning of second pregnancy</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 243</p> <p>Group Description: G1: Mothers included in study G2: Mothers excluded from study</p> <p>Group N: G1: 243 G2: 2,154</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton births Multiparous women with 2 consecutive births at hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Incomplete obstetric records for 1 or more previous pregnancy (n = 863) Not weighed regularly during both first and second pregnancies (n = 247) Missing first trimester measurements of body weight in both pregnancies (n = 2,077) Women who became pregnant with second child less than 12 months after birth of first child (n = 69) Missing data on key variables (n = 8) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Used weight measurements recorded during first trimester of pregnancy (up to 13 weeks gestation) <p>Pregravid BMI: G1: 24.2 (0.5) G2: 23.5 (0.1)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 26.2 (0.4) G2: 24.5 (0.1)</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: Nonsmoker: 76.6% G2: Nonsmoker: 70.0%</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: G1: PIH: 23.4% G2: 24.5%</p> <p>Additional characteristics: Married: G1: 79.8% G2: 66.9%</p> <p>Left hospital breast feeding: G1: 59.1% G2: 53.4%</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 243 G2: 2154 Total weight gain: G1: rate of weight gain (kg/week): 0.48 (0.01) G2: 0.48 (0.01) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3.3338 (0.0533) G2: 3.2886 (0.017) Gestational diabetes, %: NR Cesarean delivery, %: G1: 18.1 G2: 14.1 Instrumental delivery, %: Assisted Non-Cesarean: G1: 13.8% G2: 13.3% Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> Examining change in maternal body weight from beginning of first pregnancy to beginning of second pregnancy (interpregnancy weight change) and gestational weight gain during first pregnancy Other infant outcomes: NA	Outcomes Description: Postpartum weight retention Groups G1: Maternal weight gain during first pregnancy as a continuous measure (kg) G2: Interpregnancy weight change (kg), defined as the difference between weight at start of first pregnancy and weight at start of the second pregnancy Results ANCOVA model with G2 as dependent variable and G1 as independent variable: $B = 0.176$ $\beta = 0.169$ $SEM = 0.070$ $P < 0.013$ Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Marital status Lactation Smoking status Alcohol Height Nulliparous BMI Birth weight Gestational age at start of previous pregnancy Terminations between pregnancy Interpregnancy interval Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hunt et al., 1995</p> <p>Country and setting: USA, 2 separate sources: population-based family history database and participation in a study on obesity</p> <p>Enrollment Period: 1991-1992</p> <p>Funding: NIH grant DK44655</p> <p>Study Objective: To examine impact of pregnancy during weight gain on later weight status in morbidly obese women; i.e. to study role of pregnancy in development of obesity</p> <p>Time frame: 1991 to 1992</p> <p>Duration of the study: Beginning of first pregnancy up to time of study recruitment (includes multiple pregnancies per woman)</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: Controls = 115 Morbidly obese = 96</p> <p>Group Description: G1: Morbidly obese G2: Random control</p> <p>Group N: G1: 96 G2: 115</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with 1 or more pregnancies Ages 30-59 Living in Utah <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Morbidly obese women were excluded if more than 13.6 kg over ideal weight between ages 20 and 24 or prior to first pregnancy occurring before age 20 Controls were excluded if not less than 13.6kg over ideal weight at ages 20-24 or prior to first pregnancy occurring before age 20 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported validated by hospital records <p>G1: at ages 20-24: 64.4 (9.0) G2: at ages 20-24: 55.8 (7.0)</p> <p>Pregravid BMI: G1: at ages 20-24: 23.3 (2.9) G2: at ages 20-24: 20.6 (2.2)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NR <p>Age (mean, yrs): G1: 48.1 (8.6) G2: 44.0 (5.2)</p> <p>Parity: G1: Number of pregnancies: 4.2 (2.0) G2: Number of pregnancies: 4.3 (1.8)</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Weight at 6 weeks after last delivery (kg): G1: 90.8 (18.8) G2: 65.0 (12.9)</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Other - please define Collected from: <ul style="list-style-type: none"> not collected Ascertained by: <ul style="list-style-type: none"> Self-reported/validated by hospital records 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Postpartum weight retention Groups G1: Population-based sample G2: Morbidly obese women who were normal weight at age 20-24 years or prior to first pregnancy Results Regression of current weight on total number of pregnancies showed a 1.3kg/pregnancy increase in current weight ($P = 0.03$) with no difference between G1 and G2 ($P = 0.60$) Maternal weight gain was significantly greater in G2 than G1 for the first pregnancy only ($P < 0.05$) G2 had a net weight retention after the first pregnancy of 4.0 kg greater than G1 at 6 weeks postpartum G2 averaged 1.6 kg/pregnancy greater weight retention than G1 for additional pregnancies Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Weight at ages 20 to 24 Current age Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Linne et al., 2004</p> <p>Country and setting: Sweden, Stockholm Pregnancy and Weight Development study</p> <p>Enrollment Period: 1 and 15 year followup of women recruited in 1984-85</p> <p>Funding: NR</p> <p>Study Objective: Aim of this study was to evaluate how well prepregnancy BMI, gestational weight gain, and postpartum weight retention predict retention of weight 15 years later among parous women</p> <p>Time frame: 1 and 15 year followup of women recruited in 1984 to 1985</p> <p>Duration of the study: 15 years</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 563</p> <p>Group Description:</p> <p>G1: Total</p> <p>G2: Normal weight group (BMI < 25)</p> <p>G3: Overweight group (> 25)</p> <p>G4: Low weight gain < 12kg</p> <p>G5: Intermediate weight gain 12-15.6kg</p> <p>G6: High weight gain > 15.6kg</p> <p>Group N:</p> <p>G1: 563</p> <p>G2: 514</p> <p>G3: 45</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Participants in Stockholm Pregnancy and Weight Development study in 1984 and 1985 who agreed to participate in 15 year follow up study <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Death or moving abroad BMI = 47 1 woman who had her first child at age 49 	<p>Pregravid weight:</p> <p>NR</p> <p>G1: 59.8 (7.9)</p> <p>G2: 58.5 (6.3) kg,</p> <p>G3: 74.4 (7.6) kg</p> <p>G4: 58.3 (7.8)</p> <p>G5: 59.4 (7.7)</p> <p>G6: 61.8 (7.7) $P < 0.001$</p> <p>Pregravid BMI:</p> <p>G1: 21.5 (2.4) kg/m²</p> <p>G2: 21.0 (1.7)kg/m²,</p> <p>G3: 26.3 (1.1)</p> <p>G4: 21.4 (2.7)</p> <p>G5: 21.2 (2.1)</p> <p>G6: 21.9 (2.4)$P < 0.05$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%:</p> <p>G1: 25%</p> <p>G2: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics:</p> <p>G1: diet advice 61%</p> <p>G2: NR</p> <p>G3:</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: NR G2: NR</p> <p>Total weight gain: G1: NR G2: 9.8 (1.9) G3: 14.0 (0.9) G4: 18.8 (2.3) $P < 0.001$</p> <p>G5: At 12 months, gained 1.1 +/- 0.4 kg from prepregnancy weight G6: At 12 months, gained 1.2 +/- 0.5 kg $P = 0.64$</p> <p>Categorized:</p> <ul style="list-style-type: none"> Tertiles based on weight gain during pregnancy and defined as low weight gain (< 12.0 kg), intermediate weight gain (between 12 and 15.6 kg), and high weight gain (> 15.6 kg) <p>Collected from:</p> <ul style="list-style-type: none"> Collected by study investigators details of initial SPAWN study methods NR here <p>Ascertained by:</p> <ul style="list-style-type: none"> NR 	<p>Birth weight: G1: NR G2: 3,269 (509) G3: 3,507 (482) G4: 3,628 (492) $P < 0.001$</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <ul style="list-style-type: none"> At 15-year follow-up, overweight women had a mean waist circumference of 81 +/- 9.3 cm, and normal weight women had a mean waist circumference of 77 +/- 9.1 cm ($P = 0.73$). Hip circumference was 101.1 +/- 8.4 cm in overweight women and 98 +/- 8.5 cm in normal weight women ($P = 0.28$). At 6 months postpartum, normal weight women had retained 1.4 +/- 3.1 kg from prepregnancy weight, and overweight women had retained 2.0 +/- 6.7 kg ($P < 0.40$). 	<p>Outcomes Description: Postpartum weight retention</p> <p>Groups Maternal weight gain was used a continuous measure (kg):</p> <p>Results G1: Pregravid BMI ≤ 25 G2: Pregravid BMI > 25 G2 had significantly greater weights at prepregnancy, delivery, 1 year postpartum, and 15 years postpartum compared to G1 ($P < 0.001$); however, G2 did not have a higher risk of postpartum retention than G1</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Alcohol use Smoking Number of pregnancies since index child Employment area <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Linne et al., 2004
(continued)

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<ul style="list-style-type: none"> At 15-year follow-up, weight increase from before pregnancy was 7.7 +/- 7.0 kg in normal weight women and 6.2 +/- 12.1 kg in overweight women ($P = 0.36$). A multiple regression was performed to predict weight at 15-year follow-up. It is evident that weight before pregnancy and weight at 1 year were most strongly correlated with body weight at 15-year follow-up. Multiple regression (using an enter model) showed that these variables explained 58.1% of variation in body weight at 15-year follow-up [$F(3.499) = 232.87, P < 0.001$]. Weight at 1 year had largest (Beta) (0.782), which was most important predictor of body weight at 15-year follow-up ($t = 24.38, P < 0.001$) 		
	<p>Other infant outcomes: NR</p>		

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Linne et al., 2003</p> <p>Country and setting: Stockholm, Pregnancy and Women's Nutrition study</p> <p>Enrollment Period: 15 year follow-up of women who delivered infants in 1984-85</p> <p>Funding: NR</p> <p>Study Objective: To investigate women who participated in Stockholm Pregnancy Weight Development study 15 years later, focusing on women whose weight trajectories changed after their pregnancies and in particular those women who were normal weight (BMI \leq 25) before</p> <p>Time frame: 15 year follow-up of women who delivered infants in 1984 to 1985</p> <p>Duration of the study: Questionnaires administered at 2.5, 6, and 12 months and at 15 years postpartum (initial questionnaires given to women who delivered children in 1984 to 1985)</p>	<p>Design:</p> <ul style="list-style-type: none"> • Cross-sectional • Combination: retrospective for factors occurring prior to/during pregnancy and prospective for weight gain following pregnancy <p>Total Study N: 563</p> <p>Group Description:</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> • Women who took part in Stockholm Pregnancy and Weight Development Study, 1984 to 1985 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> • BMI > 47 (n = 1) • First child at age 49 (n = 1) • Women who were overweight at both time points (prepreg and 15y followup) (n = 33) and women who were overweight and who lost weight and regained a BMI in normal range at 15y (n = 10) were excluded from analysis 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> • Routine pre-natal care • Maternity records from original study <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> • No <p>Categorized:</p> <ul style="list-style-type: none"> • Continuous <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Postpartum weight retention Groups G1: Women with normal BMI (20-25) at prepregnancy and 15 years postpartum G2: Women with normal BMI at prepregnancy who had overweight BMI (> 25) at 15 years postpartum Results G1: Mean (SD) maternal weight gain, 13.6 (3.7) kg G2: Mean (SD) maternal weight gain, 15.4 (4.4) kg t-Test: $P < 0.001$ Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Muscati et al., 1996</p> <p>Country and setting: Canada, public health department</p> <p>Enrollment Period: 1979 to 1989</p> <p>Funding: NR</p> <p>Study Objective: To examine association of extent and timing of pregnancy weight gain with infant birth weight and postpartum weight retention</p> <p>Time frame: 1979 to 1989</p> <p>Duration of the study: Pregnancy through 6 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 371</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 371 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, low income, non-smoking women Pregnant women <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Prematurity < 37 weeks Adolescents < 16 years Women > 40 years Maternal health problems Women who consume alcohol or drugs Pregnancy complications such as proteinuria, hypertension, diabetes, negative weight gain, missing values 	<p>Pregravid weight: Family physicians' records G1: 62.8 +/- 16.0 kg G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Pregravid weight status categorized into 3 groups as a percentage of standard weight: underweight < 90%, normal 90-120%, and overweight > 120% <p>Age (mean, yrs): G1: 24.5 +/- 5.6 G2: NR</p> <p>Parity: G1: Primiparous 52% G2: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: G1: PPWR: 5.3 +/- 5.7 kg G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain: G1: 16.1 +/- 6.4 kg G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Collected from:</p> <ul style="list-style-type: none"> Collected by study investigators <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	<p>Birth weight: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: From Table 1: Pearson's Correlation Coefficient and determination coefficient of maternal weight gain with PP weight retention and Infant BW. Maternal PP weight retention and Preg weight gain: [Total amount $r = 0.808$, R square 65.3%, $P < 0.001$], [Up to week 20 $r = 0.682$, R square 46.5%, $P < 0.001$], [Weeks 21-30 $r = 0.411$, R square 16.9%, $P < 0.001$], [Week 31 - term $r = 0.414$, R square 17.1%, $P < 0.001$]</p> <p>Other infant outcomes: Pregnancy Weight Gain and Infant Birth Weight (from Table 1): [Total amount $r = 0.216$, R square 4.7%, $P < 0.001$], [Up to week 20 $r = 0.114$, R-square 1.3%, $P < 0.05$], [Weeks 21-30 $r = 0.157$, R square 2.5%, $P < 0.01$], [Week 31 - term $r = 0.160$, R square 2.6%, $P < 0.01$]</p>	<p>Outcomes Description: Postpartum weight retention</p> <p>Groups Maternal weight gain categories: G1: Weight gain \leq week 20 (kg) G2: Weight gain weeks 21-30 (kg)</p> <p>Results Regression model of weight retention (kg) at 6 weeks postpartum as the dependent variable and G1-G5 as independent variables: G1: $\beta = 0.86$ (SE: 0.05) $P < 0.001$ G2: $\beta = 0.68$ (SE: 0.07) $P < 0.001$ G3: $\beta = 0.49$ (SE: 0.07) $P < 0.001$ G4: $\beta = 0.58$ (0.13) $P = \text{NR}$ G5: $\beta = 0.77$ (0.04) $P = \text{NR}$</p> <p>Among women with AGA infants, women with 6 week postpartum weights greater than the median value (6.2kg, underweight; 5.7kg, normal weight; 3.1kg, overweight) had significantly greater total weight gains and weight gains during the first 20 weeks' gestation compared to women with 6 week postpartum weights of the median value or lower</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Standard weight for height (based on 1983 Metropolitan Life Insurance Tables) Pregravid weight above standard (difference between actual weight and standard weight) Parity <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Gestational age Infant sex 	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Fair</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Poor</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Poor</p> <p>Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ohlin and Rossner, 1990</p> <p>Country and setting: Sweden, maternity clinics</p> <p>Enrollment Period: NR</p> <p>Funding: NR</p> <p>Study Objective: To make a survey of weight changes after pregnancy; to analyze if and how different factors, such as parity, age, body weight, and lactation, correlate to post partum weight retention; and to analyze if any of these factors could be used as predictors fo</p> <p>Time frame: NR</p> <p>Duration of the study: Pregnancy through 1 year postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: retrospectively during pregnancy and prospectively up to 1 year after delivery <p>Total Study N: 1,423 at 1 year postpartum</p> <p>Group Description: G1: Total group entering study G2: NR</p> <p>Group N: G1: 2295 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women coming to maternity clinic for last routine control (6-15 weeks after delivery) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Twin births Insulin use during pregnancy Gastrointestinal problems with severe energy losses (heavy vomiting or diarrhea) Missing prepregnancy weight. Drop out frequency 1 year postpartum = 38% 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 59.6kg (8.5) G2: NR</p> <p>Pregravid BMI: G1: 21.5 (2.8) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs): G1: 29.5 (4.8) G2: NR</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 2295 G2: NR</p> <p>Total weight gain: G1: 14.1kg (4.3) G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Collected from:</p> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	<p>Birth weight: G1: 3442 (522) G2: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: Mean Change in body weight from pre-pregnancy weight to 1 year postpartum (n = 1423) = 1.5kg (SD 3.6) $P < 0.001$. Overweight women (BMI > 23.8, n = 190) tended to retain more weight after the index time - 1.9kg +/- 5.3kg than lighter women (BMI < 23.9, n = 1233) - 1.5kg +/- 3.2kg (NS). There was a highly significant correlation between weight change and pregnancy weight gain (r = 0.36, $P < 0.001$). This correlation was slightly lower when using the first and last weight recorded in the maternity clinic (vs. self reported pre-pregnancy weight), but still significant (r < 0.29, $P < 0.001$). Women gaining in the highest decentile (16.5kg) had a mean weight change of 3.3 +/- 3.9 kg while women in the lowest decentile (7.5kg) had a mean weight change of 0.0 +/- 3.3 kg. Using multiple stepwise regression analysis, weight gain during the third trimester explained 5% of the variation of weight change from pre-pregnancy to 1 year postpartum: Beta = 3.6, the second trimester gains explained 2% of the change (beta = 2.8); and the first trimester explained 1% of the change (beta = 1.4). Total weight gain explained 8% of change (multiple r = 0.29), $P < 0.001$)</p> <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Postpartum weight retention</p> <p>Groups Maternal weight gain categories: G1: Continuous weight gain (kg) G2: Weight change (kg), defined as the difference between prepregnancy and 1 year postpartum weights</p> <p>Results Regression model for G2 as the dependent variable and G1 as the independent variable: B = 0.32 $P < 0.001$</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Lactation score Age Prepregnancy BMI Parity <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Good</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Good</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Parham et al., 1990</p> <p>Country and setting: USA, prenatal clinics</p> <p>Enrollment Period: NR</p> <p>Funding: NR</p> <p>Study Objective: To explore relationship between pregnancy weight gain and postpartum weight and to identify variables associated with return to prepregnancy weight</p> <p>Time frame: NR</p> <p>Duration of the study: Entry into PNC up to 9 months postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Other observational: pregnant women vs non pregnant selected from the same clinic Retrospective <p>Total Study N: 260 (158 pregnant + 102 non pregnant)</p> <p>Group Description: G1: Prenatal patients G2: Control</p> <p>Group N: G1: 158 G2: 102</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Prenatal patients in 2 clinics serving low-income patients ; singleton births Non pregnant women who also had weight info during a 12 month period of time <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Incomplete or unusable data on weight changes during pregnancy and postpartum periods 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> < 20 (underweight), 20-25 (acceptable), > 25 (overweight) <p>Age (mean, yrs): G1: 23 G2: 23</p> <p>Parity: NR</p>	<p>Race,%: White G1: ~50 G2: ~50</p> <p>Black G1: ~25 G2: ~25</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 158 G2: NR</p> <p>Total weight gain: G1: 12.9 kg (SD 5.8) G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> < 9.1kg, 9.1-13.6, and > 13.6kg <p>Collected from:</p> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	<p>Birth weight: G1: 3,299 g (SD 628) G2: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: Mean maternal weight gain was 9.7kg ("maternal weight gain" in this study is weight at delivery minus baby's BW). Lower third of maternal weight gains ranged from -7.1 to 6.7 kg, with a mean of 3.7 [+ or -] 2.9 kg; middle third had a range of 6.8 to 11.9 kg (mean = 9.4 [+ or -] 1.3 kg); and the upper third had a range of 11.9 to 32.8 kg (mean = 16.0 [+ or -] 3.7). Three maternal weight gain categories differed significantly in initial BMI ($P = .03$). Residual weight I was significantly correlated with maternal weight gain ($r = .84$, $P < .001$) and with prepregnancy BMI ($r = .14$, $P = .05$). Residual weight II was also significantly correlated with maternal weight gain ($r = .68$, $P < .001$) but not with prepregnancy BMI</p> <p>Other infant outcomes: Among underweight and normal-weight women, gains were roughly evenly distributed among 3 maternal gain tertiles, but 50% of overweight women had gains in lower tertile and only 24% in upper tertile. Groups did not differ significantly</p>	<p>Outcomes Description: Postpartum weight retention, percent change in BMI category between prepregnancy and 1-3 months postpartum</p> <p>Groups Maternal weight gain for population in tertiles, mean (se): G1: 3.7 (2.9) G2: 9.4 (1.3) G3: 16.0 (3.7)</p> <p>Results G1, G2: 83% No change; 7% Desirable change (i.e. underweight women becoming normal weight); 10% Undesirable change (~5% had an increase in BMI category and ~5% had a decrease in BMI category) G3: 42% no change; 19% desirable change; 39% Undesirable change (all increases in BMI category)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NR</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Poor</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Poor</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Poor</p> <p>Sum of Good/Fair/Poor: 1 Good, 5 Fair, 3 Poor</p> <p>Final Quality Score: Poor</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Soltani and Fraser, 2000 Country and setting: UK, hospital Enrollment Period: NR Funding: NR Study Objective: To investigate pattern of changes in weight gain and fat distribution during pregnancy and postpartum and whether this differed by maternal BMI measured in first trimester Time frame: NR Duration of the study: First prenatal visit to 6 months postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 77 Group Description: G1: Total sample G2: Normal weight G3: Overweight G4: Obese Group N: G1: 77 G2: 29 G3: 23 G4: 25 Inclusion criteria: <ul style="list-style-type: none"> Women attending first prenatal visit at Northern General Hospital Exclusion criteria: NR	Pregravid weight: <ul style="list-style-type: none"> Measured during first prenatal visit G1: 73.0 (16.8) G2: 60.8 (5.6) G3: 72.0 (5.9) G4: 93.0 (10.6) Pregravid BMI: G1: 27.4 (5.9) G2: 22.7 (1.3) G3: 27.7 (1.4) G4: 34.5 (3.54) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 26.71 (4.77) G2: 26.44 (5.32) G3: 26.91 (4.50) G4: 27.68 (3.83) Parity: G1: 0.78 (0.86) G2: 0.55 (0.87) G3: 0.81 (0.75) G4: 1.00 (0.96)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 24% G2: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Fat mass (kg) at first visit: G1: 24.5 (9.9) G2: 16.5 (3.6) G3: 24.6 (3.9) G4: 36.1 (5.9) Waist:hip ratio: G1: 0.92 (0.08) G2: 0.88 (0.06) G3: 0.92 (0.08) G4: 0.96 (0.08) Total Skinfold Thickness (mm): G1: 117.09 (40.19) G2: 84.3 (25.31) G3: 125.02 (22.76) G4: 158.74 (21.52)

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 77 G2: 29 G3: 25 Total weight gain: G1: 13-36 weeks: 10.8 (4.7) G2: 11.0 (3.2) G3: 11.9 (6.4) G4: 9.7 (4.3) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3443.0 (589.60) G2: 3331.5 (481.7) G3: 3423.7 (543.2) G4: 3670.4 (489.5) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Postpartum weight retention Groups Pregravid BMI categories: G1: Normal Weight G2: Underweight G3: Overweight G4: Obese Results G1: Patterns of changes in body weight (kg) and fat mass follow a monotonous trend; body weight and fatness increased during gestation, decreased substantially at 6 weeks postpartum, and then stayed the same or slightly decreased until 6 months postpartum G2: Showed similar pattern to G1. G3: Divergent pattern of weight gains and losses; body fat mass changes show a very scattered pattern G4: Divergent pattern of both weight and fat mass gains and losses; heavier and greater fat masses at 6 months postpartum compared to 13 weeks gestation; significantly lower fat mass loss and greater skinfold thickness gain between 36 weeks gestation and 6 months postpartum compared to normal weight women ($P < 0.05$) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Walker et al., 2004</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1999 to 2001</p> <p>Funding: National Instituted of Nursing Research</p> <p>Study Objective: Longitudinal analysis of behavioral and psychosocial correlates of weight trends during first postpartum year</p> <p>Time frame: 1999 to 2001</p> <p>Duration of the study: Initiation of prenatal care to 12 months postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 382</p> <p>Group Description: G1: Total cohort G2: White G3: African American G4: Hispanic</p> <p>Group N: G1: 382 G2: 113 G3: 100 G4: 169</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with healthy, term, singleton pregnancies with prenatal care funded through Medicaid Parity ≤ 3 English speaking ≥ 18 years free of prenatal complications (hypertension or diabetes) <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reportedOther-please explain! <p>G1: NR G2: 65.44 (15.82) kg G3: 67.96 (13.99) G4: 67.26 (15.24)</p> <p>Pregravid BMI: G1: NR G2: 24.23 (5.78); Underwt% 18.75; Normal wt% 53.57; Overwt% 11.61; Obese % 16.07 G3: 25.39 (5.40); Under 11.34%; Normal 56.7%; Over 9.28%; Obese 22.68% G4: 26.75 (6.19); Under 7.78%; Normal 48.5%; Over 13.77%; Obese 29.94%</p> <p>Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous IOM guidelines <p>Age (mean, yrs): G1: NR G2: 22.79 (4.72) G3: 22.40 (3.75) G4: 21.89 (3.36)</p> <p>Parity: G1: NR G2: Parity = 1 (%): 45.13 G3: 35.00% G4: 30.77%</p> </p>	<p>Race,%: White G1: 29.6 G2: NR Black G1: 26.2 G2: NR Hispanic G1: 44.2 G2: NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 34. Gestational weight gain and postpartum weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 113 G2: 100 G3: 169</p> <p>Total weight gain: G1: kg 16.44 (6.51); below IOM rec 16.07%; within IOM rec 30.36%; more than IOM rec 53.57% G2: kg 15.20 (7.88); below IOM rec 25.53%; within IOM rec 17.02%; more than IOM rec 57.45% G3: kg 14.87 (7.76); below IOM rec 22.29%; within IOM rec</p> <p>Categorized:</p> <ul style="list-style-type: none"> Continuous according to IOM <p>Collected from:</p> <ul style="list-style-type: none"> Self-reported Collected by study investigators gestational weight gain based on self report Postpartum weight gain was measured by study investigators postdelivery, and at 6 wks, 3, 6, and 12 months postpartum <p>Ascertained by:</p> <ul style="list-style-type: none"> Self-reported 	<p>Birth weight: NR</p> <p>Gestational diabetes,%: NR</p> <p>Cesarean delivery,%: G1: 10.62 G2: 15.00 G3: 16.57</p> <p>Instrumental delivery,%: NR</p> <p>Episiotomy,%: NR</p> <p>Other maternal outcomes: NA</p> <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Postpartum weight retention</p> <p>Groups Continuous maternal weight gain (kg)</p> <p>Results Each kg of maternal weight gain was associated with 0.314 kg/m² of postpartum BMI ($P < 0.001$)</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Ethnicity Time Interaction of ethnicity and time Pregavid BMI Weight-related distress Energy intake <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Good</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Poor</p> <p>Followup: Good</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 35. Gestational weight gain and premenopausal breast cancer

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hilakivi-Clarke et al., 2005</p> <p>Country and setting: Finland, primary care</p> <p>Enrollment Period: Apr 1990-Dec 1993</p> <p>Funding: Supported by grants from National Cancer Institute, Susan G. Komen Breast Cancer Research Foundation, and Breast Cancer Research Foundation</p> <p>Study Objective: To investigate whether excessive maternal weight gain alters a woman's risk of developing premenopausal breast cancer</p> <p>Time frame: Apr 1990 to Dec 1993</p> <p>Duration of the study: 3 to 6 years after insertion of IUD</p> <p>Quality: Fair</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 490</p> <p>Group Description: G1: Cases G2: Controls</p> <p>Group N: G1: 98 G2: 392</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Cases of reported breast cancer per survey, for each case- 4 controls matched for age and Mirena status chosen randomly from cohort <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing info on birth year, nulliparous women, development of breast cancer before pregnancy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Change in BMI < 3.5, 3.5 to 7, > 7 units <p>Age (mean, yrs): G1: 46.7 G2: 46.7</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Family history of breast cancer: G1: 9.4% G2: 5.7%</p>

Evidence Table 35. Gestational weight gain and premenopausal breast cancer (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 98 G2: 392 Total weight gain: G1: < 10 kg 23.4% 10-15 47.9% 16-20 21.3% 20+ 7.5% G2: < 10 kg 22.2% 10-15 50.3% 16-20 19.4% 20+ 8.2% Categorized: <ul style="list-style-type: none"> Categorical: < 10kg, 10-15, 16-20, > 20 Collected from: <ul style="list-style-type: none"> Self-reported data collected on weight gain during any pregnancy - not first or last specified Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> AOR for Premenopausal breast cancer (95% CI) Groups: weight gain (kg) G1: < 10kg G2: 10-15 kg G1: 16-20 kg G2: >20 kg Results: G1: 1.0 reference G2: 0.8 (0.44,1.47) G2: NR G3: 1.0 (0.47, 2.04) G4: 0.8 (0.27, 2.13) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Education Age at menarche Age at first birth Family history of breast cancer Pregnancy weight gain Change in BMI during adult life Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) <i>Categorized:</i> <i>Only calculated for morbidly obese:</i> <i>0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs</i> <i>Collected from:</i> <ul style="list-style-type: none"> <i>Routine pre-natal care or maternity records</i> <i>Ascertained by:</i> <ul style="list-style-type: none"> <i>Not stated - from medical records</i> 	Birth weight: G1: 3352 (598) G2: 3269 (532) <i>(P < 0.05)</i> Gestational diabetes, %: G1: 14.2% G2: 4.3% (<i>P</i> < 0.01) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Distribution of GDM, %: Groups Maternal weight gain categories among morbidly obese (BMI > 35): G1: Weight loss/no change G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: > 35 lbs Results G1: 15.7 G2: 15.0 G3: 14.4 G4: 13.4 G5: 12.5 <i>P</i> = NS Maternal confounders and effect modifiers accounted for in analysis: Race, parity, clinic service, substance abuse, preexisting medical condition Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Edwards et al., 1996</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1997-1993</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change</p> <p>Time frame: 1997-1993</p> <p>Duration of the study: 1997-1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,443</p> <p>Group Description: G1: Obese G2: Normal Weight G3: total sample</p> <p>Group N: G1: 683 G2: 660</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Fetal deaths 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 103.5 G2: 61</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) <p>Age (mean, yrs): G1: 27.1 G2: 25.4</p> <p>Parity: NR</p>	<p>Race,%: White G1: NR G2: NR G3: 69.0 (Total sample)</p> <p>Black G1: NR G2: NR G3: 21.0 (Total sample)</p> <p>Hispanic G1: NR G2: NR G3: 7.0 (Total sample)</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: NR G2: NR G3: 4.0 (Total sample)</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percent with Gestational Diabetes by weight group Groups Obese BMI > 29 (kg): G1: Lost weight/no change G2: 0.5-6.5 G3: 7-11.5 G4: 12-16 G5: > 16 Normal weight BMI 19.8-26 G6: < 11.5 G7: 11.5-16 G8: > 16 Results Gestational diabetes, % G1: 13.3 G2: 24.3 G3: 11.9 G4: 16.7 G5: 17.3 P for linear trend (G1-G5) = 0.554 G6: 2.3 G7: 3.3 G8: 2.9 P for linear trend (G6-G8) = 0.759 Maternal confounders and effect modifiers accounted for in analysis: None Infant and child confounders and effect modifiers accounted for in analysis: None	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Saldana et al., 2006</p> <p>Country and setting: United States, hospital</p> <p>Enrollment period: August 1, 1995 through May 31, 2000</p> <p>Funding: Supported in part by National Institute of General Medical Sciences (Grant R25GM55336), National Institute of Child Health and Development (Grant 28684), and North Carolina Clinical Nutrition Research (Grant DK56350)</p> <p>Study Objective: Objective of study to examine weight and its relationship to glucose intolerance during pregnancy</p> <p>Time frame: August 1, 1995 through May 31, 2000</p> <p>Duration of the study: Entry into prenatal care through end of second trimester</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 952</p> <p>Group Description: G1: Normal Glucose Tolerance G2: Impaired Glucose Tolerance G3: GDM</p> <p>Group N: G1: 809 G2: 48 G3: 95</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy More than 16 years of age English speaking Access to phone Planned to continue care at 1 of study sites <p>Exclusion criteria:</p> <ul style="list-style-type: none"> From non-white or non-black racial group Having a second pregnancy in cohort Pre-existing diabetes No glucose screening data High screen without an oral glucose tolerance test 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 25 (0.24) G2: 28 (1.1) G3: 30 (0.82)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26 (0.22) G2: 29 (0.91) G3: 28 (0.59)</p> <p>Parity: G1: 0.9 (0.04) G2: 1.1 (0.16) G3: 0.9 (0.10)</p>	<p>Race, %: White G1: 58% G2: 73% G3: 69% Black G1: 42% G2: 27% G3: 31% Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 25% G2: 26% G3: 25%</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Weight gain ratio (observed/recommended[compared with IOM range]) G1: 1.43 (0.04) G2: 1.48 (0.21) G3: 1.88 (0.15)</p> <p>Additional characteristics: NR</p>

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Groups (N): NR Total weight gain: G1: 9.1 (0.19) G2: 8.1 (0.90) G3: 9.4 (0.62) Categorized: <ul style="list-style-type: none"> 2 weight gain variables were created. Weight gain was calculated by subtracting prepregnancy weight from weight at end of second trimester (G2 weeks). Weight gain ratio calculated as ratio of observed weight gain to recommended Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Mean and adjusted odds ratio (95% CI) for weight gain Groups G1: Normal glucose tolerance G2: Impaired glucose tolerance G3: Gestational diabetes mellitus BMI IOM Results Mean (SE) weight gain ratio (defined as observed weight gain/IOM recommended weight gain): G1: 1.43 (0.04) G2: 1.48 (0.21) G3: 1.88 (0.15) P < 0.05 AOR for weight gain ratio G1: 1.0 (reference) G3: 1.2 (0.9-1.4) Maternal confounders and effect modifiers accounted for in analysis: Race, age Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Good Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 2 Fair, 0 Poor Final Quality Score: Good

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Thorsdottir et al., 2002</p> <p>Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight</p> <p>Time frame: NR</p> <p>Duration of the study: 1998</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 614</p> <p>Group Description:</p> <p>G1: No complication</p> <p>G2: Complications in pregnancy or delivery</p> <p>G3: Complications in pregnancy</p> <p>G4: Complications in delivery</p> <p>Group N:</p> <p>G1: 452</p> <p>G2: 162</p> <p>G3: 56</p> <p>G4: 106</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.1 (6.2)</p> <p>G2: 62.0 (5.6) $P = 0.059$</p> <p>G3: 61.7 (4.8) $P = 0.174$</p> <p>G4: 62.2 (6.1) $P = 0.274$</p> <p>Pregravid BMI:</p> <p>G1: 22.2</p> <p>G2: 22.4 (1.6) $P = 0.270$</p> <p>G3: 22.4 (1.5) $P = 0.338$</p> <p>G4: 22.3 $P = 0.584$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs):</p> <p>G1: 29</p> <p>G2: 29 $P = 0.857$</p> <p>G3: 29 $P = 0.404$</p> <p>G4: 29 $P = 0.398$</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Proportional weight gain, %:</p> <p>G1: 26.0</p> <p>G2: 28.0 $P = 0.018$</p> <p>G3: 30.0 $P = 0.005$</p> <p>G4: 27.0 $P = 0.546$</p> <p>Additional characteristics: NR</p>

Evidence Table 36. Gestational weight gain with reference to IOM recommendations and gestational diabetes (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) <i>P</i> = 0.080 G3: 18.4 (5.1) <i>P</i> = 0.013 G4: 16.9 (5.1) <i>P</i> = 0.887 Categorized: <ul style="list-style-type: none"> According to IOM < 11.5, 11.-16.0, ≥ 16.1, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to deliverynot stated - based on records? 	Birth weight: G1: 3789 (469) G2: 3749 (565) <i>P</i> = 0.389 G3: 3643 (526) <i>P</i> = 0.032 G4: 3806 (578) <i>P</i> = 0.529 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Gestational diabetes,% Groups Maternal weight gain categories (kg): G1: < 11.5 G2: 11.5-16.0 G3: 16.1-20.0 G4: > 20.0 Results Gestational diabetes,% G1: 2.9 G2: 0 G3: 0 G4: 0 <i>P</i> for trend < 0.015 Maternal confounders and effect modifiers accounted for in analysis: None Infant and child confounders and effect modifiers accounted for in analysis: None	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 37. Gestational weight gain with reference to IOM recommendations and hypertension

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 37. Gestational weight gain with reference to IOM recommendations and hypertension
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) <i>Categorized:</i> <i>Only calculated for morbidly obese:</i> <i>0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs</i> <i>Collected from:</i> <ul style="list-style-type: none"> <i>Routine pre-natal care or maternity records</i> <i>Ascertained by:</i> <ul style="list-style-type: none"> <i>Not stated - from medical records</i> 	Birth weight: G1: 3352 (598) G2: 3269 (532) <i>(P < 0.05)</i> Gestational diabetes, %: G1: 14.2% G2: 4.3% (<i>P < 0.01</i>) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Pregnancy-induced hypertension Groups: G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results: G1: 11.8% G2: 13.7% G3: 13.7% G4: 12.4% G5: 21.3% (<i>P = NS</i>) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Devader et al., 2007</p> <p>Country and setting: United States, birth certificate data</p> <p>Enrollment period: 1999 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI</p> <p>Time frame: 1999 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 94,696</p> <p>Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs</p> <p>Group N: G1: 16,852 G2: 37,292 G3: 40,552</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8 –26.0 kg/m2) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized: NR</p> <p>Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4%</p> <p>Parity: NR</p>	<p>Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7</p> <p>Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: AOR (95% CI) for preeclampsia	Background: Good
Total weight gain: NR	Gestational diabetes, %: NR	Groups Maternal weight gain categories (lbs): G1: < 25 G2: 25-35 G3: > 35	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results G1: 0.56 (0.49-0.64) G2: 1.00 (reference) G3: 1.88 (1.74-2.04)	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Education Income Alcohol use Height Prior pregnancy Inadequate prenatal care use Smoking 	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Child's gender Birth year 	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 		Followup: Fair
			Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor
			Final Quality Score: Fair

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia
(continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Devader et al., 2007
(combined)

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	Other infant outcomes: NR		

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Edwards et al., 1996 Country and setting: USA, hospital Enrollment Period: 1997-1993 Funding: NR Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change Time frame: 1997-1993 Duration of the study: 1997-1993	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,443 Group Description: G1: Obese G2: Normal Weight G3: total sample Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births Exclusion criteria: <ul style="list-style-type: none"> Missing data Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 G2: 61 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) Age (mean, yrs): G1: 27.1 G2: 25.4 Parity: NR	Race, %: White G1: NR G2: NR G3: 69.0 (Total sample) Black G1: NR G2: NR G3: 21.0 (Total sample) Hispanic G1: NR G2: NR G3: 7.0 (Total sample) Asian/Pacific Islander NR Other G1: NR G2: NR G3: 4.0 (Total sample) Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Preeclampsia Groups Obese BMI > 29 (kg): G1: Lost weight/ no change G2: 0.5-6.5 G3: 7-11.5 G4: 12-16 G5: > 16 Normal weight BMI 19.8-26: G6: < 11.5 G7: 11.5-16.0 G8: > 16.0 Results G1: 10.7 G2: 7.7 G3: 8.3 G4: 7.9 G5: 16.5 P for linear trend (for G1-G5) = 0.076 G6: 2.8 G7: 2.9 G8: 6.6 P for linear trend (for G6-G8) = 0.048 Maternal confounders and effect modifiers accounted for in analysis: None Infant and child confounders and effect modifiers accounted for in analysis: None	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: <i>Kiel et al., 2007</i> Country and setting: <i>United States, birth registry</i> Enrollment period: <i>1990 to 2001</i> Funding: <i>NR</i> Study Objective: <i>To examine effect of gestational weight change on pregnancy outcomes in obese women</i> Time frame: <i>1990 to 2001</i> Duration of the study: <i>Entry into prenatal care through delivery</i>	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NIH guidelines Age (mean, yrs): G1: <26: 46% 26–35: 47% Older than 35: 8% G2: <26: 44% 26–35: 48% Older than 35: 8% G3: <26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 Black G1: 22 G2: 23 G3: 27 Hispanic NR Asian/Pacific Islander NR Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% (P < 0.05) G2: SGA: 7% LGA: 16% (P < 0.05) G3: SGA: 6% LGA: 18% (P < 0.05) Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Outcomes Description: Odds ratios (95% CI) for preeclampsia Groups Maternal weight gain categories stratified by prepregnancy obesity status, Obese Class I (BMI 30–34.9), Obese Class II (BMI 35–39.9), Obese Class III (BMI ≥ 40): G1: ≤ -10lbs G2: -2 to -9 lbs G3: No change G4: 2-9 lbs G5: 10-14 lbs G6: 15-25 lbs G7: 26-35 lbs G8: > 35 lbs Results For Obese Class I: OR (95% CI) for preeclampsia were significantly lower (< 1.00, G6 was reference) for G2-G5 and significantly higher for G7-G8 . For Obese Class II: OR (95% CI) for preeclampsia were significantly greater (> 1.00, G6 was reference) for G1 and G3- G5 and significantly lower for G8 . For Obese Class III: OR (95% CI) for preeclampsia were significantly greater (> 1.00, G6 was reference) for G1-G3 and G5 and significantly lower for G7-G8 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in Medicaid, WIC, food stamp programs) • Tobacco use • Chronic hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%			
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, and • greater than 35 lb gain 			
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 			
Ascertained by: NR			

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia
(continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 of 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Thorsdottir et al., 2002</p> <p>Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight</p> <p>Time frame: NR</p> <p>Duration of the study: 1998</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 614</p> <p>Group Description:</p> <p>G1: No complication</p> <p>G2: Complications in pregnancy or delivery</p> <p>G3: Complications in pregnancy</p> <p>G4: Complications in delivery</p> <p>Group N:</p> <p>G1: 452</p> <p>G2: 162</p> <p>G3: 56</p> <p>G4: 106</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.1 (6.2)</p> <p>G2: 62.0 (5.6) $P = 0.059$</p> <p>G3: 61.7 (4.8) $P = 0.174$</p> <p>G4: 62.2 (6.1) $P = 0.274$</p> <p>Pregravid BMI:</p> <p>G1: 22.2</p> <p>G2: 22.4 (1.6) $P = 0.270$</p> <p>G3: 22.4 (1.5) $P = 0.338$</p> <p>G4: 22.3 $P = 0.584$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs):</p> <p>G1: 29</p> <p>G2: 29 $P = 0.857$</p> <p>G3: 29 $P = 0.404$</p> <p>G4: 29 $P = 0.398$</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Proportional weight gain, %:</p> <p>G1: 26.0</p> <p>G2: 28.0 $P = 0.018$</p> <p>G3: 30.0 $P = 0.005$</p> <p>G4: 27.0 $P = 0.546$</p> <p>Additional characteristics: NR</p>

Evidence Table 38. Gestational weight gain with reference to IOM recommendations and pre-eclampsia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) $P = 0.080$ G3: 18.4 (5.1) $P = 0.013$ G4: 16.9 (5.1) $P = 0.887$ Categorized: <ul style="list-style-type: none"> According to IOM < 11.5, 11.5-16.0, ≥ 16.1, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery, not stated - based on records 	Birth weight: G1: 3789 (469) G2: 3749 (565) $P = 0.389$ G3: 3643 (526) $P = 0.032$ G4: 3806 (578) $P = 0.529$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Maternal weight gain categories (kg): G1: < 11.5 G2: 11.5-16.0 G3: 16.1-20.0 G4: > 20.0 Preeclampsia, % G1: 1.4 G2: 2.3 G3: 5.4 G4: 4.4 P for trend = 0.262 Maternal confounders and effect modifiers accounted for in analysis: None Infant and child confounders and effect modifiers accounted for in analysis: None	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR Imputed: No Categorized: NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <ul style="list-style-type: none"> Black NR Hispanic NR Asian/Pacific Islander NR Other NR <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <ul style="list-style-type: none"> Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) <ul style="list-style-type: none"> • Categorize d: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs • Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records • Ascertain ed by: <ul style="list-style-type: none"> • Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) (P < 0.05) Gestational diabetes, %: G1: 14.2% G2: 4.3% (P < 0.01) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> • Preeclampsia • Placental abruption • Meconium • Failure to progress • Shoulder dystocia • Postpartum hemorrhage • Endomyometritis • Wound infections Other infant outcomes <ul style="list-style-type: none"> • Fetal growth restriction • Preterm delivery • Fetal demise • Fetal distress 	Outcomes Description: Cesarean delivery Groups G1: wt loss or 0 lbs G2: 1-15 lb G3: 16-25 lb G4: 26-35 lb G5: >35 lb Results G1: 25.5% G2: 26.8% G3: 28.8% G4: 35.0% G5: 33.8% (P = NS) No significant difference among morbidly obese women by weight gain categories. OR for Cesarean comparing morbidly to nonobese =2.3 (1.9, 2.8) Maternal confounders and effect modifiers accounted for in analysis: Macrosomia Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: DeVader et al., 2007 Country and setting: United States, birth certificate data Enrollment period: 1999 to 2001 Funding: NR Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI Time frame: 1999 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 94,696 Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs Group N: G1: 16,852 G2: 37,292 G3: 40,552 Inclusion criteria: <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8 –26.0 kg/m²) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 Exclusion criteria: <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> No Categorized: NR Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4% Parity: NR	Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 <ul style="list-style-type: none"> Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7 Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR Total weight gain: NR <ul style="list-style-type: none"> • Categorize d: • According to IOM • Collected from: • Routine pre-natal care or maternity records • Ascertain d by: NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> • Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes • Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% • Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% Other infant outcomes: <ul style="list-style-type: none"> • NR 	Outcomes Description: AOR for cesarean delivery (additionally controlled for LGA and cephalopelvic disproportion) Groups G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs <ul style="list-style-type: none"> • Results G1: 0.82 (0.78–0.87) G2: 1.0 G3: 1.35 (1.29–1.40) Maternal confounders and effect modifiers accounted for in analysis: Age, race, education, income, alcohol use, height, prior pregnancy, inadequate prenatal care use, smoking Infant and child confounders and effect modifiers accounted for in analysis: Child's gender, birth year	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Edwards et al., 1996</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1997-1993</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change</p> <p>Time frame: 1997-1993</p> <p>Duration of the study: 1997-1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,443</p> <p>Group Description: G1: Obese G2: Normal Weight G3: total sample</p> <p>Group N: G1: 683 G2: 660</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Fetal deaths 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 103.5 G2: 61</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> Imputed: No Categorized: IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) <p>Age (mean, yrs): G1: 27.1 G2: 25.4</p> <p>Parity: NR</p>	<p>Race, %: White G1: NR G2: NR G3: 69.0 (Total sample)</p> <ul style="list-style-type: none"> Black G1: NR G2: NR G3: 21.0 (Total sample) Hispanic G1: NR G2: NR G3: 7.0 (Total sample) Asian/Pacific Islander NR Other G1: NR G2: NR G3: 4.0 (Total sample) <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ <ul style="list-style-type: none"> • Categorize d: • According to IOM • Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records • Ascertain ed by: <ul style="list-style-type: none"> • Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes,%: NR Cesarean delivery,%: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery,%: Episiotomy,%: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Cesarean delivery Groups Obese G1: wt loss or 0 lbs G2: 1-14 lb G3: 15-25 lb G4: 26-35 lb G5: >35 lb <ul style="list-style-type: none"> • Normal weight G1: <25 lb G2: 25-35 lb G3: >35 lb Results Obese G1: 30.7% G2: 21.6% G3: 23.8% G4: 26.2% G5: 30.1% <ul style="list-style-type: none"> • Normal weight G1: 5.7% G2: 12.1% G3: 8.6% • No significant difference in rates of cesarean delivery by IOM weight gain categories for normal weight or obese women • Obese women AOR =3.2 (2.3,4.4) for cesarean delivery Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Parity • Pre-gravid BMI • GDM • Pregnancy induced hypertension • Prenatal adequacy • Alcohol use • Drug use • Smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Jain et al, 2007</p> <p>Country and setting: United States, hospitals</p> <p>Enrollment period: 2002-2005</p> <p>Funding: Not reported</p> <p>Study Objective: To analyze risks of cesarean section, macrosomia, and breastfeeding at 10 weeks postpartum using logistic regression to estimate independent effects of prepregnancy BMI and gestational weight gain</p> <p>Time frame: 2002-2005</p> <p>Duration of the study: Entry into prenatal care to 10 weeks postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 7661</p> <p>Group Description: NR</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Term (> 37 weeks) and singleton for macrosomia and breastfeeding <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Cesarean analysis limited to women with cephalic presentation-records with missing data excluded 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR Imputed: No Categorized: IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p>

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: Cesarean delivery	Background: Fair
Total weight gain: <ul style="list-style-type: none"> NR 	Gestational diabetes, %: NR	Groups G1: ≤ 15 lbs G2: 16 - < 25 lbs G3: 25 - < 35 lbs G4: ≥ 35 lbs G5: interaction term overweight/obese and gaining 25-35	Sample selection: Poor
<ul style="list-style-type: none"> Categorize 	Cesarean delivery, %: NR	Results Primipara (AOR, 95% CI) G5: 0.71 (0.43-1.19)	Definition of maternal weight gain: Poor
<ul style="list-style-type: none"> ≤ 15 lbs 15-25 lbs 25-35 lbs 35+ lbs 	Instrumental delivery, %: NR	Results Primipara (AOR, 95% CI) G5: 0.71 (0.43-1.19)	Definition of outcomes: Fair
<ul style="list-style-type: none"> Collected 	Episiotomy, %: NR	Results Primipara (AOR, 95% CI) G5: 0.71 (0.43-1.19)	Source of information on exposure, outcomes, and confounders: Fair
<ul style="list-style-type: none"> Not outlined 	Other maternal outcomes: NR	Maternal confounders and effect modifiers accounted for in analysis: Pre-gravid BMI, parity	Followup: Fair
<ul style="list-style-type: none"> Ascertained by: 	Other infant outcomes: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Analysis comparability: Fair
<ul style="list-style-type: none"> Birth certificate 			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 0 Good, 7 Fair, 2 Poor
			Final Quality Score: Fair

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kaiser and Kirby, 2001</p> <p>Country and setting: USA, university nurse-midwifery system</p> <p>Enrollment Period: 1994 to 1998</p> <p>Funding: NR</p> <p>Study Objective: To determine whether low risk maternity patients in a nurse-midwifery service with prepregnant BMI > 29.0 are at increased risk for cesarean delivery</p> <p>Time frame: 1994 to 1998</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,881</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 1881 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Healthy women who met criteria for nurse-midwifery care according to practice's guidelines Women who delivered preterm or attempted trials of labor All pregnancies were included for women who delivered more than once within study period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with chronic conditions (diabetes, hypertension, unstable asthma), prenatal complications (multiple gestations, fetal malformations, and gestational diabetes), repeat cesarean delivery Women with missing height or prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported Used measured weight at first prenatal visit (if less than 12 weeks gestation) if women did not know <p>Pregravid BMI: G1: NR BMI</p> <ul style="list-style-type: none"> ≤ 19.7: 13.2% 19.8-26.0: 50.7% 26.1-28.9: 12.0% ≥ 29.0: 24.0% <p>G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 21.1 (4.7) G2: NR</p> <p>Parity: G1: % primiparous: 36.5 G2: NR</p>	<p>Race, %: White G1: 14.9 G2: NR</p> <ul style="list-style-type: none"> Black G1: 77.1 G2: NR Hispanic G1: 6.6 G2: NR Asian/Pacific Islander G1: 1.4 G2: NR Other NR <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: G1: married: 9.4 G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1881 G2: NR Total weight gain: <ul style="list-style-type: none"> • Categorize d: • Study by Parker and Abrams-weight gain cut offs are different • Collected from: • Routine pre-natal care or maternity records • Ascertained by: • Based on last clinically measured weight prior to delivery: difference between prepregnant weight and prenatal visit closest to delivery (not longer than 3 weeks from delivery) 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: G1: 5.1 G2: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Odds ratios (95% CI) for cesarean delivery Groups G1: Below IOM G2: within IOM <ul style="list-style-type: none"> • G3: Above IOM Weight gain below IOM recommendations Results Crude OR G1: 0.82 (0.49, 1.36) G3: 1.0 (0.62, 1.63) <ul style="list-style-type: none"> • AOR for weight gain above IOM recommendations: 2.04 (95% CI 1.02, 4.05) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Pre-gravid BMI • Pre-eclampsia • Height • Previous live births • Failure to progress • Breech presentation • Birth weight Infant and child confounders and effect modifiers accounted for in analysis: Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kiel et al., 2007 Country and setting: United States, birth registry Enrollment period: 1990 to 2001 Funding: NR Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women Time frame: 1990 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% <ul style="list-style-type: none"> Imputed: No Categorized: NIH guidelines Age (mean, yrs): G1: <26: 46% 26–35: 47% Older than 35: 8% G2: <26: 44% 26–35: 48% Older than 35: 8% G3: <26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 <ul style="list-style-type: none"> Black Hispanic Asian/Pacific Islander Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA:13% ($P < 0.05$)	Outcomes Description: Risk of cesarean delivery	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56%	G2: SGA: 7% LGA:16% ($P < 0.05$) G3: SGA: 6% LGA:18% ($P < 0.05$)	Groups G1: wt loss > 10 lbs G2: wt loss 2-9 lb G3: no change G4: 2-9 lb G5: 10-14 lb G6: 15-25 lb G7: 26-35 lb G8: >35 lb	Sample selection: Fair
G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43%	Gestational diabetes, %: NR	Results For all three classes of obese women, risks of cesarean delivery rise above an OR of 1 when weight gain exceeds 25 pounds	Definition of maternal weight gain: Fair
G3: GWG (lb) Less than 2: 15%	Cesarean delivery, %: G1: 28 G2: 34 G3: 41	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in medicaid) • WIC • Food stamp programs) • Tobacco use • Chronic hypertension 	Definition of outcomes: Good
<ul style="list-style-type: none"> • Categorized: • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, • and greater than 35 lb gain 	Instrumental delivery, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Source of information on exposure, outcomes, and confounders: Fair
<ul style="list-style-type: none"> • Collected from: • Routine pre-natal care or maternity records 	Episiotomy, %: NR		Followup: Fair
<ul style="list-style-type: none"> • Ascertained by: NR 			Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Poor
			Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor
			Final Quality Score: Fair

**Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery
(continued)**

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 of 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Parker and Abrams, 1992</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Sept 1980 to Dec 1988</p> <p>Funding: UC Committee on Research & MCH and Resources Development, Health Resources and Services Administration</p> <p>Study Objective: To test whether gains outside IOM reference ranges were associated with increased risks of suboptimal pregnancy outcome (SGA, LGA, cesarean delivery) and to determine whether locally developed ranges were more applicable to study population</p> <p>Time frame: Sept 1980 to Dec 1988</p> <p>Duration of the study: From entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 6,690</p> <p>Group Description: G1: Overall G2: NR</p> <p>Group N: G1: 6,690 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutive live singleton births at Moffitt Hospital between September 1980 and December 1988 with gestational ages of 37 to 42 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Maternal transfers or transports and deliveries complicated by fetal malformations, maternal diabetes, or maternal hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 56.8 kg(SD 11.0) G2: NR</p> <p>Pregravid BMI: G1: Underweight: 27.7%, Normal weight 61.8%, Overweight: 5.6%, Obese 4.9% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 27.7 (5.5) G2: NR</p> <p>Parity: Primiparous: G1: 58.8% G2: NR</p>	<p>Race, %: White G1: 44.0 G2: NR</p> <ul style="list-style-type: none"> Black G1: 8.3 G2: NR Hispanic G1: 9.4 G2: NR Asian/Pacific Islander G1: 21.4 G2: NR Other G1: 12.0 G2: NR <p>Smoking, %: G1: 12.0 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 6690 G2: NR</p> <p>Total weight gain: G1: 15.2kg (5.2) G2: NR</p> <ul style="list-style-type: none"> • Categorize d: • According to IOM Weight gain ranges based on percentiles from previous study of UC population with good pregnancy outcomes: 25th -75th, 10-90th percentiles. For 25-75th, weight gain range = 12-17kg for underweight women (BMI < 19.8); • Collected from: • Routine pre-natal care or maternity records • Ascertain ed by: • Based on last clinically measured weight prior to delivery 	<p>Birth weight: G1: 3408g (462) G2: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NR</p> <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Risks for cesarean delivery</p> <p>Groups G1: Below IOM G2: Above IOM</p> <p>Results AOR for all women weight gain >IOM (G2) =1.48 (1.25,1.76)</p> <ul style="list-style-type: none"> • For overweight women, there was no significant association between cesarean delivery and weight gain (AOR = 0.71 (0.40-1.26). • For non-overweight women, the association between cesarean delivery and weight gain in non-overweight women was 1.45 (1.21 - 1.73) <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Age • Race • Parity • Pre-gravid BMI • Height • Maternal high and low weight gain • Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age • Birth weight 	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Poor</p> <p>Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Stotland et al., 2004 Country and setting: USA, university hospital Enrollment Period: Not stated Funding: Grant HD01262, Women's Reproductive Health Research Scholar Study Objective: To examine how association between excessive weight gain and cesarean birth is modified by infant birth weight in nondiabetic women Time frame: Not stated Duration of the study: During pregnancy until deliver	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 9,788 Group Description: G1: All weight gain categories G2: Women gaining > IOM guidelines G3: Women gaining within IOM guidelines G4: Women gaining < IOM guidelines Group N: G1: 9,788 G2: 4,675 G3: 3,479 G4: 1,634 Inclusion criteria: <ul style="list-style-type: none"> Singleton Term Exclusion criteria: <ul style="list-style-type: none"> Multiple gestation Preterm birth (< 37 completed weeks) Birth weight less than 2500g Multiparity Noncephalic presentation Gestational or pregestational diabetes Placenta previa Active herpes at delivery Abdominal cerclage Fetal anomaly requiring cesarean delivery Missing data on maternal prepregnancy bmi Missing data on gestational weight gain 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Not stated - records Pregravid BMI: <ul style="list-style-type: none"> Imputed: No Categorized: IOM guidelines Age (mean, yrs): G1: 26.6 G2: 26.5 G3: 26.8 G4: 26.2 Parity: NR	Race, %: White G1: 45 G2: 50 G3: 43 G4: 37 <ul style="list-style-type: none"> Black G1: 11 G2: 11 G3: 9 G4: 14 <ul style="list-style-type: none"> Hispanic G1: 10 G2: 10 G3: 9 G4: 10 <ul style="list-style-type: none"> Asian/Pacific Islander G1: 19 G2: 15 G3: 24 G4: 24 <ul style="list-style-type: none"> Other G1: 11 G2: 10 G3: 12 G4: 12 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 9788 G2: 4675 G3: 3479 G4: 1634 Total weight gain: <ul style="list-style-type: none"> • Categorize d: • According to IOM • Collected from: • Routine pre-natal care or maternity records • Ascertain e d by: • Based on last clinically measured weight prior to delivery: measured as (1) difference between prepregnancy weight and last measurement prior to delivery and (2) absolute GWG = subtraction of infant birth weight and placental weight from total maternal weight 	Birth weight: G1: 3437 G2: 3562 G3: 3360 G4: 3242 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Cesarean delivery Groups G1: Below IOM G2: Above IOM Results AOR with birth weight in model G1: 0.99 (0.82,1.19) G2: 1.40 (1.22,1.59) <ul style="list-style-type: none"> • BMI <19.8 G1 =0.96 (0.67,1.37) G2 =1.93 (1.45,2.53) • BMI 19.8-26 G1 =1.04 (0.81,1.33) G2 =1.26 (1.06,1.50) • BMI >26 G1 =0.74 (0.38,1.44) G2 =1.21 (0.83,1.78) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Pre-gravid BMI • Year of delivery • Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Gestational age • Birth weight • Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Thorsdottir et al., 2002</p> <p>Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight</p> <p>Time frame: NR</p> <p>Duration of the study: 1998</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 614</p> <p>Group Description:</p> <p>G1: No complication</p> <p>G2: Complications in pregnancy or delivery</p> <p>G3: Complications in pregnancy</p> <p>G4: Complications in delivery</p> <p>Group N:</p> <p>G1: 452</p> <p>G2: 162</p> <p>G3: 56</p> <p>G4: 106</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.1 (6.2)</p> <p>G2: 62.0 (5.6) $P = 0.059$</p> <p>G3: 61.7 (4.8) $P = 0.174$</p> <p>G4: 62.2 (6.1) $P = 0.274$</p> <p>Pregravid BMI:</p> <p>G1: 22.2</p> <p>G2: 22.4 (1.6) $P = 0.270$</p> <p>G3: 22.4 (1.5) $P = 0.338$</p> <p>G4: 22.3 $P = 0.584$</p> <ul style="list-style-type: none"> Imputed: No Categorized: Continuous <p>Age (mean, yrs):</p> <p>G1: 29</p> <p>G2: 29 $P = 0.857$</p> <p>G3: 29 $P = 0.404$</p> <p>G4: 29 $P = 0.398$</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <ul style="list-style-type: none"> Black NR Hispanic NR Asian/Pacific Islander NR Other NR <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Proportional weight gain, %:</p> <p>G1: 26.0</p> <p>G2: 28.0 $P = 0.018$</p> <p>G3: 30.0 $P = 0.005$</p> <p>G4: 27.0 $P = 0.546$</p> <p>Additional characteristics: NR</p>

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and cesarean delivery (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) $P = 0.080$ G3: 18.4 (5.1) $P = 0.013$ G4: 16.9 (5.1) $P = 0.887$ <ul style="list-style-type: none"> • Categorized: • According to IOM < 11.5, 11.5-16.0, ≥ 16.1, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 • Collected from: • Routine pre-natal care or maternity records • Ascertained by: • Based on last clinically measured weight prior to delivery, not stated - based on records? 	Birth weight: G1: 3789 (469) G2: 3749 (565) $P = 0.389$ G3: 3643 (526) $P = 0.032$ G4: 3806 (578) $P = 0.529$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percent cesarean deliveries Groups G1 <11.5 kg G2 11.5-16 kg G3 16.1-20 kg G4 >20 kg Results G1: 17.4% G2: 9.5% G3: 12.9 % G4: 13.1% <ul style="list-style-type: none"> • No significant differences in cesarean delivery rates by IOM weight gain categories in normal weight women Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Parity • Height Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Gestational age • Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth

Study Description	Study Design Patient Population Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1995</p> <p>Country and setting: USA university prenatal clinics</p> <p>Enrollment Period: Dec 1985 to Oct 1988</p> <p>Funding: NIH MCH grant</p> <p>Study Objective: To examine relationship between prenatal weight gain and spontaneous preterm delivery using IOM guidelines</p> <p>Time frame: Dec 1985 to Oct 1988</p> <p>Duration of the study: Entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1518</p> <p>Group Description: G1: Black women G2: White women</p> <p>Group N: G1: 677 G2: 338</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Low income Multiparous women Must have at least 1 risk factor: > 2 spontaneous abortions previous stillborn/neonatal death previous birth < 37 weeks previous birth < 2750g maternal height < 157cm maternal weight < 50kg hypertension history of phlebitis current alcohol use current smoking first visit after 26 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Outlying or missing prepregnancy weight Missing height Pregpregnancy BMI > 26.0 Multiple births Missing data for type of preterm delivery Indicated preterm delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 55.8 (8.4) G2: 54.1 (7.9)</p> <p>Pregravid BMI: G1: < 19.8: 37.7% 19.8-26.0: 62.3% G2: < 19.8: 43.3% 19.8-26.0: 57.7%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean yrs): G1: 24.8 (4.4) G2: 24.4 (4.4)</p> <p>Parity: G1: 1: 58.9%; 2: 41.1% G2: 1: 68.6%; 2: 31.4%</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 34.6 G2: 75.7</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: First trimester: 353 Second trimester: 474 Third trimester: 615 G2: First trimester: 175 Second trimester: 244 Third trimester: 301 Total weight gain: G1: First trimester: Low BMI -2.61 (2.91); Normal BMI- 2.54 (3.68); Second trimester: Low BMI: 0.49 (0.19) Normal BMI: 0.46 (0.21) Third trimester: Low BMI- 0.46 (0.27) Normal BMI-0.45 (0.27) G2: First trimester: low BMI - 2.93 (3.39); normal Categorized: <ul style="list-style-type: none"> According to IOM weight gain by trimester Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: using weight measured at last visit prior to delivery 	Birth weight: NR Gestational diabetes %: NR Cesarean delivery %: NR Instrumental delivery %: NR Episiotomy %: NR Other maternal outcomes: <ul style="list-style-type: none"> Low first trimester weight gain: < 2.3kg for low BMI women and < 1.6kg for normal BMI women Low second and low third trimester weight gain: < 0.38kg/wk for low BMI women and < 0.37 kg/wk for normal BMI women Other infant outcomes: <ul style="list-style-type: none"> Spontaneous preterm birth: 12.4% in black women and 8.0% in white women 	Outcomes Description: Odds ratio(95% CI) for spontaneous preterm; and pattern of weight gain Groups G1: Low rate of weight gain first trimester-underweight (BMI < 19.8) & < 2.3 kg and normal weight (BMI 19.8-26)& < 1.6 kg G2: Low rate of weight gain in second trimester (Underwt & < 0.38 kg/wk or normal wt & < 0.37 kg/wk) G3: Low rate of weight gain in third trimester (Underwt & < 0.38 kg/wk or normal wt & < 0.37 kg/wk) Results OR (95% CI) for Spontaneous Preterm G1 1.27 (0.7 2.3) G2 1.23 (0.7 2.18) G3 2.46 (1.53 3.92) Pattern of weight gain G1 only 2.94 (0.73 11.98) G2 only 1.08 (0.1 11.23) G3 only 11.54 (2.93 45.28) G1 & G2 4.89 (0.85 28.14) G1 & G3 4.49 (0.96 20.96) G2 & G3 7.37 (1.66 32.76) All trimesters 4.18 (0.75 23.35)	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth

Study Description	Study Design	Baseline Characteristics	
	Patient Population Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)

Author, year:
Hickey et al., 1995
(continued)

**Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Age • Race • Pre-gravid BMI • Height • Alcohol use • History of previous infant less than 2750g • Number of days between last weight observation and delivery • Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>Infant sex</p>	

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Study Description	Study Design Patient Population Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, Year: Schieve et al., 2000 Country and setting: USA National Maternal and Infant Health Survey Enrollment Period: 1988 Funding: NR Study Objective: To examine associations between rate of pregnancy weight gain and preterm delivery among women of varying prepregnancy body mass indices (BMI) Time frame: 1988 Duration of the study: From initiation of prenatal care to delivery	Design: <ul style="list-style-type: none"> Cohort Combination: medical charts but then women were asked to self report info after pregnancy Total Study N: 3,511 Group Description: G1: Preterm G2: Term Group N: Inclusion criteria: <ul style="list-style-type: none"> Singleton births delivered between 28 and 43 weeks' gestation with data available for 3 or more prenatal weight measurements between 14 and 28 weeks' gestation Exclusion criteria: <ul style="list-style-type: none"> Women with weight gain per week of > 5.0 lb. or less than - 2.5lb. Women missing data for pregnancy weight or height 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean yrs): G1: Age at delivery (y): 15–19 12.5%* 20–29 56.0% 30–50 31.6% G2: Age at delivery (y) 15–19 8.3% 20–29 60.3% 30–50 31.4% Parity: Parity 0 G1: 49.9% 1 31.8% 2 or more 18.3% G2: 47.7% 1 30.8% 2 or more 21.6%	Race, %: White G1: 67.1% G2: 81.1% Black G1: 20.9% G2: 9.1% Hispanic G1: 12.1% G2: 9.8% Asian/Pacific Islander NR Other NR Smoking, %: G1: 38.2 G2: 32.4 Diabetes mellitus, %: G1: 6.4 G2: 4.4 Hypertension, %: G1: 10.9 G2: 6.6 Additional characteristics: Marital status: G1: Married 72.1% Not married 27.9% G2: Married 84.2% Not married 15.8% Additional characteristics: Maternal education G1: Less than high school 17.8% High school 43.0% More than high school 39.3% G2: Less than high school 12.7% High school 39.9% More than high school 47.4%

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM pounds per week: Low - 0.5 or less/week; average 0.5-1.5 lb/week; high > 1.5 lb/week Collected from: <ul style="list-style-type: none"> Routine prenatal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to deliveryNR 	Birth weight: NR Gestational diabetes %: G1: 6.4 G2: 4.4 Cesarean delivery, %: Instrumental delivery %: NR Episiotomy %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Adjusted odds ratio for preterm birth Groups G1: Low < 0.5 less/week; G2: Average 0.5-1.5 lb/week G3: High > 1.5 lb/week Results Low BMI: G1 =6.7 (1.1 40.6) G2 =0.8 (0.4 1.4) G3 =1.0 (0.4 2.6) Average BMI: G1 =3.6 (1.6 8.0) G2 (Reference) G3 =1.0 (0.6 1.9) High BMI: G1 =1.6 (0.7 3.5) G2 =1.1 (0.6 2.1) G3 =0.1 (0.03 0.6) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Marital status Education Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Study Description	Study Design Patient Population Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, Year: Siega-Riz et al., 1994</p> <p>Country and setting: USA public health clinics</p> <p>Enrollment Period: 1983 to 1986</p> <p>Funding: March of Dimes NIGMS-predoc grant</p> <p>Study Objective: To describe gestational weight gain patterns by prepregnancy weight and trimester of pregnancy and to examine risk of preterm birth associated with prepregnancy weight and gestational weight gain using various definitions of adequacy based on IOM</p> <p>Time frame: 1983 to 1986</p> <p>Duration of the study: Entry into prenatal care up to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 5854</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women attending 8 public health clinics in West Los Angeles area Only included first pregnancy for which women received care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women who left prenatal care setting after at least 2 visits with no birth outcome available Mismatched prenatal and outcome files Erroneous gestational age Pregnancy complications (diabetes hypertension Stillbirths Multiple pregnancies Implausible values 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: Underweight: 12%; Normal weight: 60%; Overweight: 17.7%; Obese: 10.5% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean yrs): G1: 24.3 G2: NR</p> <p>Parity: Primiparous: G1: 35% G2: NR</p>	<p>Race,%: White NR Black NR Hispanic G1: 80 G2: NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: Married: G1: 61% G2: NR Less than 12 years of education: G1: 71% G2: NR</p>

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: Underweight women: 14.3kg; Normal weight: 13.7 kg; Overweight: 12kg; Obese: 11.7kg G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3424 G2: NR Gestational diabetes %: NR Cesarean delivery %: NR Instrumental delivery %: NR Episiotomy %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Risk of preterm birth Groups Total weight gain expressed as a ratio of observed: expected based on the IOM recommendation for a given gestational age Results- outcomes by groups Preterm birth (< 37 weeks) <ul style="list-style-type: none"> Adequacy of weight gain in the third trimester was predictive of preterm birth - the data suggested a threshold effect for all weight status groups with a marked decrease in risk at 90-110% of the IOM recommendation With the rate of weight gain less than 60% of the IOM value women in all four groups had more than double the risk of delivering preterm which was statistically significant for all but the obese category Excessive rate of weight gain was significantly associated with a preterm birth only for women of normal prepregnancy weight status at a value greater than 200% of the IOM value Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Poor Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 4 Good, 3 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Study Description	Study Design Patient Population Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, Year: Stotland et al., 2006</p> <p>Country and setting: USA academic medical center</p> <p>Enrollment Period: 1976 to 2001</p> <p>Funding: NIH</p> <p>Study Objective: To study how relationship between gestational weight gain and spontaneous preterm birth interacts with maternal race or ethnicity and previous preterm birth status</p> <p>Time frame: 1976 to 2001</p> <p>Duration of the study: From entry into prenatal care until delivery (actually used a perinatal data base and looked at info)</p> <p>Quality: Fair</p>	<p>Design:</p> <ul style="list-style-type: none"> Perinatal data base review Retrospective <p>Total Study N: 15,101</p> <p>Group Description: G1: Total G2: White G3: African American G4: Latina G5: Asian</p> <p>Group N: G1: 15,101 G2: 6,513 G3: 1,533 G4: 1,614 G5: 3,440</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of low or normal prepregnancy BMI delivering singleton during study period with complete data on all variables considered <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Hypertension Diabetes Delivery before 24 weeks of gestation Congenital anomalies Missing data on any key variables Prepregnancy BMI of 26 or greater Transport from another hospital 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported data base <p>Pregravid BMI: G1: Low 29.6%; Normal 70.4% G2: Low 25.9%; Normal 74.1% G3: Low 23.0%; Normal 77% G4: Low 19%; Normal 81% G5: Low 42.2%; 57.9%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines Low (< 19.8) Normal (19.8-25.9) but this is not explicitly stated <p>Age (mean yrs): G1: 28.19 G2: 29.43 G3: 24.25 G4: 26.17 G5: 29.10</p> <p>Parity: Nulliparous G1: 53.8% G2: 57.5 G3: 48.0 G4: 49.0 G5: 52.9</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 10.9% G2: 14.5% G3: 21.4% G4: 6.7% G5: 4.5%</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Previous preterm birth (%) G1: NR G2: 4.4 G3: 4.1 G4: 8.3 G5: 5.58 G6: 2.91</p> <p>Additional characteristics: NR</p>

Evidence Table 40. Gestational weight gain with reference to IOM recommendations and preterm birth (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 15,101 G2: 6,513 G3: 1,533 G4: 1,614 G5: 3,440 Total weight gain: G1: Below IOM: 20.5; % Within IOM 39.1%; Above 40.4% $P < .001$ G2: Below 15.5%; Within 38.5%; above 46.1% $P < .001$ G3: Below 16.9%; Within 30.9%; Above 41.2% $P < .001$ G4: Below 21.1%; Within 37.4%; Above 41.5% $P < .001$ G5: Below 25.4%; Within Categorized: <ul style="list-style-type: none"> Continuous According to IOM3-way categorical variable low (less than 0.27 kg/wk) normal (between 0.27 and 0.52 kg/wk) and high (greater than 0.52kg/wk) Collected from: <ul style="list-style-type: none"> Rate of weight gain was determined by:total weight gain divided by GA minus 2 weeks Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes %: NR Cesarean delivery %: NR Instrumental delivery %: NR Episiotomy %: NR Other maternal outcomes: <ul style="list-style-type: none"> Spontaneous PTB for All women 4.0% White 3.6% Blacks 6.8% Latinas 4.4% Asians 3.6% Other infant outcomes: NR	Outcomes Description: Odds ratio of spontaneous preterm birth Groups G1: low rate of weight gain <.27 kg/wk G2: ref 0.27-0.52 kg/wk G3: high rate of weight gain >0.52 kg/wk Results Crude OR G1: 2.6 (95% CI 2.1–3.2) G3: 1.0 (95% CI 0.8–1.2) AOR G1: 2.5 (95% CI 2.0–3.1) G3: 1.0 (95% CI 0.8–1.3) No differences in results by parity combined with Hx PTB Slightly higher risks for Af Am and high wt gain close to sign for Af Am Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race-EMM Parity-EMM Pre-gravid BMI History of previous PTB Year of delivery Number of days between last weighing and DOB Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight: Routine pre-natal care G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) (<i>P</i> < 0.05) Gestational diabetes, %: G1: 14.2% G2: 4.3% (<i>P</i> < 0.01) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: Increase in birthweight Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 3,302 G2: 3,192 G3: 3,337 G4: 3,506 G5: 3,453 (<i>P</i> < 0.05) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1997</p> <p>Country and setting: USA, public health programs</p> <p>Enrollment Period: Jan 1993 to Dec 1994</p> <p>Funding: MCH grant, University of Alabama School of Public Health/NIH Intramural Basic Sciences Research grant</p> <p>Study Objective: Examine differences in birth weight among term infants of black and white women with weight gains in upper or lower half of recommended ranges</p> <p>Time frame: Jan 1993 to Dec 1994</p> <p>Duration of the study: From first visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 5198</p> <p>Group Description: G1: Black G2: White</p> <p>Group N: G1: 2219 G2: 3699</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women enrolled in Medicaid Maternity Waiver programs operated in 24 counties by Alabama Department of Public Health during study period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Delivered before 37 weeks or after 42 weeks Maternal age ≤ 17 years Last prenatal weight recording more than 3 weeks before delivery Maternal risk factors (diabetic, cardiac, genetic, and obstetric conditions/complications) requiring external referral Multiple fetuses Stillborn/neonatal death Missing or outlying anthropometric data Missing data for ethnicity Missing gestational age Congenital anomalies Missing birth weight Invalid country code 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 70.8 (19.6) G2: 65.8 (17.6)</p> <p>Pregravid BMI: G1: 26.6 (7.1) G2: 24.8 (6.3)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 23.7 (5.0) G2: 23.4 (4.6)</p> <p>Parity:</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR</p> <p>Smoking, %: G1: 9.2 G2: 35.1</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOMgain below range (for pregravid BMI), gain in lower range, gain in upper range, gain above range Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Birth Weight (gms) by IOM Categories Groups G1: Below IOM Range G2: Lower end of IOM Range G3: Upper end of IOM range G4: Gain above IOM range Results BMI < 19.8 G1: Black: 2840 White: 3002 G2: Black: 2995 White: 3151 G3: Black: 3017 White: 3200 G4: Black: 3163 White: 3353 BMI 19.8-26.0 G1: Black: 3052 White: 3176 G2: Black: 3105 White: 3199 G3: Black: 3180 White: 3307 G4: Black: 3228 White: 3389 BMI > 26.0 G1: Black: 3126 White: 3385 G2: Black: 3192 White: 3376 G3: Black: 3312 White: 3402 G4: Black: 3300 White: 3504	Background: Good Sample selection: Good Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

**Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight
(continued)**

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Hickey et al., 1997
(continued)

**Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Age • Education • Height • Street drugs • Alcohol use • Time between last prenatal weight observation and delivery • Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age • Infant sex 	

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1996</p> <p>Country and setting: USA, university prenatal clinics</p> <p>Enrollment Period: Dec 1985 to Oct 1988</p> <p>Funding: Maternal and Child Health grant</p> <p>Study Objective: To examine association between prenatal weight gain patterns and birth weight using IOM guidelines</p> <p>Time frame: Dec 1985 to Oct 1988</p> <p>Duration of the study: During prenatal care to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 415</p> <p>Group Description: G1: Black G2: White</p> <p>Group N: G1: 275 G2: 140</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who identified as black or white, were nonobese, and were para 1 or 2 and who enrolled in prenatal care clinic with at least one or more of following risk factors: > 2 spontaneous abortions, previous stillborn/neonatal death, previous birth < 37 weeks GA, previous birth < 2750g, maternal height < 157cm, maternal weight < 50kg, hypertension, history of phlebitis, current alcohol use, current smoking <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with missing or outlying prepregnancy weight data Prepregnancy BMI exceeding 26.0 Multiple births Delivery before 37 weeks gestation Prenatal weight observations that did not fall within time frames specified at beginning and end of any trimester 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 55.2 (9.0) G2: 53.8 (7.7)</p> <p>Pregravid BMI: G1: < 19.8: 42.9% 19.8-26.0: 57.1% G2: < 19.8: 41.4% 19.8-26.0: 58.6%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 25.8 (4.2) G2: 25.2 (4.3)</p> <p>Parity: G1: 1: 61.4%; 2: 38.6% G2: 1: 68.6%; 2: 31.4%</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR</p> <p>Smoking, %: G1: 35.6 G2: 77.9</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: G1: 0.7 G2: 0.0</p> <p>Additional characteristics: NR</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 415 G2: 415 G3: 275 G4: 275 G5: 140 G6: 140 Total weight gain: G1: First trimester: 2.6 (3.2) Second trimester: 0.50 (0.17) Third trimester: 0.47 (0.24) G2: First trimester: 2.4 (3.5) Second trimester: 0.49 (0.22) Third trimester: 0.46 (0.26) G3: Total weight gain: 14.2 (4.4) First trimester: 2.4 Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> First trimester weight gain (kg) was compared to IOM guideline for low BMI women = 2.3kg and normal BMI women = 1.6kg Second and third trimester weight gain (kg/wk) was compared to IOM guideline for low BMI women = 0.49 kg/wk and normal BMI women = 0.44 kg/wk Other infant outcomes: NA	Outcomes Description: Birth weight Groups G1: First Trimester <2.6 kg for underwt & <1.6 kg for normal wt G2: Second Trimester <0.38 kg/wk for underwt & <0.37 kg/wk for normal wt G3: <0.38 kg/wk for underwt & <0.37 kg/wk for normal wt Results Association of low trimester gain with birthweight G1: All women -18 g $p=.65$ Black -15 g $P = .76$ White -42 g $P = .53$ G2: All women -166g $p<.001$ Black -164 g $P = .005$ White -158 g $P = .05$ G3: All women -111g $p=.008$ Black -77 g $P = .14$ White -194 g $P = .004$ No association with low weight gain in only the first or second trimester. G3: All -164 g $P = .01$ Black -80 g $P = .38$ White -300 g $P = .005$ Association with low weight gain during more than one trimester G1 & G2: All -236 g $P = .01$ Black -265 g $P = .04$ White -169 g $P = .25$ G1 & G3: No significant diff G2 & G3: All -206 g $P = .01$ Black -178 g $P = .08$ White -268 g $P = .06$ G1, G2 & G3: All -284 g $P = .002$ Black -252g $P = .03$ White -379g $P = .008$	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Hickey et al., 1996 (continued)	<ul style="list-style-type: none"> Prenatal weight observations that did not fall within time frames specified at beginning and end of all 3 trimesters 		

**Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Age • Race • Pre-gravid BMI • Height • Alcohol use • Third trimester number of weeks between last weight observation and delivery • History of previous infant < 2750 g • Smoking • Gestational age • Infant sex <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age • Infant sex 	

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1993</p> <p>Country and setting: USA, prenatal clinics</p> <p>Enrollment Period: December 1985 to October 1998</p> <p>Funding: NIH, Maternal and Child Health Department, and Agency for Health care policy and research grants</p> <p>Study Objective: To examine association of prenatal weight gain below, within, and above IOM guidelines with birth weight and fetal growth restriction among low income, high risk black and white women</p> <p>Time frame: December 1985 to October 1998</p> <p>Duration of the study: Entry to prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination, perinatal database <p>Total Study N: 1,168</p> <p>Group Description: G1: black G2: white</p> <p>Group N: G1: 803 G2: 365</p> <p>Inclusion criteria: At least 1 of following risk factors:</p> <ul style="list-style-type: none"> History of more than 2 spontaneous abortions Previous fetal or neonatal death Previous live birth before 37 weeks' gestation Previous infant weighing less than 2750g Maternal height less than 157cm Prepregnancy weight less than 50kg First prenatal visit before 26 weeks' gestation Hypertension (systolic bp above 140mmHg or diastolic bp above 90 mmHg) Current use of cigarettes or alcohol 15% random sample of multiparous women in clinic population was also included after it was determined that 70% of these women exhibited one or more of the risk factors (listed above) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.9 (17.1) G2: 61.0 (16.0)</p> <p>Pregravid BMI: G1: < 19.8: 27.5% 19.8-26.0: 43.6% > 26.0-29.0: 10.5% > 29.0: 18.4% G2: < 19.8: 32.3% 19.8-26.0: 46.0% > 26.0-29.0: 8.0% > 29.0: 13.7%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 25.2 (4.4) G2: 24.8 (4.4)</p> <p>Parity: Para 1: G1: 1: 59.3% G2: 1: 68.2%</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: G1: 37.1 G2: 73.4</p> <p>Diabetes mellitus, %: G1: 5.8 G2: 9.6</p> <p>Hypertension, %: G1: 2.7 G2: 1.1</p> <p>Additional characteristics: Married: G1: 24.9% G2: 65.6%</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 803 G2: 365 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self report and last measure weight (76,4% made within 2 weeks prior to delivery) 	Birth weight: G1: 3227 (440) G2: 3358 (467) Gestational diabetes, %: G1: 5.8 G2: 9.6 Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Adjusted birthweight Groups BMI ≤ 29 G1: gain < range G2: gain in the range G3: gain > range BMI >29 G4: gain <6.0 kg G5: gain >6.0 kg Results G1 Black 3027 White 3246 G2 Black 3177 White 3233 G3 Black 3293 White 3523 G4 Black 3214 White 3500 G5 Black 3553 White 3596 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal height Education Parity Marital status Smoking Alcohol use Hypertension GDM Gestational age at delivery SES Time between last weight and delivery Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Infant sex 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Luke et al., 1996</p> <p>Country and setting: USA, clinic</p> <p>Enrollment Period: March 1, 1974 to June 15, 1979</p> <p>Funding: NR</p> <p>Study Objective: Reanalysis of original data to examine contribution of maternal weight gain to infant birth weight and retained maternal weight in immediate postpartum period, and effect of weight gains below, at, and above IOM guidelines on both infant birth</p> <p>Time frame: March 1, 1974 to June 15, 1979</p> <p>Duration of the study: Prenatal visit through 2 days postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 487</p> <p>Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI > 26.0</p> <p>Group N: G1: 104 G2: 268 G3: 115</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Referred for nutrition counseling > 37- < 43 weeks gestation Singleton pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with history of or concurrent metabolic disease, such as diabetes, seizure disorder, hypertension, cardiac disease, asthma, or drug dependence Women developing antepartum complications such as preeclampsia, GDM, or multiple gestation 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 47.9 (5.1) G2: 58.7 (6.3) G3: 83.9 (16.9)</p> <p>Pregravid BMI: G1: 18.3 (1.0) G2: 22.6 (1.7) G3: 31.7 (5.3)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 23.1 (5.5) G2: 23.8 (5.5) G3: 27.4 (6.2)</p> <p>Parity: % primipara: G1: 60.6 G2: 48.1 G3: 27.0</p>	<p>Race,%: White NR</p> <p>Black G1: 48.1 G2: 48.8 G3: 63.5</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: G1: 17.3 G2: 15.3 G3: 13.0</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 104 G2: 268 G3: 115 Total weight gain: G1: 12.6 (0.7) G2: 13.2 (0.4) G3: 11.7 (0.7) Significantly different from mean for normal BMI group at $P < 0.05$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: total weight gain: difference between last measurement and pregravid weight; net weight gain: difference between pregravid weight and last measured weight minus infant birth weight 	Birth weight: G1: 3,067 (44) $P < 0.05$ significantly different from mean for normal BMI G2: 3308 (27) G3: 3300 (43) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Net gain (kg): 9.5 (0.6), 9.9 (0.4), 7.8 (0.6) significantly different from mean for normal BMI group at $P < 0.05$ Retained weight (kg): 6.6 (0.6), 6.6 (0.4), 4.2 (0.6) significantly different from mean for normal BMI group at $P < 0.05$ Percent retained weight (%): 11.4 (0.9), 9.4 (0.5), 4.4 (0.8) significantly different from mean for normal BMI group at $P < 0.05$ Other infant outcomes: NA	Outcomes Description: Adjusted birthweight Groups G1: Gain <IOM G2: gain equal to IOM G3: gain > IOM Results G1: BMI <19.8 2873g* BMI 19.8-26.0 3157 g* BMI >26 3138 g G2: BMI <19.8 3190 g BMI 19.8-26 3298g BMI >26 3338g G3 BMI <19.8 3489g* BMI 19.8-26 3494g* BMI >26 3347g * significantly different from gains within range within each BMI grouping Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal age Parity Black ethnicity Smoking Gestational duration Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> fetal sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: May, 2007 Country and setting: United States, WIC clinics Enrollment period: As of February 2001 Funding: NR Study Objective: Study was designed to test predictors of infant birth weight based on categories of prepregnancy BMI, GWG, and smoking Time frame: As of February 2001 Duration of the study: NR	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 233 Group Description: G1: Total NR Group N: G1: 233 NR Inclusion criteria: <ul style="list-style-type: none"> Singleton live birth with gestation length between 36 to 44 weeks Exclusion criteria: NR	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 70.3kg (20.4) Pregravid BMI: G1: 26.7kg (7.0) <ul style="list-style-type: none"> Imputed: No <ul style="list-style-type: none"> Categorized: IOM guidelines Age (mean, yrs): G1: 24.7 (5.3) Parity: G1: 29.2% Primipara	Race, %: White G1: 58.8 Black G1: NR Hispanic G1: 31.8 Asian/Pacific Islander G1: NR Other G1: 9.4 Smoking, %: G1: 23.6% Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR Total weight gain: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Birthweight Beta's from multiple linear regression Groups G1: Below IOM G2: Greater IOM Results G1: -162 g G2: -153 g Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Maternal BMI Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 1 Good, 6 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Nielsen et al., 2006 Country and setting: USA, clinic Enrollment Period: 1990 to 2000 Funding: NR Study Objective: To examine whether such weight gains improve birth outcomes in a cohort of disadvantaged African American adolescents Time frame: 1990 to 2000 Duration of the study: First prenatal care visit to delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 815 Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI > 26.0 Group N: G1: 193 G2: 431 G3: 191 Inclusion criteria: <ul style="list-style-type: none"> Adolescents ≤ 17 years at conception African American pregnancies Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: 18.3 (1.1) G2: 22.4 (1.6) G3: 30.9 (4.6) Imputed: <ul style="list-style-type: none"> Yes Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: mean age at infant birth (SD): 16.9 (1.2) G2: 16.8 (1.1) G3: 17.0 (1.1) Parity: % primiparous: G1: 83.9 G2: 85.2 G3: 74.9	Race, %: White NR Black G1: 100 G2: 100 G3: 100 Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 11.4 G2: 9.7 G3: 10.5 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 193 G2: 431 G3: 191 Total weight gain: G1: < IOM: 30.3%; lower half of IOM: 18.1%; upper half of IOM: 21.9%; > IOM: 29.7% G2: < IOM: 31.3%; lower half of IOM: 16.1%; upper half of IOM: 17.6%; > IOM: 35.0% G3: < IOM: 16.5%; lower half of IOM: 9.4%; upper half of IOM: 10.6%; > IOM: 63.5 Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight within 4 weeks delivery and self-reported prepregnancy weight 	Birth weight: G1: 2899 (595) G2: 3083 (645) <i>P</i> < 0.005 compared to BMI < 19.8 G3: 3181 (673) <i>P</i> < 0.005 compared to BMI < 19.8 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Size for gestational age (small, average, large) Birth weight category (suboptimal < 3000g, optimal 3000-4000g, above optimal > 4000g) 	Outcomes Description: Adjusted birthweight in grams Groups G1: <IOM G2: lower half IOM range G3: Upper half IOM range G4: >IOM Results Adjusted birthweight <19.8 grams G1: 2986 g G2: 3167 g G3: 3198 g G4: 3277 g All significantly different from each other except G2 & G3 Adjusted birthweight 19.8 to 26 grams G1: 3018 g G2: 3166 g G3: 3255 g G4: 3318 g All significantly different from each other Adjusted birthweight >26 grams G1: 3127 g G2: 3351 g G3: 3384 g G4: 3434 g G1 significantly different from the others, G2 , G3 & G4 not significantly different from each other Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Pre-gravid BMI Pre-eclampsia Time between last weight measure and delivery Height Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Infant sex 	Background: Good Sample selection: Fair Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ogunyemi et al., 1999</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1990 to 1995</p> <p>Funding: NR</p> <p>Study Objective: To test IOM guidelines in a predominantly rural black population</p> <p>Time frame: 1990 to 1995</p> <p>Duration of the study: 582 women who delivered and then their medical record was abstracted</p>	<p>Design:</p> <ul style="list-style-type: none"> Other observational : 582 women consecutive women who delivered Retrospective <p>Total Study N: 582</p> <p>Group Description: G1: Underweight G2: Normal G3: Overweight G4: Obese </p> <p>Group N: G1: 78 G2: 223 G3: 78 G4: 203 </p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Single child > 37 weeks gestation Black Registration for prenatal care within first trimester of pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Difference between recalled pregravid weight and measured first trimester weight was $\geq 10\%$ 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 20.3 G2: 22.1 G3: 23.7 G4: 25.4 ($P < 0.01$) </p> <p>Parity: G1: # nulliparous: 53 G2: 54 G3: 42 G4: 26 ($P < 0.01$) </p>	<p>Race, %: White NR Black G1: 100 G2: 100 G3: 100 G4: 100 Hispanic NR Asian/Pacific Islander NR Other NR </p> <p>Smoking, %: NR </p> <p>Diabetes mellitus, %: G1: n = 0 G2: n = 4 G3: n = 3 G4: n = 8 ($P = 0.02$) </p> <p>Hypertension, %: G1: n = 1 G2: n = 2 G3: n = 4 G4: n = 14 ($P < 0.01$) </p> <p>Additional characteristics: NR </p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 196 G2: 181 G3: 205 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: weight at last prenatal visit 	Birth weight: G1: 3,029 G2: 3,210 G3: 3,283 ($P < 0.01$) Gestational diabetes, %: G1: n = 0 G2: n = 4 G3: n = 3 G4: n = 8 ($P = 0.02$) Cesarean delivery, %: G1: n = 20 G2: n = 10 G3: n = 17 ($P = 0.02$) Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: <ul style="list-style-type: none"> Asthma, preeclampsia Vomiting C-section Other infant outcomes: <ul style="list-style-type: none"> Low birth weight Fetal distress NICU 	Outcomes Description: Birthweight Groups G1: Low <IOM G2: Normal =IOM G3: High >IOM Results G1: 3,029 G2: 3,210 G3: 3,283 $P < 0.01$ Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Fair Sample selection: Poor Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Scholl et al., 1995</p> <p>Country and setting: USA, Camden Study</p> <p>Enrollment Period: September 1985 to May 1990</p> <p>Funding: NIH</p> <p>Study Objective: To determine whether risk of maternal overweight associated with an excessive rate of gestational weight gain needs to be balanced against risk of impaired fetal growth associated with low rate of gain</p> <p>Time frame: September 1985 to May 1990</p> <p>Duration of the study: During pregnancy through 6 months postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 274</p> <p>Group Description: G1: Low rate of GWG G2: Moderate rate of GWG G3: Excessive rate of GWG</p> <p>Group N: G1: 59 G2: 138 G3: 77</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with pregravid BMI 19.8-26.0 Enrolled before January 1988 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing information from delivery to 6 months postpartum Pregravid under or over weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 8.5 G2: 10.9 G3: 10.4 Black G1: 61.0 G2: 59.4 G3: 62.3 Hispanic G1: 30.5 G2: 29.7 G3: 27.3 Asian/Pacific Islander NR</p> <p>Smoking, %: G1: 30.5 G2: 26.8 G3: 26.9</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 59 G2: 138 G3: 77 Total weight gain: G1: Gestation duration (wk)38.5 (0.28) $P < 0.05$, low vs. moderate plus excessive weight gain G2: 39.2 (0.17) G3: 39.4 (0.24) Categorized: <ul style="list-style-type: none"> According to IOM rate of gestational weight gain measured between 20 to 36 weeks: low GWG = < 0.34kg/wk; moderate GWG = $0.34-0.68$ kg/wk; excessive GWG = > 0.68 kg/wk Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3,049 (56.94) $P < 0.05$, low vs. moderate plus excessive weight gain G2: 3,208 (36.33) G3: 39.4 (0.24) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Birthweight (g) Groups Rate between 20-36 wks G1: low rate <0.34 kg/wk G2: moderate rate $0.34-0.68$ kg/wk G3: Excessive rate >0.68 kg/wk Results G1: 3049 (56.94) $P < 0.05$, low vs. moderate plus excessive weight gain G2: 3208 (36.33) G3: 39.4 (0.24) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stevens-Simon and McAnarney, 1992</p> <p>Country and setting: USA, adolescent maternity program</p> <p>Enrollment Period: 1986 to 1989</p> <p>Funding: Grant from Bureau of Maternal and Child Health</p> <p>Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents</p> <p>Time frame: 1986 to 1989</p> <p>Duration of the study: Entry into prenatal care through 6 weeks PP check up</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 141 (107 included in postpartum analyses)</p> <p>Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers</p> <p>Group N: G1: 28 G2: 66 G3: 47</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5)</p> <p>Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2)</p> <ul style="list-style-type: none"> Imputed: No Categorized: Continuous <p>Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 41. Gestational weight gain with reference to IOM recommendations and infant birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOMslow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) $P < 0.0001$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Birth weight Groups G1: slow <0.23 kg/wk G2: average 0.23-4 kg/wk G3: rapid >0.4 kg/wk Results G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) $P < 0.0001$ No difference in pre-gravid by weight gain groups Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) (P < 0.05) Gestational diabetes, %: G1: 14.2% G2: 4.3% (P < 0.01) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: LBW (%) Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 2.0 G2: 11.1 G3: 8.3 G4: 5.2 G5: 3.8 Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bracero and Byrne, 1997</p> <p>Country and setting: Hospital charts - Maimonides Medical Center, Brooklyn, NY</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To determine optimal weight gain in singleton pregnancy and evaluate current recommendations</p> <p>Time frame:</p> <p>Duration of the study: Jan 1, 1987 to Jan 1, 1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 20,971</p> <p>Group Description: G1: Total population G2: NR</p> <p>Group N: G1: 20,971 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Delivery at Maimonides Medical Center Singleton pregnancy No documentation of congenital anomaly, pregnancy was not terminated by abortion Documentation on chart of prepregnancy maternal weight, amount of maternal weight gain during pregnancy, and gender of infant <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Infants with any type of congenital anomaly (international classification of diseases (ICD-9-CM) codes 740.0-759.9 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: median BMI = 23.19 (range 14.46-40.07) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: % < 15 years: < 0.1; 15-19 yrs: 4.8; 20-24: 25.1; 25-29: 31.1; 30-34: 24.3; 35-39: 11.8; 40-44: 2.8; 45-49: 0.1; > 50: < 0.1 G2: NR</p> <p>Parity: % primigravida: G1: 25.1 G2: NR</p>	<p>Race, %: White G1: 92.1 G2: NR</p> <p>Black G1: 4.2 G2: NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander G1: 0.9 G2: NR</p> <p>Other G1: 2.1 G2: NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: % married: G1: 12.4 G2: NR</p> <p>Additional characteristics: Type of service: G1: Ward, 22.5% Private: 77.5% G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain:</p> <p>G1: % weight gain: lost weight, 0.4; 1 to 5lbs, 0.9; 6 to 10, 2.3; 11 to 15, 5.4; 16 to 20, 12.0; 21 to 25, 17.2; 26 to 30, 21.1; 31 to 35, 14.8; 36 to 40, 11.5; 41 to 45, 6.1; ≥ 46, 8.3</p> <p>G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> According to IOM ordinal categories in 5 pound intervals <p>Collected from:</p> <ul style="list-style-type: none"> Routine prenatal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: using last measurement obtained as an outpatient 	<p>Birth weight:</p> <p>G1: $r = .210$ correlation with maternal weight gain</p> <p>G2: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <p>Optimal weight gain defined as 36 to 40 pounds for underweight women, 31 to 40 pounds for women of ideal prepregnancy weight, 26 to 30 pounds for overweight women</p> <p>Other infant outcomes:</p> <p>Adverse outcomes:</p> <ul style="list-style-type: none"> Still birth Neonatal death Preterm delivery/low birth weight Perinatal morbidity 	<p>Outcomes Description:</p> <p>Percentage of LBW by weight gain categories</p> <p>Groups</p> <p>Maternal weight gain categories:</p> <p>G1: Maternal weight gain under the IOM guidelines</p> <p>G2: Maternal weight gain within the IOM guidelines</p> <p>G3: Maternal weight gain over the IOM guidelines</p> <p>G4: Optimal weight gain (36-40 lbs for BMI < 19.8; 31-40 lbs for BMI 19.8-26.0; 26-30 lbs for BMI > 26.0)</p> <p>G5: Suboptimal weight gain (< 36 lbs for BMI < 19.8; < 31 lbs for BMI 19.8-26.0; < 26 lbs for BMI > 26.0)</p> <p>Results</p> <p>G1: 10.1%</p> <p>G2: 3.3%</p> <p>G3: 2.5% ($P < 0.001$ comparing G1-G3)</p> <p>G4: 4.9%</p> <p>G5: 1.8% ($P < 0.001$ vs. G4)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NA</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NA</p>	<p>Background: Fair</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Cogswell et al., 1994</p> <p>Country and setting: USA, Pregnancy Nutrition Surveillance System</p> <p>Enrollment Period: 1990-1991</p> <p>Funding: NR</p> <p>Study Objective: To determine association between increased gestational weight gain and birth weight outcomes for low income women</p> <p>Time frame: 1990-1991</p> <p>Duration of the study: Women in WIC but everything is self reported so it is when they were first enrolled in WIC until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 53,541</p> <p>Group Description: G1: Average weight G2: Overweight G3: Very overweight</p> <p>Group N: G1: 33,809 G2: 7,661 G3: 12,071</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, black and hispanic women who delivered single, liveborn, term infants <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Low or high values for; birth weight, prepregnancy BMI, or weight gain during pregnancy Missing data on one or more study variables Underweight women Only 1 infant was used in analysis for women who delivered more than once during study period 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 11-17 yr: 11.9% 18-34yr: 85.0% 35-54 yr: 3.1% G2: 11-17 yr: 6.9% 18-34yr: 88.7% 35-54 yr: 4.4% G3: 11-17 yr: 4.0% 18-34yr: 90.1% 35-54 yr: 6.0%</p> <p>Parity: NR</p>	<p>Race, %: White G1: 75.1 G2: 72.4 G3: 74.5 Black G1: 13.8 G2: 14.1 G3: 16.1 Hispanic G1: 11.1 G2: 13.5 G3: 9.4 Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 29.9 G2: 28.3 G3: 25.7</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 33,809 G2: 7,661 G3: 12,071 Total weight gain: G1: < 15 lb: 6.2% 15-19: 5.8% 20-24: 11.2% 25-29: 14.4% 30-34: 17.1% 35-39: 13.9% ≥ 40: 31.4% G2: < 15 lb: 11.4% 15-19: 7.8% 20-24: 13.0% 25-29: 12.7% 30-34: 15.9% 35-39: 11.2% ≥ 40: 28.1% G3: < 15 lb: 25.1% 15-19: 10.1% 20-24: 1 Categorized: <ul style="list-style-type: none"> 4 lbs increments starting at 15 lbs Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: < 2500g: 2.7% 2500-4000g: 87.5% > 4000-4500: 8.5% > 4500g: 1.4% G2: < 2500g: 2.5% 2500-4000g: 83.9% > 4000-4500: 11.7% > 4500g: 2.0% G3: < 2500g: 2.1% 2500-4000g: 81.1% > 4000-4500: 13.2% > 4500g: 3.6% Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AOR (95% CI) for low birth weight Groups Maternal weight gain categories (lbs) stratified by pregravid BMI: Normal weight (BMI 19.8-26.0): G1: < 15 G2: 15-19 G3: 20-24 G4: 25-29 G5: 30-34 G6: 35-39 G7: ≥ 40 Overweight (BMI > 26.0-29.0): G8: < 15 G9: 15-19 G10: 20-24 G11: 25-29 G12: 30-34 G13: 35-39 G14: ≥ 40 Obese (BMI > 29.0): G15: < 15 G16: 15-19 G17: 20-24 G18: 25-29 Results G1: 2.1 (1.6-2.6) G2: 1.4 (1.1-1.8) G3: 1.0 (0.8-1.3) G4: 1.0 (reference) G5: 0.8 (0.6-1.0) G6: 0.6 (0.5-0.8) G7: 0.5 (0.4-0.6) G8: 1.1 (0.7-1.9) G9: 1.0 (reference) G10: 0.7 (0.4-1.2) G11: 0.8 (0.5-1.4) G12: 0.5 (0.3-0.8) G13: 0.6 (0.3-1.1) G14: 0.4 (0.3-0.7) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race height Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Sex of infant 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Edwards et al., 1996</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1997-1993</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change</p> <p>Time frame: 1997-1993</p> <p>Duration of the study: 1997-1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,443</p> <p>Group Description: G1: Obese G2: Normal Weight G3: total sample</p> <p>Group N: G1: 683 G2: 660</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Fetal deaths 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 103.5 G2: 61</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) <p>Age (mean, yrs): G1: 27.1 G2: 25.4</p> <p>Parity: NR</p>	<p>Race,%: White G1: NR G2: NR G3: 69.0 (Total sample)</p> <p>Black G1: NR G2: NR G3: 21.0 (Total sample)</p> <p>Hispanic G1: NR G2: NR G3: 7.0 (Total sample)</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: NR G2: NR G3: 4.0 (Total sample)</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Percentage of LBW by weight gain categories Groups Maternal weight gain categories (kg) Obese BMI > 29: G1: Lost weight/no change G2: 0.5-6.5 G3: 7-11.5 G4: 12-16 G5: > 16 Normal BMI 19.8-26 G6: < 11.5kg G7: 11.5-16 G8: > 16kg Results G1: 12.8% G2: 8.9% G3: 7.9% G4: 6.8% G5: 8.7% P (for G1-G5) = 0.405 G6: 8.5% G7: 5.6% G8: 8.9% P (for G6-G8) = 0.183 AOR (95%CI) for birthweight < 2500g among obese women (BMI > 29.0): G3: 1.0 (reference) G1: 4.2 (0.9-19.6) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI GDM Pregnancy induced hypertension Prenatal adequacy Alcohol use Drug use Smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hellerstedt et al., 1997</p> <p>Country and setting: United States, medical center</p> <p>Enrollment Period: 1977-1993</p> <p>Funding: NR</p> <p>Study Objective: To examine association between infant birth outcomes and maternal pregravid obesity, gestational weight gain, and prenatal smoking</p> <p>Time frame: 1977 to 1993</p> <p>Duration of the study: Entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,343</p> <p>Group Description: G1: Obese G2: Normal weight</p> <p>Group N: G1: 683 G2: 660</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese and normal-weight women delivering singleton during study period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Siblings Fetal deaths 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 103.5 kg (13.7) G2: 61.1kg (5.9)</p> <p>Pregravid BMI: G1: 38.3 (4.6) G2: 22.8 (1.6)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: NR</p> <ul style="list-style-type: none"> 16-34 years: 91% ≥ 35 years: 8.8% <p>G2: NR</p> <ul style="list-style-type: none"> 16-34 years: 93.5% ≥ 35 years: 5.8% <p>Parity: G1: NR</p> <ul style="list-style-type: none"> 0: 31.8% 1-3: 64.7% ≥ 4: 3.5% <p>G2: NR</p> <ul style="list-style-type: none"> 0: 33.3% 1-3: 64.9% ≥ 4: 1.8% 	<p>Race, %: White G1: 68.8 G2: 69.1</p> <p>Black G1: 20.4 G2: 20.6</p> <p>Hispanic G1: 6.6 G2: 6.5</p> <p>Asian/Pacific Islander G1: Native Am: 3.8 G2: Native Am: 3.2</p> <p>Other NR</p> <p>Smoking, %: G1: 26.4 G2: 26.2</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Percentage of LBW by weight gain categories and smoking status Groups Maternal weight gain categories stratified by pregravid BMI and smoking status: Obese (BMI > 29.0): G1: Smokers, < IOM G2: Smokers, within IOM G3: Smokers, > IOM G4: Nonsmokers, < IOM G5: Nonsmokers, within IOM G6: Nonsmokers, > IOM Normal weight (BMI 19.8-26.0): G7: Smokers, < IOM G8: Smokers, within IOM G9: Smokers, > IOM G10: Nonsmokers, < IOM G11: Nonsmokers, within IOM G12: Nonsmokers, > IOM Obese: G13: Lost/no gain G14: 0.5-6.5 kg G15: 7-11.5 kg G16: 12-16 kg G17: > 16 kg Normal weight: G18: < 11.5kg G19: 11.5-16kg G20: > 16kg Results G1: 17.3% G2: 10.0% G3: 12.3% G4: 10.5% G5: 7.8% G6: 2.6% G7: 17.5% G8: 3.5% G9: 3.6% G10: 12.4% G11: 6.0% G12: 5.3%	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Hellerstedt et al., 1997
(continued)

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>G13: 16.0%</p> <p>G14: 11.1%</p> <p>G15: 8.3%</p> <p>G16: 4.0%</p> <p>G17: 6.0%</p> <p><i>P</i> = 0.003 for G13-G17</p> <p>G18: 14.2%</p> <p>G19: 5.4%</p> <p>G20: 4.9%</p> <p><i>P</i> = 0.001 for G18-G20</p> <p>For obese women, compared to nonsmokers who gained 7-11.5 kg, smokers who gained < 7 kg were at significantly higher risk of LBW: AOR: 7.7 (95% CI, 1.5-40.0)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Maternal age, pregravid BMI, infant sex, race, parity, prenatal alcohol use, prenatal illicit drug use, adequacy of prenatal care, gestational hypertension, GDM</p> <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age 	

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hickey et al., 1997</p> <p>Country and setting: USA, public health programs</p> <p>Enrollment Period: Jan 1993 to Dec 1994</p> <p>Funding: MCH grant, University of Alabama School of Public Health/NIH Intramural Basic Sciences Research grant</p> <p>Study Objective: Examine differences in birth weight among term infants of black and white women with weight gains in upper or lower half of recommended ranges</p> <p>Time frame: Jan 1993 to Dec 1994</p> <p>Duration of the study: From first visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 5198</p> <p>Group Description: G1: Black G2: White</p> <p>Group N: G1: 2219 G2: 3699</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women enrolled in Medicaid Maternity Waiver programs operated in 24 counties by Alabama Department of Public Health during study period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Delivered before 37 weeks or after 42 weeks Maternal age ≤ 17 years Last prenatal weight recording more than 3 weeks before delivery Maternal risk factors (diabetic, cardiac, genetic, and obstetric conditions/complications) requiring external referral Multiple fetuses Stillborn/neonatal death Missing or outlying anthropometric data Missing data for ethnicity Missing gestational age Congenital anomalies Missing birth weight Invalid country code 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 70.8 (19.6) G2: 65.8 (17.6)</p> <p>Pregravid BMI: G1: 26.6 (7.1) G2: 24.8 (6.3)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 23.7 (5.0) G2: 23.4 (4.6)</p> <p>Parity:</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 9.2 G2: 35.1</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain:</p> <p>Categorized:</p> <ul style="list-style-type: none"> According to IOM gain below range (for pregravid BMI), gain in lower range, gain in upper range, gain above range <p>Collected from:</p> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	<p>Birth weight: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes: NA</p> <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Adjusted odds ratio (95% CI) for LBW by weight gain categories</p> <p>Groups Maternal weight gain categories stratified by race: Black Women: G1: Below range (< 12.5kg for BMI< 19.8; < 13.9kg for BMI 19.8-26.0; < 7.0kg for BMI > 26.0) G2: In lower range (12.5-15.2kg for BMI< 19.8; 11.5-13.8kg for BMI 19.8-26.0; 7.0-9.2kg for BMI > 26.0) G3: In upper range (15.3-18kg for BMI< 19.8; 13.9-16.0kg for BMI 19.8-26.0; 9.3-11.5kg for BMI > 26.0)</p> <p>Results G1: 2.6 (1.2-5.6) G2: 1.0 (reference) G3: 1.2 (0.4-3.3) G4: 1.4 (0.6-3.6) G5: 1.5 (0.8-2.6) G6: 1.0 (reference) G7: 0.4 (0.2-0.9) G8: 0.7 (0.3-1.2)</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Age Education Height Drug use Alcohol use Time between last prenatal weight observation and delivery Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Gestational age Infant sex 	<p>Background: Good</p> <p>Sample selection: Good</p> <p>Definition of maternal weight gain: Poor</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Good</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hulse et al., 2005</p> <p>Country and setting: USA, birth certificates linked to PRAMS data</p> <p>Enrollment Period: 1998 to 1999</p> <p>Funding: NR</p> <p>Study Objective: To describe proportion of low birth weight that could be potentially prevented by programs focusing on maternal prepregnant BMI and/or weight gain during pregnancy</p> <p>Time frame: 1998 to 1999</p> <p>Duration of the study: Cross-sectional women surveyed after delivery (PRAMS)</p>	<p>Design:</p> <ul style="list-style-type: none"> Cross-sectional Retrospective <p>Total Study N: 87,293</p> <p>Group Description:</p> <p>G1: Total</p> <p>G2: BMI < 19.8 (U-BMI)</p> <p>G3: BMI 19.8-26 (N-BMI)</p> <p>G4: BMI 26.1-29.0 (OW-BMI)</p> <p>G5: BMI > 29.0 (O-BMI)</p> <p>Group N:</p> <p>G1: 87,293 (100%)</p> <p>G2: 16.2% (Note: corrected Discrepancy between Table 1 values and Results text/Table 2&3 values)</p> <p>G3: 52.6%(Note: corrected Discrepancy between Table 1 values and Results text/Table 2&3 values)</p> <p>G4: 11.5%(Note: correcte</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Ddata consist of birth certificates linked to PRAMS for South Carolina resident women delivering in South Carolina during 1998 and 1999 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> BW < 500 g 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%:</p> <p>White</p> <p>G1: 56.3</p> <p>G2: 18.6</p> <p>G3: 55.7</p> <p>G4: 10.9</p> <p>G5: 19.2 ($P < 0.0001$)</p> <p>Black</p> <p>G1: 43.7</p> <p>G2: 11.9</p> <p>G3: 49.3</p> <p>G4: 14.3</p> <p>G5: 24.6</p> <p>Hispanic</p> <p>NR</p> <p>Asian/Pacific Islander</p> <p>NR</p> <p>Other</p> <p>NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%:</p> <p>G1: 4.1</p> <p>G2: 3.7</p> <p>G3: 36.4</p> <p>G4: 21.1</p> <p>G5: 38.8 $P < 0.09$</p> <p>Hypertension,%:</p> <p>G1: 4.8</p> <p>G2: 7.8</p> <p>G3: 36.4</p> <p>G4: 15.2</p> <p>G5: 40.6 ($P < 0.56$)</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: NR <ul style="list-style-type: none"> Adequate: 72.3% Less than adequate: 27.7 G2: NR <ul style="list-style-type: none"> Adequate: 14.9% Less than adequate: 19.6 G3: <ul style="list-style-type: none"> Adequate: 52.1% Less than adequate: 53.9 G4: <ul style="list-style-type: none"> Adequate: 13.6% Less than adequate: 5.9 G5: <ul style="list-style-type: none"> Adequate: 19.4% Less than adequate: 20.7 Categorized: <ul style="list-style-type: none"> According to IOMLTA = less than adequate; AWG = adequate weight gain 	Birth weight: NR Gestational diabetes, %: G1: 4.1 G2: 3.7 G3: 36.4 G4: 21.1 G5: 38.8 $P < 0.09$ Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Adjusted odds ratio for low birth weight by categories of weight gain Groups Pregravid BMI and gestational weight gain categories: G1: BMI < 19.8 and < IOM G2: BMI 19.8-26.0 and < IOM G3: BMI 19.8-26.0 and within IOM G4: BMI 26.1-29.0 and < IOM G5: BMI > 29.0 and < IOM G6: BMI > 29.0 and within IOM Results AOR (95% CI) for very low birth weight (500-1,499g): G1: 2.06 (1.26-2.87) G2: 1.82 (1.22-2.29) G3: 1.00 (reference) G4: 2.05 (0.90-4.44) G5: 1.25 (0.61-1.61) G6: 1.74 (1.23-2.42) AOR (95% CI) for moderately low birth weight (1500-2499g): G1: 4.83 (2.98-7.83) G2: 1.77 (1.23-2.60) G3: 1.00 (reference) G4: 0.28 (0.11-1.83) G5: 1.09 (0.67-2.13) Maternal confounders and effect modifiers accounted for in analysis: Ethnicity, intendedness of pregnancy, Medicaid status, WIC status, prenatal care, diabetes, hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 4 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Hulsey et al., 2005
(continued)

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Collected from:</p> <ul style="list-style-type: none"> To determine LTA and AWG:for each BMI group, weight gain at 20 weeks was determined from formula (12.6 lbs for U-BMI; 10.6 lbs for NBMI;6.8 lbs for OW-BMI; and 3.8 lbs for O-BMI). Next, lowest total weight gain expected from the weight gain range for women delivering at term, for each BMI, was obtained(for U-BMI, 28 lbs; N-BMI, 25 lbs; OW-BMI, 15 lbs; andO-BMI, 15 lbs). The weight gain expected at 20 weeks was then subtracted from the total weight gain to arrive at weight gain after 20 weeks. This was then divided by 20 to determine the expected weight gain per week after the 20th week of gestation.Weight gain after the 20th week of gestation is linear toterm. Each delivery was then categorized as having LTA or AWG adjusted for gestational age and prepregnant BMI. <p>Ascertained by:</p> <ul style="list-style-type: none"> Self-reported 			

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nida et al., 1996</p> <p>Country and setting: United States, multi-center</p> <p>Enrollment Period: April 1988 to March 1995</p> <p>Funding: Funding for the PRAMS Program is provided in part by the Centers for Disease Control and Prevention, Atlanta, GA (Grant No. U50/CCU602873-07), and Maternal and Child Health Bureau, Department of Health and Human Services</p> <p>Study Objective: To examine pre-pregnancy weight, prenatal weight gain and their relationship to low (< 2,500 grams) birth weight</p> <p>Time frame: April 1988-March 1995</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: NR. PRAMS data in OK collects data on 200 mothers/month. Report reflects data with 71% response rate</p> <p>Group Description: G1: Low BMI/less than recommended weight gain G2: Normal BMI/within recommended weight gain G3: High BMI/over recommended wt gain</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> New mothers of singleton births from state's live birth registry <p>Exclusion criteria: NR</p>	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: Age < 20: 21.2% (15.5-26.9) 20-24: 35.5% (29.2-41.8) 25-29: 24.2% (18.7-29.7) 30-34: 15.2% (10.9-19.5) 35+: 3.9% (1.7-6.1) [numbers in () are 95% CI] G2: Age < 20: 10.9% (8.5-13.3) 20-24: 30.0% (26.9-33.1) 25-29: 31.6% (28.7-34.5) 30-34: 19.2% (16.7-21.8) 35+: 8.3% (6.5-10.1) G3: Age < 20: 12.5% (8.7-16.2) 20-24: 33.9% (29.0-38.8) 25-29: 29.2% (24.7-33.7) 30-34: 17.5% (14.0-21.0) 35+: 6.9% (4.6-9.3)</p> <p>Parity: NR</p>	<p>Race, %: White G1: 84.7 (79.9-89.7) G2: 85.1 (82.5-87.6) G3: 75.5 (71.0-80.0) Black G1: 9.8 (5.5 - 14.1) G2: 5.8 (4.0-7.6) G3: 11.4 (7.7-15.1) Hispanic NR Asian/Pacific Islander NR Other G1: Native Am 3.9 (1.4-6.5) G2: Native Am 7.5 (5.7-9.3) G3: Native Am 12.6 (9.3-15.9)</p> <p>Smoking, %: G1: Prenatal smoking: 26.2% (20.5-31.9) G2: 19.5 % (16.8-22.2) G3: 21.6 (17.2-26.0)</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: G1: Education < 12 years: 21.7% (15.6-27.8); 12+ years: 78.3% (72.2-84.4) G2: Education < 12 years: 13.2% (10.5-15.9), 12+ years: 86.8% (84.1-89.5) G3: Education: < 12 years: 14.8% (10.8-18.8) 12+ years: 85.2% (81.2-89.2)</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: Percent LBW: 10.2%/ 6%/ 4.7% G2: 8.4%/ 3.9%/ 4.5% G3: 6.1%/ 3.8%/ 5.1% Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> LBW by smoking status by BMI and prenatal weight gain Groups: G1: Low BMI/less than recommended weight gain G2: Normal BMI/within recommended weight gain G3: High BMI/over recommended wt gain Results: Low BMI: less than rec weight gain G1: 16.9 (12.2-21.6) G2: 7.7 (6.1-9.3) Low BMI: within recommended G1: 12.7 (9.4-16.0) G2: 4.2 (3.4-5.0) Low BMI: more than recommended G1: 6.5 (14.3-8.7) G2: 3.6 (2.8-4.4) Normal BMI: less than recommended G1: 12.9 (9.6-16.2) G2: 6.9 (5.7-8.1) Normal BMI: within recommended G1: 6.9 (5.3-8.5) G2: 3.2 (2.8-3.6) Normal BMI; more than recommended G1: 8.9 (7.1-10.7) G2: 3.3 (2.9-3.7) High BMI: less than recommended G1: 7.7 (4.0-11.4) G2: 5.4 (3.8-7.0) High BMI: within recommended G1: 4.6 (2.6-6.6) G2: 3.4 (2.6-4.2) High BMI: more than recommended G1: 7.5 (5.2-9.9) G2: 4.5 (3.7-5.3) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Poor Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 0 Good, 4 Fair, 5 Poor Final Quality Score: Poor

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Ogunyemi et al., 1999</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1990 to 1995</p> <p>Funding: NR</p> <p>Study Objective: To test IOM guidelines in a predominantly rural black population</p> <p>Time frame: 1990 to 1995</p> <p>Duration of the study: 582 women who delivered and then their medical record was abstracted</p>	<p>Design:</p> <ul style="list-style-type: none"> Other observational : 582 women consecutive women who delivered Retrospective <p>Total Study N: 582</p> <p>Group Description: G1: Underweight G2: Normal G3: Overweight G4: Obese</p> <p>Group N: G1: 78 G2: 223 G3: 78 G4: 203</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Single child > 37 weeks gestation Black Registration for prenatal care within first trimester of pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Difference between recalled pregravid weight and measured first trimester weight was $\geq 10\%$ 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 20.3 G2: 22.1 G3: 23.7 G4: 25.4 ($P < 0.01$)</p> <p>Parity: G1: # nulliparous: 53 G2: 54 G3: 42 G4: 26 ($P < 0.01$)</p>	<p>Race,%: White NR Black G1: 100 G2: 100 G3: 100 G4: 100 Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: G1: n = 0 G2: n = 4 G3: n = 3 G4: n = 8 ($P = 0.02$)</p> <p>Hypertension,%: G1: n = 1 G2: n = 2 G3: n = 4 G4: n = 14 ($P < 0.01$)</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 196 G2: 181 G3: 205	Birth weight: G1: 3,029 G2: 3,210 G3: 3,283 ($P < 0.01$)	Outcomes Description: Adjusted odds ratio for low birth weight by weight gain categories	Background: Fair
Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: weight at last prenatal visit 	Gestational diabetes, %: G1: n = 0 G2: n = 4 G3: n = 3 G4: n = 8 ($P = 0.02$) Cesarean delivery, %: G1: n = 20 G2: n = 10 G3: n = 17 ($P = 0.02$) Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: asthma, preeclampsia, vomiting, c-section Other infant outcomes: low birth weight, fetal distress, NICU	Groups Maternal weight gain categories: G1: < IOM G2: Within IOM G3: > IOM BMI IOM Results AOR (95% CI) for very low birth weight: G1: 1.8 (0.6-4.7) G2: 1.1 (0.4-4.7) G3: 1.0 (Reference) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pregravid BMI Pre-eclampsia C-section Previous cesarean Tobacco use Previous fetal death Hypertension Asthma Previous LBW Vomiting NICU Infant and child confounders and effect modifiers accounted for in analysis: NR	Sample selection: Poor Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Schieve, 1998</p> <p>Country and setting: Pregnancy Nutrition Surveillance System - data from WIC clinics (99%) from Indiana, Kansas, Massachusetts, Minnesota, Nebraska, North Dakota, New York, Tennessee, and Vermont</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To examine associations between pregnancy weight gain outside and within ranges recommended by IOM and birth weight by both prepregnant BMI and race ethnicity</p> <p>Time frame: NR</p> <p>Duration of the study: 1990 to 1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 173,066</p> <p>Group Description: NR</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, black, and hispanic women who visited WIC clinics prenatally and subsequently delivered liveborn, singleton infants Delivered between 39 and 41 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data for infant birth weight (n = 4223) Prepregnant BMI (n = 31477) Pregnancy weight gain (n = 7542) Maternal age (n = 43) Maternal education (n = 3819) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized: IOM Guidelines</p> <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 112,524 G2: 33,101 G3: 27,441 Total weight gain: G1: 32.5 G2: 30.5 G3: 30.2 <i>Categorized:</i> <i>According to IOM >10 pounds below lower bound of IOM recommended range for woman's prepregnant BMI, 1-9 pounds below lower bound of IOM lower bound, in lower half of IOM recommended range, in upper half of IOM range, 1-9 pounds above IOM range, >10 pounds above IOM upper bound</i> <i>Collected from:</i> <ul style="list-style-type: none"> Self-reported <i>Ascertained by:</i> <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> NA Other infant outcomes <ul style="list-style-type: none"> NA 	Outcomes Description: Distribution of LBW, %: Groups Maternal weight gain categories stratified by pregravid BMI (IOM underweight, normal weight, overweight, and obese) and race (non-Hispanic white, non-Hispanic black, and Hispanic): G1: > = 10 lbs below IOM G2: 1-9 lbs below IOM G3: Lower half of IOM G4: Upper half of IOM G5: 1-9 lbs above IOM G6 > = 10lbs above IOM Results G1: 2.7 (2.1-3.5), 1.6 (1.3-1.9), 1.0, 0.7 (0.6-0.9), 0.4 (0.3,0.6), 0.4 (0.3,0.6) G2: 3.2 (2.1-5.1), 2.8 (1.9-4.2), 1.0, 1.3 (0.8-2.1), 0.5 (0.2-1.03), 0.7 (0.4-1.5) G3: 2.8 (1.7-4.7), 1.1 (0.6-1.8) G4: 1.4 (0.5-4.2); 0.4 (0.2-1.2); 1.0; 2.1 (1.1-4.0); 2.8 (1.4-5.4); 7.3 (4.0-13.2) G5: no data for first category 0.6 (0.05-5.6); 1.0; 0.7 (0.06-7.3); 1.8 (0.3-13.2); 10.8 (2.3-51.4) G6: no data for first category; 0.8 (0.1-4.9); 1.0; 1.8 (0.4-8.0); 3.3 (0.8-14.1); 6.1 (1.6-24.1) Group: average BMI: ≥ 10 lb< IOM, 1-9 lb< IOM, lower IOM, upper IOM, 1-9 lb >IOM, ≥ 10 lb>IOM G1: 2.5 (2.0-3.0); 1.5 (1.3-1.8); 1.0; 0.8 (0.6-0.9); 0.6 (0.5-0.7); 0.3 (0.3-0.4) G2: 2.5 (1.9-3.3); 1.7 (1.3-2.2); 1.0; 0.7 (0.5-1.03); 0.7 (0.5-1.03); 0.6 (0.4-0.9) G3: 1.8 (1.3-2.6); 1.2 (0.9-1.6); 1.0; 0.8 (0.5-1.2); 0.6 (0.4-0.9); 0.4 (0.3-0.7) G4: 0.5 (0.3-0.9); 0.7 (0.5-0.9); 1.0; 1.7 (1.3-2.2); 2.3 (1.8-3.0); 4.2 (3.3-5.2) G5: 0.8 (0.2-2.8); 1.3 (0.5-3.2); 1.0; 1.5 (0.6-3.7); 3.6 (1.7-7.7); 5.2 (2.5-10.8) G6: 0.2 (0.1-0.99); 0.8 (0.4-1.5); 1.0; 1.3 (0.7-2.4); 1.9 (1.1-3.3); 4.6 (2.8-7.5) Group: high BMI: ≥ 10 lb< IOM, 1-9 lb< IOM, lower IOM, upper IOM, 1-9 lb >IOM, ≥ 10 lb>IOM G1: 1.1 (0.6-2.3); 1.2 (0.7-1.9); 1.0; 0.7 (0.4-1.1); 0.5 (0.3-0.8); 0.5 (0.3-0.7) G2: 1.7 (0.8-3.6); 0.9 (0.4-1.7); 1.0; 0.3 (0.2-0.8); 0.5 (0.3-0.9); 0.6 (0.3-0.97) G3: 1.5 (0.6-4.0); 1.1 (0.5-2.3); 1.0; 0.9 (0.4-1.9); 0.4 (0.2-0.9); 0.4 (0.2-0.8) G4: 0.8 ((0.3-0.9); 0.2 (0.04-0.7); 1.0; 1.1 (0.6-2.1); 1.6 (0.97-2.7); 3.5 (2.2-5.6) G5: 0.7 (0.1-6.0); 0.3 (0.03-2.3); 1.0; 1.7 (0.5-5.1); 1.6 (0.5-4.4); 2.9 (1.1-7.3)	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Schieve, 1998
(continued)

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		G6: 0.9 (0.1-7.5); 0.3 (0.04-2.9); 1.0; 0.8 (0.2-3.2); 1.4 (0.5-4.1); 5.2 (2.1-13.3) Group: obese BMI: ≥ 10 lb< IOM, 1-9 lb< IOM, lower IOM, upper IOM, 1-9 lb >IOM, ≥ 10 lb>IOM G1: 1.6 (1.04-2.4); 1.3 (0.9-2.0); 1.0; 1.1 (0.7-1.7); 0.8 (0.5-1.2); 0.8 (0.6-1.2) G2: 2.6 (1.5-4.5); 1.3 (0.7-2.3); 1.0; 1.3 (0.7-2.5); 1.1 (0.6-1.9); 1.0 (0.6-1.7) G3: 1.0 (0.4-2.5); 0.8 (0.4-1.8); 1.0; 0.8 (0.3-1.7); 0.2 (0.08-0.6); 0.5 (0.3-1.1) G4: 0.7 (0.5-0.95); 0.5 (0.4-0.7); 1.0; 1.2 (0.9-1.6); 1.3 (1.03-1.7); 2.2 (1.8-2.8) G5: 0.4 (0.2-1.1); 0.6 (0.3-1.4); 1.0; 0.9 (0.4-2.1); 1.5 (0.8-2.9); 2.8 (1.6-4.8) G6: 0.8 (0.3-2.3); 0.8 (0.3-1.8); 1.0; 1.3 (0.6-2.8); 1.4 (0.7-2.7); 2.9 (1.6-5.2)	
		Results for confounders and effect modifiers G1: Non-hispanic white adjusted mean birth weight (g) G2: Non-hispanic black adjusted mean birth weight (g) G3: Hispanic adjusted mean birth weight (g) Characteristic: low BMI: ≥ 10 lb< IOM 1-9 lb< IOM lower IOM (reference) upper IOM 1-9 lb >IOM ≥ 10 lb>IOM G1: 3,073 3,161 3,274 (ref) 3,346 3,412 3,531 G2: 2,981 3,060 3,184 (ref) 3,240 3,340 3,387 (all adjusted mean birth weights are significantly different from reference category, lower IOM $P < 0.05$) G3: 3,070 3,175 3,218 (ref) 3,309 3,381 3,493 (all adjusted mean birth weights are significantly different from reference category, lower IOM $P < 0.05$)	

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Schieve, 1998
(continued)

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Average BMI: ≥ 10 lb< IOM</p> <p>1-9 lb< IOM</p> <p>lower IOM (reference)</p> <p>upper IOM</p> <p>1-9 lb >IOM</p> <p>≥ 10 lb>IOM</p> <p>G1: 3,221</p> <p>3,314</p> <p>3,389 (ref)</p> <p>3,455</p> <p>3,509</p> <p>3,618</p> <p>G2: 3,115</p> <p>3,184</p> <p>3,254 (ref)</p> <p>3,314</p> <p>3,373</p> <p>3,445 (all adjusted mean birth weights are significantly different from reference category, lower IOM $P < 0.05$)</p> <p>G3: 3,240</p> <p>3,291</p> <p>3,366 (ref)</p> <p>3,400</p> <p>3,463</p> <p>3,568 (all adjusted mean birth weights are significantly different from reference category, lower IOM $P < 0.05$)</p> <p>Characteristic: hiGh BMI: ≥ 10 lb< IOM</p> <p>1-9 lb< IOM</p> <p>lower IOM (reference)</p> <p>upper IOM</p> <p>1-9 lb >IOM</p> <p>≥ 10 lb>IOM</p> <p>G1: 3,305</p> <p>3,335</p> <p>3,421 (ref)</p> <p>3,476;3,539</p> <p>3,630</p> <p>G2: 3,188</p> <p>3,241</p> <p>3,304 (ref)</p> <p>3,349</p> <p>3,403</p> <p>3,490 (adjusted mean birth weights for first, second, fifth, and sixth categories are significantly different from reference category, lower IOM $P < 0.05$)</p> <p>G3: 3,272</p> <p>3,331</p> <p>3,384 (ref)</p> <p>3,420</p> <p>3,471</p> <p>3,593 (adjusted mean birth weights for first, second, fifth, and sixth categories are significantly different from reference category, lower IOM $P < 0.05$)</p>	

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Schieve, 1998
(continued)

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Obese BMI: ≥ 10 lb < IOM</p> <p>1-9 lb < IOM</p> <p>lower IOM (reference)</p> <p>upper IOM</p> <p>1-9 lb > IOM</p> <p>≥ 10 lb > IOM</p> <p>G1: 3,431</p> <p>3,485</p> <p>3,528 (ref)</p> <p>3,575</p> <p>3,620</p> <p>3,700</p> <p>G2: 3,280</p> <p>3,353</p> <p>3,393 (ref)</p> <p>3,412</p> <p>3,461</p> <p>3,525 (adjusted mean birth weights for first, second, fifth, and sixth categories are significantly different from reference category, lower IOM $P < 0.05$)</p> <p>G3: 3,350</p> <p>3,420</p> <p>3,445 (ref)</p> <p>3,517</p> <p>3 (adjusted mean birth weights for first, fourth, fifth, and sixth categories are significantly different from reference category, lower IOM $P < 0.05$) 555</p> <p>3,615</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Age • Height • Education • Trimester of the Special Supplemental Nutrition Program for Women, Infants, and Children <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NR</p>	

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stevens-Simon and McAnarney, 1992</p> <p>Country and setting: USA, adolescent maternity program</p> <p>Enrollment Period: 1986 to 1989</p> <p>Funding: Grant from Bureau of Maternal and Child Health</p> <p>Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents</p> <p>Time frame: 1986 to 1989</p> <p>Duration of the study: Entry into prenatal care through 6 weeks PP check up</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 141 (107 included in postpartum analyses)</p> <p>Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers</p> <p>Group N: G1: 28 G2: 66 G3: 47</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5)</p> <p>Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

**Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOM slow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) $P < 0.0001$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Distribution of LBW, %: Groups Maternal weight gain categories (kg/wk): G1: < 0.23 G2: 0.23-0.40 G3: > 0.40 Results G1: 21.4 G2: 10.6 G3: 4.3 $P = \text{NS}$ Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Strauss and Dietz, 1999</p> <p>Country and setting: USA, National Collaborative Perinatal Project and Child Health and Development Study</p> <p>Enrollment Period: NCPP: 1959 to 1976 CHDS: 1959 to 1973</p> <p>Funding: Grants from NIH and Massachusetts Dept of Public Health</p> <p>Study Objective: To examine relationship between maternal weight gain and risk of intrauterine growth retardation</p> <p>Time frame: NCPP: 1959 to 1976 CHDS: 1959 to 1973</p> <p>Duration of the study: First visit (prior to 14 weeks since LMP) to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: Total = 10,756 NCPP = 5,403 CHDS = 5,353</p> <p>Group Description: G1: NCPP G2: CHDS</p> <p>Group N: G1: 4,771 G2: 5,333</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women enrolled in NCPP or CHDS Patients enrolled within 14 weeks of last menstrual period <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with missing trimester weight gain data 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 22.8 (4.1) G2: 22.7 (3.6)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous WHO International Taskforce < 20, ≥ 20 - < 25, ≥ 25 <p>Age (mean, yrs): G1: 25.2 (5.8) G2: 27.4 (5.7) sig dif from NCPP $P < 0.001$</p> <p>Parity: G1: % primiparous: 28 G2: 38 sig dif from NCPP $P < 0.001$</p>	<p>Race, %: White NR Black G1: 30 G2: 16 sig dif from NCPP $P < 0.001$ Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 39 G2: 28 sig dif from NCPP $P < 0.001$</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: G1: % single mothers: 10.4 G2: 2.1 sig dif from NCPP $P < 0.001$</p>

Evidence Table 42. Gestational weight gain with reference to IOM recommendations and low birth weight (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4771 G2: 5333 Total weight gain: G1: 10.4 (4.5) G2: 11.5 (4.6) <i>P</i> < 0.001 Categorized: <ul style="list-style-type: none"> According to IOM low weight gain in first trimester: < 0.1kg/wk; low weight gain in second and third trimesters: < 0.3kg/wk; low pregnancy weight gain: < 6.8 kg Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery first trimester weight gain: prepregnancy to 13 to 16 wk since LMP; second trimester: end of first trimester to 26-29 wk since LMP; third trimester: end of second trimester to delivery 	Birth weight: G1: 3287 (469) G2: 3401 (470) <i>P</i> < 0.001 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> First trimester weight gain (kg/wk): in NCPP, 0.14 (0.23); in CHDS, 0.19 (0.24) Second trimester weight gain (kg/wk): in NCPP, 0.36 (0.17); in CHDS, 0.41 (0.16) Third trimester weight gain (kg/wk): in NCPP, 0.27 (0.20); in CHDS, 0.30 (0.16) Other infant outcomes: % IUGR: in NCPP, 4.5%; in CHDS, 2.2%	Outcomes Description: Adjusted odds ratios(95% CI) for < 2500g: Groups Maternal weight gain categories stratified by pregravid BMI: BMI < 20.0: G1: Low 1st trimester gain (< 0.1kg/wk) G2: Low 2nd trimester gain (< 0.3kg/wk) G3: Low 3rd trimester gain (< 0.3kg/wk) BMI 20.0-25.0: G4: Low 1st trimester gain G5: Low 2nd trimester gain G6: Low 3rd trimester gain BMI > 25.0: G7: Low 1st trimester gain G8: Low 2nd trimester gain G9: Low 3rd trimester gain Results AOR (95% CI) for < 2500g: G1: 0.88 (0.50-1.57) G2: 2.68 (1.46-4.94) G3: 2.07 (1.22-3.51) G4: 1.31 (0.88-1.95) G5: 1.92 (1.29-2.87) G6: 2.12 (1.48-3.04) G7: 1.02 (0.50-2.08) G8: 1.88 (1.03-3.43) G9: 1.53 (0.86-2.74) Reference group-normal rate of weight gain in the trimester Maternal confounders and effect modifiers accounted for in analysis: Race, GDM, toxemia, smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) (<i>P</i> < 0.05) Gestational diabetes, %: G1: 14.2% G2: 4.3% (<i>P</i> < 0.01) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: LGA (%) Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 12.0 G2: 11.8 G3: 18.8 G4: 25.8 G5: 23.8 <i>P</i> < 0.01 Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Fair Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 3 Fair, 4 Poor Final Quality Score: Poor

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Caulfield et al., 1998</p> <p>Country and setting: USA, hospital obstetric database</p> <p>Enrollment Period: 1987 to 1989</p> <p>Funding: NR</p> <p>Study Objective: To examine relation between gestational weight gain and risk of delivering a small for gestational age and large for gestational age infant by race</p> <p>Time frame: 1987-1989</p> <p>Duration of the study: Entry into pn care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 3,870</p> <p>Group Description: G1: BMI < 19.8 Black G2: BMI < 19.8 White G3: BMI 19.8 to 26.0 Black G4: BMI 19.8 to 26.0 White G5: BMI > 26.0 Black G6: BMI > 26.0 White</p> <p>Group N: G1: 523 G2: 267 G3: 1,479 G4: 796 G5: 615 G6: 190</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancies White or black ethnicity At least 28 weeks' gestation One delivery per woman (randomly chosen) Information on anthropometric data <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Improbable data Non-black or non-white ethnicity 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3)</p> <p>Pregravid BMI: G1: 18.4 (1.0) G2: 18.5 (1.0) G3: 22.7 (1.8) G4: 22.1 (1.8)</p> <p>Imputed: <ul style="list-style-type: none"> No <p>Categorized: <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 21.7 (4.8) G2: 27.1 (6.6) G3: 22.7 (5.3) G4: 29.8 (5.8) G5: 24.9 (6.0) G6: 28.2 (5.5)</p> <p>Parity: G1: % primiparous: 52.4 G2: 55.4 G3: 50.1 G4: 48.0 G5: 36.9 G6: 46.9</p> </p></p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 32.8 G2: 20.6 G3: 35.4 G4: 20.0 G5: 28.8 G6: 25.4</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: G1: 4.3 G2: 3.0 G3: 6.0 G4: 5.7 G5: 11.9 G6: 17.0</p> <p>Additional characteristics: NR</p>

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: <ul style="list-style-type: none"> AOR for LGA (95% CI) 	Background: Good
Total weight gain: G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3)	Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Groups: G1: Underweight, BMI< 19.8 G2: Normal weight, BMI 19.8-26.0 G3: Overweight, BMI> 26.0 Black women: G4: No weight gain < IOM G5: No weight gain > IOM White women: G6: No weight gain < IOM G7: No weight gain > IOM Results: AOR (95%CI) for LGA and rate of weight gain (per 50 g/wk): G1: 1.25 (1.11-1.41) G2: 1.14 (1.08-1.20) G3: 1.13 (1.07-1.20) Expected Absolute Change (as % of baseline) in Incidence of LGA associated with modifiable risk factor (G4-G7): G4: +1.28 (+26) G5: -0.77 (-16) G6: +2.58 (+17) G7: -2.87 (-19) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Height Hypertension Provider type Smoking Infant and child confounders and effect modifiers accounted for in analysis: Female infant	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good
Categorized: <ul style="list-style-type: none"> According to IOM 			
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 			
Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between selfreport prepregnancy weight and last recorded weight 			

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Devader et al., 2007 Country and setting: United States, birth certificate data Enrollment period: 1999 to 2001 Funding: NR Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI Time frame: 1999 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 94,696 Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs Group N: G1: 16,852 G2: 37,292 G3: 40,552 Inclusion criteria: <ul style="list-style-type: none"> All mothers with normal prepregnancy BMI (19.8–26.0 kg/m²) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001 Exclusion criteria: <ul style="list-style-type: none"> Women aged younger than 18 years and older than 35 years Non-Missouri residents Preterm deliveries Multiple gestations 	Pregravid weight: <ul style="list-style-type: none"> Routine pre-natal care If missing, obtained from mother during postpartum hospital stay Pregravid BMI: NR Imputed: <ul style="list-style-type: none"> No Categorized: NR Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4% Parity: NR	Race, %: White G1: 79.7 G2: 85.6 G3: 85.2 Black G1: 15.7 G2: 10.8 G3: 12.1 Hispanic NR Asian/Pacific Islander NR Other G1: 4.6 G2: 3.5 G3: 2.7 Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: AOR for Women With Normal Prepregnancy BMI (19.8 –26.0 kg/m2) by GWG Category, Missouri Birth Certificates, 1999–2001 (95% CI)	Background: Good
Total weight gain: NR	Gestational diabetes, %: NR	Groups: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results: AOR (95%CI) for LGA: G1: 0.40 (0.37-0.44) G2: 1.00 (reference) G3: 2.43 (2.30-2.56)	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Education Income Alcohol use Height Prior pregnancy Inadequate prenatal care use Smoking 	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Child's gender Birth year 	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 		Followup: Fair
			Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor
			Final Quality Score: Fair

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Hellerstedt et al., 1997 Country and setting: United States, medical center Enrollment Period: 1977-1993 Funding: NR Study Objective: To examine association between infant birth outcomes and maternal pregravid obesity, gestational weight gain, and prenatal smoking Time frame: 1977 to 1993 Duration of the study: Entry into prenatal care until delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,343 Group Description: G1: Obese G2: Normal weight Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese and normal-weight women delivering singleton during study period Exclusion criteria: <ul style="list-style-type: none"> Missing data Siblings Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 kg (13.7) G2: 61.1kg (5.9) Pregravid BMI: G1: 38.3 (4.6) G2: 22.8 (1.6) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: NR <ul style="list-style-type: none"> 16-34 years: 91% ≥ 35 years: 8.8% G2: NR <ul style="list-style-type: none"> 16-34 years: 93.5% ≥ 35 years: 5.8% Parity: G1: NR <ul style="list-style-type: none"> 0: 31.8% 1-3: 64.7% ≥ 4: 3.5% G2: NR <ul style="list-style-type: none"> 0: 33.3% 1-3: 64.9% ≥ 4: 1.8% 	Race, %: White G1: 68.8 G2: 69.1 Black G1: 20.4 G2: 20.6 Hispanic G1: 6.6 G2: 6.5 Asian/Pacific Islander G1: Native Am: 3.8 G2: Native Am: 3.2 Other NR Smoking, %: G1: 26.4 G2: 26.2 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: LGA (%) Groups Maternal weight gain categories stratified by pregravid BMI and smoking status: Obese (BMI > 29.0): G1: Smokers, < IOM G2: Smokers, within IOM G3: Smokers, > IOM G4: Nonsmokers, < IOM G5: Nonsmokers, within IOM G6: Nonsmokers, > IOM Normal weight (BMI 19.8-26.0): G7: Smokers, < IOM G8: Smokers, within IOM G9: Smokers, > IOM G10: Nonsmokers, < IOM G11: Nonsmokers, within IOM G12: Nonsmokers, > IOM Obese: G13: Lost/no gain G14: 0.5-6.5 kg G15: 7-11.5 kg G16: 12-16 kg G17: > 16 kg Normal weight: G18: < 11.5kg G19: 11.5-16kg G20: > 16kg Results Frequencies of LGA, %: G1: 5.3 G2: 10.0 G3: 12.3 G4: 12.2 G5: 11.7 G6: 22.2 G7: 0 G8: 1.8 G9: 9.1 G10: 4.4 G11: 8.1 G12: 14.3	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Hellerstedt et al., 1997
(continued)

Evidence Table 39. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>G13: 9.3 G14: 10.5 G15: 11.3 G16: 17.5 G17: 21.8 <i>P</i> = 0.001 for G13-G17</p> <p>G18: 2.8 G19: 6.7 G20: 13.1 <i>P</i> < 0.001 for G18-G20</p> <p>Compared with infants of obese nonsmokers who gained 7-11.5kg, the only group at significantly higher risk of LGA was non smokers who gained > 11.5kg: AOR: 2.3 (95%CI: 1.2-4.5)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Maternal age, pregravid BMI, infant sex, race, parity, prenatal alcohol use, prenatal illicit drug use, adequacy of prenatal care, gestational hypertension, GDM</p> <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age 	

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Kiel et al., 2007 Country and setting: United States, birth registry Enrollment period: 1990 to 2001 Funding: NR Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women Time frame: 1990 to 2001 Duration of the study: Entry into prenatal care through delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 120,170 Group Description: G1: Obese Class I (BMI 30–34.9) (n = 70,536) G2: Obese Class II (BMI 35–39.9) (n = 30,609) G3: Obese Class III (BMI 40 and More) (n = 19,025) Group N: NR Inclusion criteria: <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16% Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> NIH guidelines Age (mean, yrs): G1: <26: 46% 26–35: 47% Older than 35: 8% G2: <26: 44% 26–35: 48% Older than 35: 8% G3: <26: 40% 26–35: 52% Older than 35: 9% Parity: Nulliparous: G1: 34% G2: 33% G3: 32%	Race, %: White G1: 78 G2: 77 G3: 73 Black G1: 22 G2: 23 G3: 27 Hispanic NR Asian/Pacific Islander NR Other G1: 22 Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% ($P < 0.05$) G2: SGA: 7% LGA: 16% ($P < 0.05$) G3: SGA: 6% LGA: 18% ($P < 0.05$)	Outcomes Description: Absolute risk and OR (95% CI) of pregnancy outcomes for various classes of obese women (class I, II, III)	Background: Good
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Groups: Maternal weight gain categories stratified by prepregnancy obesity status, Obese Class I (BMI 30–34.9), Obese Class II (BMI 35–39.9), Obese Class III (\geq BMI 40): G1: ≤ -10 lbs G2: -2 to -9 lbs G3: No change G4: 2-9 lbs G5: 10-14 lbs G6: 15-25 lbs G7: 26-35 lbs G8: > 35 lbs	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair
Categorized: <ul style="list-style-type: none"> 10-lb or less loss 2 to 9 lbs loss, no weight change, 2 to 9 lbs gain, 10 to 14 lbs gain, 15–25 lb gain, 26–35 lb gain, and greater than 35 lb gain 		Result: For Obese Class I: OR (95% CI) for LGA were significantly lower (< 1.00 , G6 was reference) for G1- G5 and significantly higher for G7-G8. For Obese Class II: OR (95% CI) for LGA were significantly lower (< 1.00 , G6 was reference) for G1- G5 and significantly higher for G7-G8. For Obese Class III: OR (95% CI) for LGA were significantly lower (< 1.00 , G6 was reference) for G1- G4 and significantly higher for G7-G8	Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Education Poverty (enrollment in Medicaid, WIC, food stamp programs) Tobacco use Chronic hypertension 	Interpretation: Poor
Ascertained by: NR		Infant and child confounders and effect modifiers accounted for in analysis: NR	Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Kiel et al., 2007
(continued)

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<p>Other maternal outcomes:</p> <ul style="list-style-type: none"> Figures 1 to 3 show absolute risk of preeclampsia, cesarean delivery, LGA, and SGA by GWG category for each obesity class. All 3 figures show similar patterns of increasing risk of preeclampsia, cesarean delivery, and LGA birth and decreasing risk of SGA birth with increasing GWG. Collectively, minimal risk for all 4 outcomes corresponds to GWG categories where risk of LGA and SGA births intersect. This equates to GWG of 10 of 25 lb for class I obese women, a gain of 0 to 9 lb for class II obese women, and weight loss of 0 to 9 lb for class III obese women. Adjusted odds ratios and 95% CIs for preeclampsia, cesarean delivery, SGA, and LGA by GWG category and obesity class. Compared with women who gained 15 to 25 lb during their pregnancies, those who gained less weight had significantly lower odds of preeclampsia, cesarean delivery, and LGA births, but higher odds for SGA births. Women who gained more than 25 lbs had higher odds for same 3 pregnancy outcomes and lower odds for SGA births. <p>Other infant outcomes: NR</p>		

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Parker and Abrams, 1992</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Sept 1980 to Dec 1988</p> <p>Funding: UC Committee on Research & MCH and Resources Development, Health Resources and Services Administration</p> <p>Study Objective: To test whether gains outside IOM reference ranges were associated with increased risks of suboptimal pregnancy outcome (SGA, LGA, cesarean delivery) and to determine whether locally developed ranges were more applicable to study population</p> <p>Time frame: Sept 1980 to Dec 1988</p> <p>Duration of the study: From entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 6,690</p> <p>Group Description: G1: Overall G2: NR</p> <p>Group N: G1: 6,690 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutive live singleton births at Moffitt Hospital between September 1980 and December 1988 with gestational ages of 37 to 42 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Maternal transfers or transports and deliveries complicated by fetal malformations, maternal diabetes, or maternal hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 56.8 kg(SD 11.0) G2: NR</p> <p>Pregravid BMI: G1: Underweight: 27.7%, Normal weight 61.8%, Overweight: 5.6%, Obese 4.9% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 27.7 (5.5) G2: NR</p> <p>Parity: Primiparous: G1: 58.8% G2: NR</p>	<p>Race, %: White G1: 44.0 G2: NR</p> <p>Black G1: 8.3 G2: NR</p> <p>Hispanic G1: 9.4 G2: NR</p> <p>Asian/Pacific Islander G1: 21.4 G2: NR</p> <p>Other G1: 12.0 G2: NR</p> <p>Smoking, %: G1: 12.0 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 6690 G2: NR Total weight gain: G1: 15.2kg (5.2) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM %: Weight gain ranges based on percentiles from previous study of UC population with good pregnancy outcomes: 25th - 75th, 10-90th percentiles. For 25-75th, weight gain range = 12-17kg for underweight women (BMI < 19.8); Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3408g (462) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> AOR for LGA (95% CI) Groups: G1: < IOM range G2: Within IOM range G3: > IOM Results: AOR (95% CI) for LGA: G3: 1.92 (1.52-2.43) G2: 1.00 (reference) Incidence of LGA in nonobese women, %: G1: 3.25 G2: 6.14 G3: 13.11 Incidence of LGA in obese women, %: G1: 5.88 G2: 17.53 AOR for LGA and high weight gain UCSF 25-75 1.89 (1.51-2.37) UCSF 10-90 1.87 (1.39-2.52) IOM 1.92 (1.52-2.43) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Height Maternal high and low weight gain Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Stevens-Simon and McAnarney, 1992 Country and setting: USA, adolescent maternity program Enrollment Period: 1986 to 1989 Funding: Grant from Bureau of Maternal and Child Health Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents Time frame: 1986 to 1989 Duration of the study: Entry into prenatal care through 6 weeks PP check up	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 141 (107 included in postpartum analyses) Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers Group N: G1: 28 G2: 66 G3: 47 Inclusion criteria: <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons Exclusion criteria: <ul style="list-style-type: none"> NA 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5) Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2 Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOMslow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) <i>P</i> < 0.0001 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Distribution of LGA, %: Groups Maternal weight gain categories (kg/wk): G1: < 0.23 G2: 0.23-0.40 G3: > 0.40 Results G1: 3.6 G2: 4.5 G3: 12.8 <i>P</i> = NS Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Stotland et al., 2006 Country and setting: USA, university hospital Enrollment Period: 1980 to 2001 Funding: NR Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more) Time frame: 1980 to 2001 Duration of the study: Entry into PN care up till delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 20465 Group Description: G1: Gain below IOM recommendations G2: Gain within IOM recommendations G3: Gain above IOM recommendations Group N: G1: 4,114 G2: 7,490 G3: 8,861 Inclusion criteria: <ul style="list-style-type: none"> Singleton Exclusion criteria: <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: < 19.8: 25.8% 19.8-26.0: 19.4% 26.1-29.0: 9.2% > 29.0: 20.6% G2: < 19.8: 49.1% 19.8-26.0: 34.8% 26.1-29.0: 23.3% > 29.0: 25.5% G3: < 19.8: 25.0% 19.8-26.0: 45.8% 26.1-29.0: 67.5% > 29.0: 53.9% <i>P</i> < 0.001 Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: < 20 years: 23.4% 20-29 years: 19.3% 30-39 years: 19.9% > 40 years: 25.3% G2: < 20 years: 31.3% 20-29 years: 36.6% 30-39 years: 37.6% > 40 years: 36.3% G3: < 20 years: 45.4% 20-29 years: 44.0% 30-39 years: 42.5% > 40 years: 38.4% <i>P</i> < 0.001 Parity: % Nulliparous: G1: 17.3 G2: 36.2 G3: 46.6 <i>P</i> < 0.001	Race, %: White G1: 16.2 G2: 35.8 G3: 48.0 Black G1: 25.5 G2: 29.4 G3: 45.1 Hispanic G1: 19.2 G2: 34.8 G3: 46.0 Asian/Pacific Islander G1: 24.3 G2: 43.3 G3: 32.4 Other G1: 21.7 G2: 37.9 G3: 40.4 <i>P</i> for all race categories < 0.001 Smoking, %: G1: 23.5 G2: 30.8 G3: 45.8 <i>P</i> < 0.001 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 43. Gestational weight gain with reference to IOM recommendations and large for gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOMpercentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 $P < 0.001$ Gestational diabetes,%: NR Cesarean delivery,%: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery,%: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 Aassisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: <ul style="list-style-type: none"> Risk of adverse neonatal outcomes by gestational weight gain by IOM guidelines, adjusted ORs compared to women with GWG within IOM guidelines and risk of adverse neonatal outcomes by extremes of GWG compared to women with weight gain 11.5-16.0kg Groups: G1: < IOM G2: Within IOM G3: > IOM G4: < 7kg G5: > 18kg Results: Unadjusted Rates of LGA: G1: 3.85 $P < 0.001$ vs. G2 G2: 6.62 G3:13.76 $P < 0.001$ vs. G2 G4: 5.26 G5: 14.60 $P < 0.05$ vs. G2 AOR (95% CI) for LGA: G1: 0.58 (0.47-0.72) G2: 1.00 (reference) G3: 1.98 (1.74-2.25) G4: 0.50 (0.33-0.78) G5: 2.28 (2.00-2.62) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Cogswell et al., 1994</p> <p>Country and setting: USA, Pregnancy Nutrition Surveillance System</p> <p>Enrollment Period: 1990-1991</p> <p>Funding: NR</p> <p>Study Objective: To determine association between increased gestational weight gain and birth weight outcomes for low income women</p> <p>Time frame: 1990-1991</p> <p>Duration of the study: Women in WIC but everything is self reported so it is when they were first enrolled in WIC until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 53,541</p> <p>Group Description: G1: Average weight G2: Overweight G3: Very overweight</p> <p>Group N: G1: 33,809 G2: 7,661 G3: 12,071</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, black and hispanic women who delivered single, liveborn, term infants <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Low or high values for; birth weight, prepregnancy BMI, or weight gain during pregnancy Missing data on one or more study variables Underweight women Only 1 infant was used in analysis for women who delivered more than once during study period 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 11-17 yr: 11.9% 18-34yr: 85.0% 35-54 yr: 3.1% G2: 11-17 yr: 6.9% 18-34yr: 88.7% 35-54 yr: 4.4% G3: 11-17 yr: 4.0% 18-34yr: 90.1% 35-54 yr: 6.0%</p> <p>Parity: NR</p>	<p>Race, %: White G1: 75.1 G2: 72.4 G3: 74.5 Black G1: 13.8 G2: 14.1 G3: 16.1 Hispanic G1: 11.1 G2: 13.5 G3: 9.4 Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 29.9 G2: 28.3 G3: 25.7</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 33,809 G2: 7,661 G3: 12,071 Total weight gain: G1: < 15 lb: 6.2% 15-19: 5.8% 20-24: 11.2% 25-29: 14.4% 30-34: 17.1% 35-39: 13.9% ≥ 40: 31.4% G2: < 15 lb: 11.4% 15-19: 7.8% 20-24: 13.0% 25-29: 12.7% 30-34: 15.9% 35-39: 11.2% ≥ 40: 28.1% G3: < 15 lb: 25.1% 15-19: 10.1% 20-24: 1 Categorized: <ul style="list-style-type: none"> 4 lbs increments starting at 15 lbs Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: < 2500g: 2.7% 2500-4000g: 87.5% > 4000-4500: 8.5% > 4500g: 1.4% G2: < 2500g: 2.5% 2500-4000g: 83.9% > 4000-4500: 11.7% > 4500g: 2.0% G3: < 2500g: 2.1% 2500-4000g: 81.1% > 4000-4500: 13.2% > 4500g: 3.6% Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: AOR (95% CI) for high birth weight Groups Maternal weight gain categories (lbs) stratified by pregravid BMI: Normal weight (BMI 19.8-26.0): G1: < 15 G2: 15-19 G3: 20-24 G4: 25-29 G5: 30-34 G6: 35-39 G7: ≥ 40 Overweight (BMI > 26.0-29.0): G8: < 15 G9: 15-19 G10: 20-24 G11: 25-29 G12: 30-34 G13: 35-39 G14: ≥ 40 Obese (BMI > 29.0): G15: < 15 G16: 15-19 G17: 20-24 G18: 25-29 Results AOR (95% CI) for high birth weight: G1: 1.0 (0.5-2.0) G2: 0.4 (0.2-1.0) G3: 0.6 (0.3-1.1) G4: 1.0 (reference) G5: 1.1 (0.7-1.8) G6: 1.5 (1.0-2.3) G7: 3.3 (2.3-4.7) G8: 0.8 (0.2-2.6) G9: 1.0 (reference) G10: 1.1 (0.4-3.5) G11: 2.1 (0.8-5.7) G12: 2.4 (0.9-6.4) G13: 1.6 (0.6-4.6) G14: 4.0 (1.6-10.1) G15: 0.7 (0.5-1.1) G16: 1.0 (reference) G17: 1.1 (0.7-1.7) G18: 1.3 (0.8-2.0) G19: 1.9 (1.3-2.9) G20: 2.1 (1.3-3.2) G21: 2.3 (1.6-3.3)	

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia
(continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Cogswell et al., 1994
(continued)

**Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • height • Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Gestational age • Sex of infant 	

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Edwards et al., 1996</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 1997-1993</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change</p> <p>Time frame: 1997-1993</p> <p>Duration of the study: 1997-1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,443</p> <p>Group Description: G1: Obese G2: Normal Weight G3: total sample</p> <p>Group N: G1: 683 G2: 660</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Fetal deaths 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 103.5 G2: 61</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) <p>Age (mean, yrs): G1: 27.1 G2: 25.4</p> <p>Parity: NR</p>	<p>Race,%: White G1: NR G2: NR G3: 69.0 (Total sample)</p> <p>Black G1: NR G2: NR G3: 21.0 (Total sample)</p> <p>Hispanic G1: NR G2: NR G3: 7.0 (Total sample)</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: NR G2: NR G3: 4.0 (Total sample)</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes,%: NR Cesarean delivery,%: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery,%: Episiotomy,%: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Birthweight $\geq 4000g$ <p>Groups: Maternal weight gain categories (kg) Obese > 29: G1: Lost weight/no change G2: 0.5-6.5 G3: 7-11.5 G4: 12-16 G5: > 16 Normal BMI 19.8-26 G6: < 11.5kg G7: 11.5-16 G8: > 16kg</p> <p>Results: Birthweight $\geq 4000g$, %: G1:12.0 G2: 12.5 G3: 13.3 G4: 15.4 G5: 24.4 P (for G1-G5) = 0.026</p> <p>G6: 5.7 G7: 6.6 G8: 16.9 P (for G6-G8) < 0.001</p> <p>AOR (95%CI) for birthweight$\geq 4000g$ among obese women (BMI> 29.0): G3: 1.0 (reference) G8: 2.8 (1.4-5.6)</p> <p>AOR (95%CI) for birthweight$\geq 4000g$ among normal weight women (BMI 19.8-26.0): G7: 1.0 (reference) G8: 2.4 (1.3-4.7)</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Age Parity Pre-gravid BMI GDM Pregnancy induced hypertension Prenatal adequacy Alcohol use Drug use Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis: Gestational age</p>	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hedderson et al., 2006</p> <p>Country and setting: USA, Kaiser Permanente Medical Care Program</p> <p>Enrollment Period: January 1, 1996 - June 31, 1998</p> <p>Funding: R01 DK 54834 from National Institute of Diabetes and Digestive and Kidney Diseases, grant from American Diabetes Association and Kaiser Community Benefit research support</p> <p>Study Objective: To examine whether pregnancy weight gains outside IOM recommendations and rates of maternal weight gain are associated with neonatal complications</p> <p>Time frame: January 1, 1996 to June 31, 1998</p> <p>Duration of the study: First prenatal care visit to 30 days post delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 45,245</p> <p>Group Description: G1: Controls G2: Macrosomia G3: Hypoglycemia G4: Hyperbilirubinemia</p> <p>Group N: G1: 652 G2: 391 G3: 328 G4: 432</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton livebirth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No pregestational diabetes or history of gestational diabetes (screened at 24-28 weeks gestation - meeting National Diabetes Data Group criteria for GDM) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported in some cases used measured weight recorded in chart closes to woman's last menstrual period but no more than 12 months before her last menstrual period <p>Pregravid BMI: G1: < 19.8: 13.5% 19.8-24.9: 56.4% 25.0-29.0: 12.4% > 29.0: 17.6% G2: < 19.8: 5.1% 19.8-24.9: 51.2% 25.0-29.0: 16.6% > 29.0: 27.1% G3: < 19.8: 10.1% 19.8-24.9: 50.0% 25.0-29.0: 17.1% > 29.0: 22.9% G4: < 19.8: 13.9% 19.8-24.9: 57.9% 25.0-29.0: 13.2% > 29.0: 57.1%</p> <p>Imputed: <ul style="list-style-type: none"> No </p> <p>Categorized: <ul style="list-style-type: none"> IOM guidelines </p> <p>Age (mean, yrs): G1: < 25 years: 22.1% 25-29: 24.2% 30-34: 33.6% ≥ 35: 20.1% G2: < 25 years: 15.9% 25-29: 28.0% 30-34: 31.7% ≥ 35: 24.3% G3: < 25 years: 24.1% 25-29: 25.3% 30-34: 26.8% ≥ 35: 23.8% G4: < 25 years: 17.1% 25-29: 29.4% 30-34: 32.6% ≥ 35: 20.8%</p> <p>Parity: % primiparous: G1: 56.9 G2: 31.2 G3: 50.0 G4: 59.3</p>	<p>Race, %: White G1: 54.0 G2: 67.8 G3: 47.6 G4: 42.6 Black G1: 10.0 G2: 5.1 G3: 11.3 G4: 4.4 Hispanic G1: 17.2 G2: 15.1 G3: 20.4 G4: 15.5 Asian/Pacific Islander G1: 8.1 G2: 3.6 G3: 6.7 G4: 20.1 Other G1: 10.7 G2: 8.4 G3: 14.0 G4: 17.4</p> <p>Smoking, %: G1: %nonsmoking during pregnancy: 92.0; %smoked but quit: 4.2; %smoked 3.9 G2: %nonsmoking during pregnancy: 90.8; %smoked but quit: 5.3; %smoked 4.0 G3: %nonsmoking during pregnancy: 92.6; %smoked but quit: 1.5; %smoked 5.8 G4: %nonsmoking during pregnancy: 94.2; %smoked but quit: 4.9; %smoked 1.0</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Screening glucose value less than 140: G1: 85.0%; > 140: 15.0% G2: 81.6%; > 140: 18.4% G3: 81.4%; > 140: 18.6% G4: 83.3%; > 140: 16.7%</p>

Evidence Table 48. Gestational weight gain with reference to IOM recommendations and macrosomia
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records rate of maternal weight gain was calculated as total pregnancy weight gain minus infant birth weight divided by weeks of gestation when last weight was measured; rate of maternal weight gain before the third trimester was calculated using the weight measured at or before the screening test for GDM (24-28 wks of gestation) minus prepregnancy weight divided by weeks of gestation Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight at last prenatal visit (within 2 weeks of delivery date) and prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> AOR for birthweight>4500g (95% CI) Groups: G1: < IOM recommendations G2: Within IOM recommendations G3: > IOM recommendations Results: % Distribution of maternal weight gain categories among women with macrosomia: G1: 4.0 G2: 16.3 G3: 79.7 P< 0.05 (compared to controls) AOR (95% CI) for macrosomia: G1: 0.38 (0.20-0.70) G2: 1.00 reference G3: 3.05 (2.19-4.26) OR (95% CI) for macrosomia: Underweight women (BMI < 19.8) G2: 1.00 (reference) G3: 2.70 (0.83-8.61) Normal weight women (BMI 19.8-26.0) G2: 1.00 (reference) G3: 3.60 (2.27-5.83) Overweight/obese women (BMI > 26.0) G2: 1.00 (reference) G3: 2.00 (1.14-3.47) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Screening glucose value from 1 hour after 50g oral glucose challenge test Difference between age at delivery and gestational age at last weight measured Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kabali, C and Werler, MM, 2007</p> <p>Country and setting: Canada and United States, multicenter</p> <p>Enrollment period: 1996 to 2002</p> <p>Funding: National Institute of Dental and Craniofacial Research, grant # DE11393</p> <p>Study Objective: To establish whether excessive pre-pregnancy weight as measured by BMI, excessive PWG, or their combined effects are risk factors for delivering large babies</p> <p>Time frame: 1996 to 2002</p> <p>Duration of the study: Entry into prenatal care through pregnancy</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 815</p> <p>Group Description: G1: Total Study</p> <p>Group N: G1: 815</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Controls were selected by pediatric practice (or one of similar size and location) of each case by identifying next four children seen in practice whose ages were within 2 months of case's age. <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Diabetic women Multiple gestations Missing weight, height, or weight gain data Women with outlying data 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: <24 years 208 (25.5%) 24 to 34 years 478 (58.7%) 35 to 45 years 129 (15.8%)</p> <p>Parity: G1: Primiparae (56.2%)</p>	<p>Race, %: White G1: (67.7)</p> <p>Black G1: (11.3)</p> <p>Hispanic G1: (16.2)</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: (4.8)</p> <p>Smoking, %: G1: throughout pregnancy - yes: 8.2%</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: OR for maternal BMI and weight gain in relation to risk of macrosomia (95% CI)	
Total weight gain: NR	Gestational diabetes, %: NR	Groups: G1: < IOM G2: Within IOM G3: > IOM	
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR		
Collected from: <ul style="list-style-type: none"> NR 	Instrumental delivery, %: NR	Results: AOR G1: 1.0 (0.4, 1.9) G2: ref G3: 1.5 (0.7, 2.5)	
Ascertained by: <ul style="list-style-type: none"> Self-reported 	Episiotomy, %: NR		
	Other maternal outcomes: NR		
	Other infant outcomes:	Combined effect with BMI OR (AOR similar but not all could be calculated) Underweight/G1: 0.7 (0.2, 3.3) Underweight/G2: 1.0 (0.3, 3.5) Underweight/ G3: 1.7 (0.4, 6.4) Normal/G1: 0.7 (0.3, 1.8) Normal/G2 Ref Normal/ G3: 1.1 (0.5, 2.3) Overweight/G1: 1.2 (0.4, 3.8) Overweight/G2: 0.8 (0.2, 2.7) Overweight/G3: 2.4 (1.2, 4.8)	
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Marital status Family income Alcohol intake Smoking 	
		Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Child's sex	

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rode et al., 2007</p> <p>Country and setting: Smoke-free Newborn Study, University Hospital, Denmark</p> <p>Enrollment period: November 1996 to October 1998</p> <p>Funding: NR</p> <p>Study Objective: To investigate association between maternal weight gain and birthweight</p> <p>Time frame: November 1996 to October 1998</p> <p>Duration of the study: 12 to 18 weeks gestation through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 2248</p> <p>Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI 26.1-29.0 G4: BMI > 29.0</p> <p>Group N: G1: 385 G2: 1,531 G3: 177 G4: 385</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who answered questionnaire at both 12 to 18 weeks and 37 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestation Women who delivered prior to 37 weeks 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized: IOM Guidelines</p> <p>Age (mean, yrs): G1: Less than 25:15.3% 25-30: 45.7% 30-35: 33.5% >35: 5.5% G2: Less than 25:17.5% 25-30: 36.7% 30-35: 34.5% >35: 11.3% G3: Less than 25:15.3% 25-30: 45.7% 30-35: 33.5% >35: % G4: Less than 25: 20.0% 25-30: 39.4% 30-35: 29.7% >35: 11.0% $P < 0.001$</p> <p>Parity: % nulliparous: G1: 52.2 G2: 58.6 G3: 51.4 G4: 49.0 $P = 0.02$</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: %nonsmokers: G1: 58.3 G2: 65.5 G3: 61.1 G4: 67.3</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: % married/cohabiting: G1: 92.3 G2: 91.4 G3: 94.2 G4: 92.7</p> <p>Additional characteristics: NR</p>

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 385 G2: 1,531 G3: 177 G4: 385 Total weight gain: G1: < 1kg: 0% 1-5: 0.5% 6-10: 16.1% 11-15: 45.7% 16-20: 30.1% >20: 7.5% G2: < 1kg: 0.3% 1-5: 1.6% 6-10: 16.9% 11-15: 41.5% 16-20: 29.1% >20: 10.5% G3: < 1kg: 1.7% 1-5: 4.5% 6-10: 24.9% 11-15: 40.1% 16-20: 24.3% >20: 4.5% G4: Categorized: According to IOM Collected from: • Self-reported Ascertained by: • Self-reported	Birth weight: G1: less than 2500g: 1.8% 2500-2999: 10.9% 3000-3999: 72.7% 4000-4499: 11.4% ≥ 4500: 3.1% G2: less than 2500g: 1.1% 2500-2999: 7.1% 3000-3999: 69.6% 4000-4499: 18.2% ≥ 4500: 4.0% G3: less than 2500g: 2.3% 2500-2999: 4.5% 3000-3999 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes NR Other infant outcomes • Birthweight	Outcomes Description: • AOR for birthweight ≥ 4000g (95% CI) Groups: Maternal weight gain categories stratified by pregravid BMI status: BMI less than 19.8 G1: < IOM G2: Within IOM G3: > IOM BMI 19.8–26.0 G4: < IOM G5: Within IOM G6: > IOM BMI 26.1–29.0 G7: < IOM G8: Within IOM G9: > IOM Results: AOR (95%CI) for birthweight > = 4000g: G1: 0.8 (0.4-1.6) G2: 1.0 (reference) G3: 1.7 (0.8-3.6) G4: 0.7 (0.5-0.999) G5: 1.0 (reference) G6: 1.9 (1.5-2.5) G7: 0.6 (0.1-3.1) G8: 1.0 (reference) G9: 1.8 (0.8-3.9) G10: 0.8 (0.4-1.7) G11: 1.0 (reference) G12: 0.9 (0.4-2.0) Maternal confounders and effect modifiers accounted for in analysis: • Pre-eclampsia • Caffeine consumption • Smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 2 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Schieve, 1998</p> <p>Country and setting: Pregnancy Nutrition Surveillance System - data from WIC clinics (99%) from Indiana, Kansas, Massachusetts, Minnesota, Nebraska, North Dakota, New York, Tennessee, and Vermont</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To examine associations between pregnancy weight gain outside and within ranges recommended by IOM and birth weight by both prepregnant BMI and race ethnicity</p> <p>Time frame: NR</p> <p>Duration of the study: 1990 to 1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 173,066</p> <p>Group Description: NR</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, black, and hispanic women who visited WIC clinics prenatally and subsequently delivered liveborn, singleton infants Delivered between 39 and 41 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data for infant birth weight (n = 4223) Prepregnant BMI (n = 31477) Pregnancy weight gain (n = 7542) Maternal age (n = 43) Maternal education (n = 3819) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported NR <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized: IOM Guidelines</p> <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 112,524 G2: 33,101 G3: 27,441 Total weight gain: G1: 32.5 G2: 30.5 G3: 30.2 <i>Categorized:</i> <i>According to IOM >10 pounds below lower bound of IOM recommended range for woman's prepregnant BMI, 1-9 pounds below lower bound of IOM lower bound, in lower half of IOM recommended range, in upper half of IOM range, 1-9 pounds above IOM range, >10 pounds above IOM upper bound</i> <i>Collected from:</i> <ul style="list-style-type: none"> Self-reported <i>Ascertained by:</i> <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> NA Other infant outcomes <ul style="list-style-type: none"> NA 	Outcomes Description: Macrosomia (>4500g) Groups Maternal weight gain categories stratified by pregravid BMI (IOM underweight, normal weight, overweight, and obese) and race (non-Hispanic white, non-Hispanic black, and Hispanic): G1: > = 10 lbs below IOM G2: 1-9 lbs below IOM G3: Lower half of IOM G4: Upper half of IOM G5: 1-9 lbs above IOM G6 > = 10lbs above IOM Results Within every BMI-race ethnicity stratum, the odds of delivering a > 4500g infant tended to increase as weight gain increased. This trend was statistically significant for all strata; however, the trend diminished with decreasing BMI. Women in G6 were 2.2–10.8 times more likely to deliver a > 4500 g infant compared to women in G3, irrespective of BMI status. Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Height Education Trimester of the Special Supplemental Nutrition Program for Women, Infants, and Children Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Thorsdottir et al., 2002</p> <p>Country and setting: Maternity records, Department of Obstetrics and Gynecology at Landspítali University Hospital, Iceland</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To investigate relation between gestational weight gain in women of normal prepregnant weight and complications during pregnancy and delivery in a population with high gestational weight gain and birth weight</p> <p>Time frame: NR</p> <p>Duration of the study: 1998</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 614</p> <p>Group Description:</p> <p>G1: No complication</p> <p>G2: Complications in pregnancy or delivery</p> <p>G3: Complications in pregnancy</p> <p>G4: Complications in delivery</p> <p>Group N:</p> <p>G1: 452</p> <p>G2: 162</p> <p>G3: 56</p> <p>G4: 106</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women of normal prepregnancy weight randomly selected within 1 year (1998) No history of diabetes, hypertension, CVD, or thyroid problems Singleton births 38 to 43 weeks gestation 20 to 40 years of age Routine fetal biometry at 18 to 20 week ultrasound Received early and regular antenatal care <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.1 (6.2)</p> <p>G2: 62.0 (5.6) $P = 0.059$</p> <p>G3: 61.7 (4.8) $P = 0.174$</p> <p>G4: 62.2 (6.1) $P = 0.274$</p> <p>Pregravid BMI:</p> <p>G1: 22.2</p> <p>G2: 22.4 (1.6) $P = 0.270$</p> <p>G3: 22.4 (1.5) $P = 0.338$</p> <p>G4: 22.3 $P = 0.584$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs):</p> <p>G1: 29</p> <p>G2: 29 $P = 0.857$</p> <p>G3: 29 $P = 0.404$</p> <p>G4: 29 $P = 0.398$</p> <p>Parity: NR</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Proportional weight gain, %:</p> <p>G1: 26.0</p> <p>G2: 28.0 $P = 0.018$</p> <p>G3: 30.0 $P = 0.005$</p> <p>G4: 27.0 $P = 0.546$</p> <p>Additional characteristics: NR</p>

Evidence Table 44. Gestational weight gain with reference to IOM recommendations and macrosomia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 452 G2: 162 G3: 56 G4: 106 Total weight gain: G1: 16.6 (4.9) G2: 17.4 (5.1) $P = 0.080$ G3: 18.4 (5.1) $P = 0.013$ G4: 16.9 (5.1) $P = 0.887$ Categorized: <ul style="list-style-type: none"> According to IOM < 11.5, 11.5-16.0, ≥ 16.1, also quintiles < 12.5, 12.5-15.5, 15.6-17.8, 17.9-20.8, > 20.8 Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3789 (469) G2: 3749 (565) $P = 0.389$ G3: 3643 (526) $P = 0.032$ G4: 3806 (578) $P = 0.529$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Birthweight > 4500g Groups: Maternal weight gain categories: G1: < 11.5 kg G2: 11.5-16.0 kg G3: 16.1-20.0 kg G4: > 20.0 kg G5: 12.5-15.5kg G6: > 17.8-20.8 kg Results: Birth weight > 4500g, % G1: 4.3 G2: 4.1 ($P < 0.05$ between groups) G3: 9.1 ($P < 0.05$ between groups) G4: 10.2 ($P < 0.05$ between groups) P for trend < 0.015 RR (95%CI) for > 4500g: G5: 1.00 (reference) G6: 3.54 (1.26-9.97) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Height Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bianco et al., 1998</p> <p>Country and setting: Mount Sinai Medical Center, New York City</p> <p>Enrollment period:</p> <p>Funding: NR</p> <p>Study Objective: To compare pregnancy outcomes between morbidly obese and nonobese women and to determine effect of gestational weight gain on pregnancy outcome in morbidly obese women</p> <p>Time frame: NR</p> <p>Duration of the study: 1988 to 1995</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 613 morbidly obese 11,313 nonobese</p> <p>Group Description: G1: Obese G2: Controls</p> <p>Group N: G1: 613 G2: 11,313</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancy Age 20 to 34 years <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple gestations Extremes of age BMI between 27 and 34 Missing height Missing prepregnancy weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 104.7 (16.2) G2: 58.8 (7.1) ($P < 0.05$)</p> <p>Pregravid BMI:</p> <ul style="list-style-type: none"> NR <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NHANES II reference for women 20 to 29 <p>Age (mean, yrs): G1: 27.5 G2: 28.7 ($P = \text{NS}$)</p> <p>Parity: % multiparous: G1: 66.7% G2: 44.8% ($P < 0.01$)</p>	<p>Race, %: White G1: 17.7% G2: 57.3% ($P < 0.01$)</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: G1: 14.2% G2: 4.3% ($P < 0.01$)</p> <p>Hypertension, %: G1: 5.4% G2: 0.3% ($P < 0.01$)</p> <p>Additional characteristics: % college education: G1: 37.1% G2: 63.1% ($P < 0.01$)</p> <p>Preexisting diabetes: G1: 7.3% G2: 1.6% ($P < 0.01$)</p>

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 613 G2: 11,313 Total weight gain: G1: 20 (16.2) G2: 31.4 (11.5) Categorized: Only calculated for morbidly obese: 0 or weight loss, 1-15 lbs, 16-25 lbs, 26-35 lbs, >35 lbs Collected from: <ul style="list-style-type: none"> Routine prenatal care or maternity records Ascertained by: <ul style="list-style-type: none"> Not stated - from medical records 	Birth weight: G1: 3352 (598) G2: 3269 (532) ($P < 0.05$) Gestational diabetes, %: G1: 14.2% G2: 4.3% ($P < 0.01$) Cesarean delivery, %: G1: 31.3% G2: 15.9% Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> Preeclampsia Placental abruption Meconium Failure to progress Shoulder dystocia Postpartum hemorrhage Endomyometritis Wound infections Other infant outcomes <ul style="list-style-type: none"> Fetal growth restriction Preterm delivery Fetal demise Fetal distress 	Outcomes Description: SGA (%) Groups G1: Weight loss or 0 lbs G2: 1-15 lbs G3: 16-25 lbs G4: 26-35 lbs G5: >35 lbs Results G1: 4 G2: 3.9 G3: 5.6 G4: 3.1 G5: 3.8 Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Caulfield et al., 1998</p> <p>Country and setting: USA, hospital obstetric database</p> <p>Enrollment Period: 1987 to 1989</p> <p>Funding: NR</p> <p>Study Objective: To examine relation between gestational weight gain and risk of delivering a small for gestational age and large for gestational age infant by race</p> <p>Time frame: 1987-1989</p> <p>Duration of the study: Entry into pn care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 3,870</p> <p>Group Description:</p> <p>G1: BMI < 19.8 Black G2: BMI < 19.8 White G3: BMI 19.8 to 26.0 Black G4: BMI 19.8 to 26.0 White G5: BMI > 26.0 Black G6: BMI > 26.0 White</p> <p>Group N:</p> <p>G1: 523 G2: 267 G3: 1,479 G4: 796 G5: 615 G6: 190</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton pregnancies White or black ethnicity At least 28 weeks' gestation One delivery per woman (randomly chosen) Information on anthropometric data <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing data Improbable data Non-black or non-white ethnicity 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3)</p> <p>Pregravid BMI:</p> <p>G1: 18.4 (1.0) G2: 18.5 (1.0) G3: 22.7 (1.8) G4: 22.1 (1.8)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs):</p> <p>G1: 21.7 (4.8) G2: 27.1 (6.6) G3: 22.7 (5.3) G4: 29.8 (5.8) G5: 24.9 (6.0) G6: 28.2 (5.5)</p> <p>Parity:</p> <p>G1: % primiparous: 52.4 G2: 55.4 G3: 50.1 G4: 48.0 G5: 36.9 G6: 46.9</p>	<p>Race, %:</p> <p>White NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %:</p> <p>G1: 32.8 G2: 20.6 G3: 35.4 G4: 20.0 G5: 28.8 G6: 25.4</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %:</p> <p>G1: 4.3 G2: 3.0 G3: 6.0 G4: 5.7 G5: 11.9 G6: 17.0</p> <p>Additional characteristics: NR</p>

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: <ul style="list-style-type: none"> AOR for SGA (95% CI) 	Background: Good
Total weight gain: G1: 13.3 (5.7) G2: 14.6 (5.1) G3: 13.6 (6.7) G4: 15.3 (5.4) G5: 12.4 (7.7) G6: 14.5 (7.3)	Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Groups: G1: Underweight, BMI< 19.8 G2: Normal weight, BMI 19.8-26.0 G3: Overweight, BMI> 26.0 Black women: G4: No weight gain < IOM G5: No weight gain > IOM White women: G6: No weight gain < IOM G7: No weight gain > IOM Results: AOR (95%CI) for SGA and Rate of weight gain (per 50 g/wk): G1: 0.87 (0.78-0.97) G2: 0.90 (0.84-0.96) G3: 0.93 (0.86-1.01) Expected Absolute Change (as % of baseline) in Incidence of SGA associated with modifiable risk factors (G4-G7): G4: -1.17 (-16) G5: +0.97 (+13) G6: -0.44 (-11) G7: +0.60 (+15)Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Height Hypertension Provider type Smoking Infant and child confounders and effect modifiers accounted for in analysis: Female infant	Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Devader et al., 2007	Design: <ul style="list-style-type: none">CohortRetrospective	Pregravid weight: <ul style="list-style-type: none">Routine pre-natal careIf missing, obtained from mother during postpartum hospital stay	Race, %: White G1: 79.7 G2: 85.6 G3: 85.2
Country and setting: United States, birth certificate data	Total Study N: 94,696	Pregravid BMI: NR	Black G1: 15.7 G2: 10.8 G3: 12.1
Enrollment period: 1999 to 2001	Group Description: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs	Imputed: <ul style="list-style-type: none">No	Hispanic NR
Funding: NR	Group N: G1: 16,852 G2: 37,292 G3: 40,552	Categorized: NR	Asian/Pacific Islander NR
Study Objective: To investigate relationship between gestational weight gain and adverse pregnancy outcomes among women with normal prepregnancy BMI	Inclusion criteria: <ul style="list-style-type: none">All mothers with normal prepregnancy BMI (19.8–26.0 kg/m²) who were 18 to 35 years of age at time of delivery and who delivered full-term (37 weeks or more) singleton infant during period January 1, 1999, to December 31, 2001	Age (mean, yrs): G1: Maternal age (y) 18 to 24*: 42.3% 25 to 30: 36.2% 31 to 35: 21.5% G2: Maternal age (y) 18 to 24*: 36.7% 25 to 30: 39.5% 31 to 35: 23.8% G3: Maternal age (y) 18 to 24*: 44.7% 25 to 30: 35.9% 31 to 35: 19.4%	Other G1: 4.6 G2: 3.5 G3: 2.7
Time frame: 1999 to 2001	Exclusion criteria:	Parity: NR	Smoking, %: G1: 20.5 G2: 14.9 G3: 17.4
Duration of the study: Entry into prenatal care through delivery	<ul style="list-style-type: none">Women aged younger than 18 years and older than 35 yearsNon-Missouri residentsPreterm deliveriesMultiple gestations		Diabetes mellitus, %: NR
			Hypertension, %: NR
			Additional characteristics: NR

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: AOR for SGA for Women With Normal Prepregnancy BMI (19.8 –26.0 kg/m ²) by GWG Category, Missouri Birth Certificates, 1999–2001 (95%CI)	Background: Good
Total weight gain: NR	Gestational diabetes, %: NR	Groups: G1: Gained less than 25 lbs G2: Gained 25 to 35 lbs G3: Gained more than 35 lbs	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results: G1: 2.14 (2.01–2.27) G2: 1.0 G3: 0.48 (0.45–0.50)	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Education Income Alcohol use Height Prior pregnancy Inadequate prenatal care use Smoking 	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Child's gender Birth year 	Source of information on exposure, outcomes, and confounders: Fair
	Other maternal outcomes: <ul style="list-style-type: none"> Figures 1 to 3 plot risk for each adverse pregnancy outcome by 10-lb increments in gestational weight gain. Women who gained 25 to 34 lbs during their pregnancy had lower risks for most outcomes when balancing risk for SGA status and other adverse pregnancy outcomes Women who gained 15 to 24 lbs had lowest risks for most outcomes, but increased their risk of having an SGA infant from 9.6% to 14.3% Women who gained more than 34 lbs had higher risks for all outcomes, although their risk of having an SGA infant decreased from 9.6% to 6.6% 		Followup: Fair
			Analysis comparability: Fair
			Analysis of outcomes: Fair
			Interpretation: Fair
			Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor
			Final Quality Score: Fair

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria		Baseline Characteristics
	Baseline Characteristics		Baseline Characteristics (continued)

Author, year:
Devader et al., 2007
(combined)

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	Other infant outcomes: NR		

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Edwards et al., 1996 Country and setting: USA, hospital Enrollment Period: 1997-1993 Funding: NR Study Objective: To compare pregnancy course and outcomes in obese and normal weight women and their associations with gestational weight change Time frame: 1997-1993 Duration of the study: 1997-1993	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,443 Group Description: G1: Obese G2: Normal Weight G3: total sample Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese women and normal weight women identified from pregnancy and delivery summary records (normal weight matched to obese by race, age, parity) Singleton deliveries Live births Exclusion criteria: <ul style="list-style-type: none"> Missing data Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 G2: 61 Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelinesobese (> 29) and normal weight (BMI 19.8-26.0) Age (mean, yrs): G1: 27.1 G2: 25.4 Parity: NR	Race, %: White G1: NR G2: NR G3: 69.0 (Total sample) Black G1: NR G2: NR G3: 21.0 (Total sample) Hispanic G1: NR G2: NR G3: 7.0 (Total sample) Asian/Pacific Islander NR Other G1: NR G2: NR G3: 4.0 (Total sample) Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 683 G2: 660 Total weight gain: G1: 9.5 G2: 14.5 $P \leq 0.001$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3420 G2: 3285 $P \leq 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 25.6 G2: 9.1 $P < 0.001$ Instrumental delivery, %: Episiotomy, %: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> SGA Groups: Maternal weight gain categories (kg) Obese > 29: G1: Lost weight/no change G2: 0.5-6.5 G3: 7-11.5 G4: 12-16 G5: > 16 Normal BMI 19.8-26 G6: < 11.5kg G7: 11.5-16 G8: > 16kg Results: % SGA for Obese G1: 10.7% G2: 6.6% G3: 6.0% G4: 4.0% G5: 5.3% $P = 0.11$ For Normal weight G6: 15.9% G7: 7.5% G8: 5.7% $P = 0.001$ AOR (95%CI) Obese G1 vs G3 2.9 (1.1, 8.4) Normal weight G6 vs G7 1.7 (0.9,3.4) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Pre-gravid BMI GDM Pregnancy induced hypertension Prenatal adequacy Alcohol use Drug use Smoking Infant and child confounders and effect modifiers accounted for in analysis: Gestational age	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Fair Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Hellerstedt et al., 1997 Country and setting: United States, medical center Enrollment Period: 1977-1993 Funding: NR Study Objective: To examine association between infant birth outcomes and maternal pregravid obesity, gestational weight gain, and prenatal smoking Time frame: 1977 to 1993 Duration of the study: Entry into prenatal care until delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 1,343 Group Description: G1: Obese G2: Normal weight Group N: G1: 683 G2: 660 Inclusion criteria: <ul style="list-style-type: none"> Obese and normal-weight women delivering singleton during study period Exclusion criteria: <ul style="list-style-type: none"> Missing data Siblings Fetal deaths 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 103.5 kg (13.7) G2: 61.1kg (5.9) Pregravid BMI: G1: 38.3 (4.6) G2: 22.8 (1.6) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: NR <ul style="list-style-type: none"> 16-34 years: 91% ≥ 35 years: 8.8% G2: NR <ul style="list-style-type: none"> 16-34 years: 93.5% ≥ 35 years: 5.8% Parity: G1: NR <ul style="list-style-type: none"> 0: 31.8% 1-3: 64.7% ≥ 4: 3.5% G2: NR <ul style="list-style-type: none"> 0: 33.3% 1-3: 64.9% ≥ 4: 1.8% 	Race, %: White G1: 68.8 G2: 69.1 Black G1: 20.4 G2: 20.6 Hispanic G1: 6.6 G2: 6.5 Asian/Pacific Islander G1: Native Am: 3.8 G2: Native Am: 3.2 Other NR Smoking, %: G1: 26.4 G2: 26.2 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: SGA (%) Groups Maternal weight gain categories stratified by pregravid BMI and smoking status: Obese (BMI > 29.0): G1: Smokers, < IOM G2: Smokers, within IOM G3: Smokers, > IOM G4: Nonsmokers, < IOM G5: Nonsmokers, within IOM G6: Nonsmokers, > IOM Normal weight (BMI 19.8-26.0): G7: Smokers, < IOM G8: Smokers, within IOM G9: Smokers, > IOM G10: Nonsmokers, < IOM G11: Nonsmokers, within IOM G12: Nonsmokers, > IOM Obese: G13: Lost/no gain G14: 0.5-6.5 kg G15: 7-11.5 kg G16: 12-16 kg G17: > 16 kg Normal weight: G18: < 11.5kg G19: 11.5-16kg G20: > 16kg Results Frequencies of SGA, %: G1: 13.3 G2: 10.0 G3: 7.7 G4: 5.5 G5: 4.7 G6: 3.6 G7: 28.6 G8: 10.9 G9: 3.6 G10: 8.9 G11: 6.5 G12: 6.4	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria		Baseline Characteristics (continued)
	Baseline Characteristics		

Author, year:
Hellerstedt et al., 1997
(continued)

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>G13: 10.7 G14: 6.6 G15: 6.0 G16: 4.0 G17: 5.3 <i>P</i> = 0.115 for G13-G17</p> <p>G18: 15.9 G19: 7.5 G20: 5.7 <i>P</i> = 0.001 for G18-G20</p> <p>For obese women, compared to nonsmokers who gained 7-11.5kg, smokers who gained < 7kg were at significantly higher risk of SGA OR: 3.2 (95%CI: 1.1-10.1)</p> <p>For normal weight women, compared to nonsmokers who gained</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Maternal age, pregravid BMI, infant sex, race, parity, prenatal alcohol use, prenatal illicit drug use, adequacy of prenatal care, gestational hypertension, GDM</p> <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age 	

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Kiel et al., 2007</p> <p>Country and setting: United States, birth registry</p> <p>Enrollment period: 1990 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine effect of gestational weight change on pregnancy outcomes in obese women</p> <p>Time frame: 1990 to 2001</p> <p>Duration of the study: Entry into prenatal care through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 120,170</p> <p>Group Description:</p> <p>G1: Obese Class I (BMI 30–34.9) (n = 70,536)</p> <p>G2: Obese Class II (BMI 35–39.9) (n = 30,609)</p> <p>G3: Obese Class III (BMI 40 and More) (n = 19,025)</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Obese women residing in Missouri who delivered (at 37 or more weeks of gestation) liveborn, singleton infants during 1990–2001 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NR 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>G1: Total: Class I obese: 59% Class II obese: 25% Class III obese: 16%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> NIH guidelines <p>Age (mean, yrs):</p> <p>G1: <26: 46% 26–35: 47% Older than 35: 8%</p> <p>G2: <26: 44% 26–35: 48% Older than 35: 8%</p> <p>G3: <26: 40% 26–35: 52% Older than 35: 9%</p> <p>Parity: Nulliparous:</p> <p>G1: 34% G2: 33% G3: 32%</p>	<p>Race, %: White G1: 78 G2: 77 G3: 73</p> <p>Black G1: 22 G2: 23 G3: 27</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: 22</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: SGA: 7% LGA: 13% ($P < 0.05$) G2: SGA: 7% LGA: 16% ($P < 0.05$) G3: SGA: 6% LGA: 18% ($P < 0.05$)	Outcomes Description: Absolute risk and OR (95% CI) of pregnancy outcomes for various classes of obese women (class I, II, III) Groups: Maternal weight gain categories stratified by prepregnancy obesity status, Obese Class I (BMI 30–34.9), Obese Class II (BMI 35–39.9), Obese Class III (\geq BMI 40): G1: < -10 lbs G2: -2 to -9 lbs G3: No change G4: 2–9 lbs G5: 10–14 lbs G6: 15–25 lbs G7: 26–35 lbs G8: > 35 lbs	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 6 Fair, 1 Poor Final Quality Score: Fair
Total weight gain: G1: GWG (lb) Less than 2: 3% 2 to 14: 15% 15 to 25: 26% More than 25: 56% G2: GWG (lb) Less than 2: 8% 2 to 14: 22% 15 to 25: 27% More than 25: 43% G3: GWG (lb) Less than 2: 15%	Gestational diabetes, %: NR Cesarean delivery, %: G1: 28 G2: 34 G3: 41 Instrumental delivery, %: NR Episiotomy, %: NR	Result: For Obese Class I: AOR (95% CI) for SGA were significantly greater (> 1.00 , G6 was reference) for G1–G5 and significantly lower for G7–G8. For Obese Class II: AOR (95% CI) for SGA were significantly greater (> 1.00 , G6 was reference) for G1–G5 and significantly lower for G7–G8 For Obese Class III: AOR (95% CI) for SGA were significantly greater (> 1.00 , G6 was reference) for G1 and G3 and significantly lower for G7–G8 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Education • Poverty (enrollment in Medicaid, WIC, food stamp programs) • Tobacco use • Chronic hypertension Infant and child confounders and effect modifiers accounted for in analysis: NR	
Categorized: <ul style="list-style-type: none"> • 10-lb or less loss • 2 to 9 lbs loss, no weight change, • 2 to 9 lbs gain, • 10 to 14 lbs gain, • 15–25 lb gain, • 26–35 lb gain, and • greater than 35 lb gain 			
Collected from: <ul style="list-style-type: none"> • Routine pre-natal care or maternity records 			
Ascertained by: NR			

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nielsen et al., 2006</p> <p>Country and setting: USA, clinic</p> <p>Enrollment Period: 1990 to 2000</p> <p>Funding: NR</p> <p>Study Objective: To examine whether such weight gains improve birth outcomes in a cohort of disadvantaged African American adolescents</p> <p>Time frame: 1990 to 2000</p> <p>Duration of the study: First prenatal care visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 815</p> <p>Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI > 26.0</p> <p>Group N: G1: 193 G2: 431 G3: 191</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Adolescents ≤ 17 years at conception African American pregnancies <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 18.3 (1.1) G2: 22.4 (1.6) G3: 30.9 (4.6)</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: mean age at infant birth (SD): 16.9 (1.2) G2: 16.8 (1.1) G3: 17.0 (1.1)</p> <p>Parity: % primiparous: G1: 83.9 G2: 85.2 G3: 74.9</p>	<p>Race,%: White NR</p> <p>Black G1: 100 G2: 100 G3: 100</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: G1: 11.4 G2: 9.7 G3: 10.5</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 193 G2: 431 G3: 191 Total weight gain: G1: < IOM: 30.3%; lower half of IOM: 18.1%; upper half of IOM: 21.9%; > IOM: 29.7% G2: < IOM: 31.3%; lower half of IOM: 16.1%; upper half of IOM: 17.6%; > IOM: 35.0% G3: < IOM: 16.5%; lower half of IOM: 9.4%; upper half of IOM: 10.6%; > IOM: 63.5 Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight within 4 weeks delivery and self-reported prepregnancy weight 	Birth weight: G1: 2899 (595) G2: 3083 (645) <i>P</i> < 0.005 compared to BMI < 19.8 G3: 3181 (673) <i>P</i> < 0.005 compared to BMI < 19.8 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Size for gestational age (small, average, large) Birth weight category (suboptimal < 3000g, optimal 3000–4000g, above optimal > 4000g) 	Outcomes Description: <ul style="list-style-type: none"> SGA Groups: G1: BMI < 19.8 G2: BMI 19.8–26.0 G3: BMI > 26.0 G4: < IOM recommendation G5: Lower half of IOM recommendation G6: Upper half of IOM recommendation G7: > IOM recommendation Results: SGA, %: G1: 22.3 G2: 15.6 G3: 11.5 <i>P</i> < 0.01 for G1–G3 AOR (95%CI) for SGA: G4: 2.31 (1.22–4.37) G5: 1.00 (reference) G6: 0.88 (0.41–1.89) G7: 0.68 (0.34–1.35) <i>P</i> < 0.01 for G4–G7 Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Parity Pre-gravid BMI Pre-eclampsia time between last weight measure and delivery Height Smoking Infant and child confounders and effect modifiers accounted for in analysis: Infant sex	Background: Good Sample selection: Fair Definition of maternal weight gain: Good Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Parker and Abrams, 1992</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Sept 1980 to Dec 1988</p> <p>Funding: UC Committee on Research & MCH and Resources Development, Health Resources and Services Administration</p> <p>Study Objective: To test whether gains outside IOM reference ranges were associated with increased risks of suboptimal pregnancy outcome (SGA, LGA, cesarean delivery) and to determine whether locally developed ranges were more applicable to study population</p> <p>Time frame: Sept 1980 to Dec 1988</p> <p>Duration of the study: From entry into prenatal care until delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 6,690</p> <p>Group Description: G1: Overall G2: NR</p> <p>Group N: G1: 6,690 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutive live singleton births at Moffitt Hospital between September 1980 and December 1988 with gestational ages of 37 to 42 weeks <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Maternal transfers or transports and deliveries complicated by fetal malformations, maternal diabetes, or maternal hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 56.8 kg(SD 11.0) G2: NR</p> <p>Pregravid BMI: G1: Underweight: 27.7%, Normal weight 61.8%, Overweight: 5.6%, Obese 4.9% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 27.7 (5.5) G2: NR</p> <p>Parity: Primiparous: G1: 58.8% G2: NR</p>	<p>Race, %: White G1: 44.0 G2: NR</p> <p>Black G1: 8.3 G2: NR</p> <p>Hispanic G1: 9.4 G2: NR</p> <p>Asian/Pacific Islander G1: 21.4 G2: NR</p> <p>Other G1: 12.0 G2: NR</p> <p>Smoking, %: G1: 12.0 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 6690 G2: NR Total weight gain: G1: 15.2kg (5.2) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM %: Weight gain ranges based on percentiles from previous study of UC population with good pregnancy outcomes: 25th - 75th, 10-90th percentiles. For 25-75th, weight gain range = 12-17kg for underweight women (BMI < 19.8); Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3408g (462) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> SGA Groups: G1: < IOM range G2: Within IOM range G3: > IOM Results: AOR (95% CI) for SGA: G1: 1.78 (1.39-2.27) G2: 1.00 (reference) Incidence of SGA in nonobese women, %: G1: 3.25 G2: 6.14 G3: 13.11 Incidence of SGA in obese women, %: G1: 11.76 G2: 3.09 AOR of SGA and low weight gain UCSF 25-75 2.06 (1.62-2.63) UCSF 10-90 1.82 (1.35-2.47) IOM 1.78 (1.39-2.27) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Height Maternal high and low weight gain Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stevens-Simon and McAnarney, 1992</p> <p>Country and setting: USA, adolescent maternity program</p> <p>Enrollment Period: 1986 to 1989</p> <p>Funding: Grant from Bureau of Maternal and Child Health</p> <p>Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents</p> <p>Time frame: 1986 to 1989</p> <p>Duration of the study: Entry into prenatal care through 6 weeks PP check up</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 141 (107 included in postpartum analyses)</p> <p>Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers</p> <p>Group N: G1: 28 G2: 66 G3: 47</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5)</p> <p>Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOMslow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) <i>P</i> < 0.0001 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Distribution of SGA, %: Groups Maternal weight gain categories (kg/wk): G1: < 0.23 G2: 0.23-0.40 G3: > 0.40 Results G1: 7.1 G2: 9.1 G3: 2.1 <i>P</i> = NS Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Stotland et al., 2006 Country and setting: USA, university hospital Enrollment Period: 1980 to 2001 Funding: NR Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more) Time frame: 1980 to 2001 Duration of the study: Entry into PN care up till delivery	Design: <ul style="list-style-type: none"> Cohort Retrospective Total Study N: 20465 Group Description: G1: Gain below IOM recommendations G2: Gain within IOM recommendations G3: Gain above IOM recommendations Group N: G1: 4,114 G2: 7,490 G3: 8,861 Inclusion criteria: <ul style="list-style-type: none"> Singleton Exclusion criteria: <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: G1: < 19.8: 25.8% 19.8-26.0: 19.4% 26.1-29.0: 9.2% > 29.0: 20.6% G2: < 19.8: 49.1% 19.8-26.0: 34.8% 26.1-29.0: 23.3% > 29.0: 25.5% G3: < 19.8: 25.0% 19.8-26.0: 45.8% 26.1-29.0: 67.5% > 29.0: 53.9% $P < 0.001$ Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: < 20 years: 23.4% 20-29 years: 19.3% 30-39 years: 19.9% > 40 years: 25.3% G2: < 20 years: 31.3% 20-29 years: 36.6% 30-39 years: 37.6% > 40 years: 36.3% G3: < 20 years: 45.4% 20-29 years: 44.0% 30-39 years: 42.5% > 40 years: 38.4% $P < 0.001$ Parity: % Nulliparous: G1: 17.3 G2: 36.2 G3: 46.6 $P < 0.001$	Race, %: White G1: 16.2 G2: 35.8 G3: 48.0 Black G1: 25.5 G2: 29.4 G3: 45.1 Hispanic G1: 19.2 G2: 34.8 G3: 46.0 Asian/Pacific Islander G1: 24.3 G2: 43.3 G3: 32.4 Other G1: 21.7 G2: 37.9 G3: 40.4 P for all race categories < 0.001 Smoking, %: G1: 23.5 G2: 30.8 G3: 45.8 $P < 0.001$ Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 45. Gestational weight gain with reference to IOM recommendations and small-for-gestational age (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM percentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 $P < 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery, %: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 , Aassisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: <ul style="list-style-type: none"> Risk of adverse neonatal outcomes by gestational weight gain by IOM guidelines, adjusted ORs compared to women with GWG within IOM guidelines and risk of adverse neonatal outcomes by extremes of GWG compared to women with weight gain 11.5-16.0kg Groups: G1: < IOM G2: Within IOM G3: > IOM G4: < 7kg G5: > 18kg Results: Unadjusted Rates of SGA: G1: 11.74 $P < 0.001$ vs. G2 G2: 7.05 G3: 3.70 $P < 0.001$ vs. G2 G4: 13.99 $P < 0.05$ vs. G2 G5: 3.87 $P < 0.05$ vs. G2 AOR (95% CI) for SGA: G1: 1.66 (1.44-1.92) G2: 1.00 (reference) G3: 0.51 (0.44-0.59) G4: 2.26 (1.76-2.90) G5: 0.50 (0.42-0.60) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 46. Gestational weight gain with reference to IOM recommendations and Apgar scores

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Nixon et al., 1998</p> <p>Country and setting: USA, county nurse-midwifery services</p> <p>Enrollment Period: January 1991 to December 1994</p> <p>Funding: American College of Nurse Midwives</p> <p>Study Objective: To compare outcomes of term infants of average birth weight with outcomes of large infants using computer database</p> <p>Time frame: January 1991 to December 1994</p> <p>Duration of the study: First prenatal visit through birth collected retrospectively</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 2,228</p> <p>Group Description: G1: 2500 - 3999g G2: ≥ 4000g</p> <p>Group N: G1: 1906 G2: 322</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Gestational age ≥ 37 weeks Birth weight ≥ 2500g Live infant at onset of labor Birth occurred in hospital <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with gestational diabetes that required insulin therapy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 138 (31) G2: 158 (36) ($P < 0.0001$)</p> <p>Pregravid BMI: G1: 24 (5) G2: 26 (5.8) ($P < 0.0001$)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous IOM guidelines <p>Age (mean, yrs): G1: 25 (6) G2: 27.5 (6) ($P < 0.0001$)</p> <p>Parity: % parous: G1: 56.3 G2: 69.9 ($P < 0.00001$)</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: % shoulder dystocia: G1: 0.6 G2: 5.9 ($P < 0.001$) % NICU: G1: 4.3 G2: 6.6 ($P = \text{ns}$)</p>

Evidence Table 46. Gestational weight gain with reference to IOM recommendations and Apgar scores
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 1906 G2: 322 Total weight gain: G1: 30.7+/-15 G2: 37.2+/-15 (P < 0.0001) Categorized: <ul style="list-style-type: none"> Continuous According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Apgar scores 	Outcomes Description: Apgar scores < 7 Groups: NR Outcomes Set 2: Gestational weight gain not a predictor of Apgar scores < 7 (details NR) Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

**Evidence Table 46. Gestational weight gain with reference to IOM recommendations and Apgar scores
(continued)**

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stevens-Simon and McAnarney, 1992</p> <p>Country and setting: USA, adolescent maternity program</p> <p>Enrollment Period: 1986 to 1989</p> <p>Funding: Grant from Bureau of Maternal and Child Health</p> <p>Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents</p> <p>Time frame: 1986 to 1989</p> <p>Duration of the study: Entry into prenatal care through 6 weeks PP check up</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 141 (107 included in postpartum analyses)</p> <p>Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers</p> <p>Group N: G1: 28 G2: 66 G3: 47</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5)</p> <p>Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 46. Gestational weight gain with reference to IOM recommendations and Apgar scores
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOM slow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) <i>P</i> < 0.0001 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Distribution of 1- and 5-minute Apgar scores, %: Groups Maternal weight gain categories (kg/wk): G1: < 0.23 G2: 0.23-0.40 G3: > 0.40 Results Distribution of 1 minute Apgar score < = 4, %: G1: 25.0 G2: 4.5 G3: 14.9 <i>P</i> = 0.02 for G1 vs. G2 or G3 Distribution of 5 minute Apgar score < = 4, %: G1: 3.5 G2: 0 G3: 0 <i>P</i> = NS Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

**Evidence Table 46. Gestational weight gain with reference to IOM recommendations and Apgar scores
(continued)**

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stotland et al., 2006</p> <p>Country and setting: USA, university hospital</p> <p>Enrollment Period: 1980 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more)</p> <p>Time frame: 1980 to 2001</p> <p>Duration of the study: Entry into PN care up till delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 20465</p> <p>Group Description:</p> <p>G1: Gain below IOM recommendations</p> <p>G2: Gain within IOM recommendations</p> <p>G3: Gain above IOM recommendations</p> <p>Group N:</p> <p>G1: 4,114</p> <p>G2: 7,490</p> <p>G3: 8,861</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>G1: < 19.8: 25.8%</p> <p>19.8-26.0: 19.4%</p> <p>26.1-29.0: 9.2%</p> <p>> 29.0: 20.6%</p> <p>G2: < 19.8: 49.1%</p> <p>19.8-26.0: 34.8%</p> <p>26.1-29.0: 23.3%</p> <p>> 29.0: 25.5%</p> <p>G3: < 19.8: 25.0%</p> <p>19.8-26.0: 45.8%</p> <p>26.1-29.0: 67.5%</p> <p>> 29.0: 53.9%</p> <p>$P < 0.001$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs):</p> <p>G1: < 20 years: 23.4%</p> <p>20-29 years: 19.3%</p> <p>30-39 years: 19.9%</p> <p>> 40 years: 25.3%</p> <p>G2: < 20 years: 31.3%</p> <p>20-29 years: 36.6%</p> <p>30-39 years: 37.6%</p> <p>> 40 years: 36.3%</p> <p>G3: < 20 years: 45.4%</p> <p>20-29 years: 44.0%</p> <p>30-39 years: 42.5%</p> <p>> 40 years: 38.4%</p> <p>$P < 0.001$</p> <p>Parity:</p> <p>% Nulliparous:</p> <p>G1: 17.3</p> <p>G2: 36.2</p> <p>G3: 46.6</p> <p>$P < 0.001$</p>	<p>Race, %:</p> <p>White</p> <p>G1: 16.2</p> <p>G2: 35.8</p> <p>G3: 48.0</p> <p>Black</p> <p>G1: 25.5</p> <p>G2: 29.4</p> <p>G3: 45.1</p> <p>Hispanic</p> <p>G1: 19.2</p> <p>G2: 34.8</p> <p>G3: 46.0</p> <p>Asian/Pacific Islander</p> <p>G1: 24.3</p> <p>G2: 43.3</p> <p>G3: 32.4</p> <p>Other</p> <p>G1: 21.7</p> <p>G2: 37.9</p> <p>G3: 40.4</p> <p>P for all race categories < 0.001</p> <p>Smoking, %:</p> <p>G1: 23.5</p> <p>G2: 30.8</p> <p>G3: 45.8 $P < 0.001$</p> <p>Diabetes mellitus, %:</p> <p>NR</p> <p>Hypertension, %:</p> <p>NR</p> <p>Additional characteristics:</p> <p>NR</p>

Evidence Table 46. Gestational weight gain with reference to IOM recommendations and Apgar scores
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOMpercentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 $P < 0.001$ Gestational diabetes,%: NR Cesarean delivery,%: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery,%: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 , Aassisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: <ul style="list-style-type: none"> Risk of adverse neonatal outcomes by gestational weight gain by IOM guidelines, adjusted ORs compared to women with GWG within IOM guidelines and risk of adverse neonatal outcomes by extremes of GWG compared to women with weight gain 11.5-16.0kg Groups: G1: < IOM G2: Within IOM G3: > IOM G4: < 7kg G5: > 18kg Results: Unadjusted Rates of 5 minute Apgar score < 7: G1: 1.94 G2: 1.58 G3: 2.14 ($P < 0.05$, G3 vs. G2) G4: 2.39 G5: 2.16 ($P < 0.05$, G5 vs. G2) AOR (95% CI) for 5 minute Apgar score < 7: G1: 1.18 (0.84-1.66) G2: 1.00 (reference) G3: 1.33 (1.01-1.76) G4: 1.29 (0.70-2.39) G5: 1.30 (0.95-1.77) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 47. Gestational weight gain with reference to IOM recommendations and perinatal mortality

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bracero and Byrne, 1997</p> <p>Country and setting: Hospital charts - Maimonides Medical Center, Brooklyn, NY</p> <p>Enrollment Period:</p> <p>Funding: NR</p> <p>Study Objective: To determine optimal weight gain in singleton pregnancy and evaluate current recommendations</p> <p>Time frame:</p> <p>Duration of the study: Jan 1, 1987 to Jan 1, 1993</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 20,971</p> <p>Group Description: G1: Total population G2: NR</p> <p>Group N: G1: 20,971 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Delivery at Maimonides Medical Center Singleton pregnancy No documentation of congenital anomaly, pregnancy was not terminated by abortion Documentation on chart of prepregnancy maternal weight, amount of maternal weight gain during pregnancy, and gender of infant <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Infants with any type of congenital anomaly (international classification of diseases (ICD-9-CM) codes 740.0-759.9 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: median BMI = 23.19 (range 14.46-40.07) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: % < 15 years: < 0.1; 15-19 yrs: 4.8; 20-24: 25.1; 25-29: 31.1; 30-34: 24.3; 35-39: 11.8; 40-44: 2.8; 45-49: 0.1; > 50: < 0.1 G2: NR</p> <p>Parity: % primigravida: G1: 25.1 G2: NR</p>	<p>Race, %: White G1: 92.1 G2: NR Black G1: 4.2 G2: NR Hispanic NR Asian/Pacific Islander G1: 0.9 G2: NR Other G1: 2.1 G2: NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: % married: G1: 12.4 G2: NR</p> <p>Additional characteristics: Type of service: G1: Ward, 22.5% Private: 77.5% G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 47. Gestational weight gain with reference to IOM recommendations and perinatal mortality
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain:</p> <p>G1: % weight gain: lost weight, 0.4; 1 to 5lbs, 0.9; 6 to 10, 2.3; 11 to 15, 5.4; 16 to 20, 12.0; 21 to 25, 17.2; 26 to 30, 21.1; 31 to 35, 14.8; 36 to 40, 11.5; 41 to 45, 6.1; ≥ 46, 8.3</p> <p>G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> According to IOM ordinal categories in 5 pound intervals <p>Collected from:</p> <ul style="list-style-type: none"> Routine prenatal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: using last measurement obtained as an outpatient 	<p>Birth weight:</p> <p>G1: $r = .210$ correlation with maternal weight gain</p> <p>G2: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <p>Optimal weight gain defined as 36 to 40 pounds for underweight women, 31 to 40 pounds for women of ideal prepregnancy weight, 26 to 30 pounds for overweight women</p> <p>Other infant outcomes:</p> <p>Adverse outcomes:</p> <ul style="list-style-type: none"> Still birth Neonatal death Preterm delivery/low birth weight Perinatal morbidity 	<p>Outcomes Description:</p> <ul style="list-style-type: none"> Perinatal mortality and adverse perinatal outcome <p>Groups:</p> <p>Maternal weight gain in relation to IOM recommendations:</p> <p>G1: Under 17.6%</p> <p>G2: Within 56.9%</p> <p>G3: Over 25.5%</p> <p>Results:</p> <p>Adverse perinatal outcome %</p> <p>G1: 14.4</p> <p>G2: 8.4</p> <p>G3: 8.5 $P < 0.001$</p> <p>Birthweight < 2500 %</p> <p>G1: 10.1</p> <p>G2: 3.3</p> <p>G3: 2.5 $P < 0.001$</p> <p>Perinatal mortality %</p> <p>G1: 1.1</p> <p>G2: 0.4</p> <p>G3: 0.4 $P < 0.001$</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NR</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p> <p>G4: 0.7 $P = 0.298$</p> <p>G5: 0.6</p> <p>G6: 0.2 $P < 0.001$</p>	<p>Background: Fair</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Fair</p> <p>Analysis comparability: Fair</p> <p>Analysis of outcomes: Fair</p> <p>Interpretation: Fair</p> <p>Sum of Good/Fair/Poor: 1 Good, 8 Fair, 0 Poor</p> <p>Final Quality Score: Fair</p>

Evidence Table 48. Gestational weight gain with reference to IOM recommendations and hypoglycemia

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hedderson et al., 2006</p> <p>Country and setting: USA, Kaiser Permanente Medical Care Program</p> <p>Enrollment Period: January 1, 1996 - June 31, 1998</p> <p>Funding: R01 DK 54834 from National Institute of Diabetes and Digestive and Kidney Diseases, grant from American Diabetes Association and Kaiser Community Benefit research support</p> <p>Study Objective: To examine whether pregnancy weight gains outside IOM recommendations and rates of maternal weight gain are associated with neonatal complications</p> <p>Time frame: January 1, 1996 to June 31, 1998</p> <p>Duration of the study: First prenatal care visit to 30 days post delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Case-control Retrospective <p>Total Study N: 45,245</p> <p>Group Description: G1: Controls G2: Macrosomia G3: Hypoglycemia G4: Hyperbilirubinemia</p> <p>Group N: G1: 652 G2: 391 G3: 328 G4: 432</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton livebirth <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No pregestational diabetes or history of gestational diabetes (screened at 24-28 weeks gestation - meeting National Diabetes Data Group criteria for GDM) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported in some cases used measured weight recorded in chart closes to woman's last menstrual period but no more than 12 months before her last menstrual period <p>Pregravid BMI: G1: < 19.8: 13.5% 19.8-24.9: 56.4% 25.0-29.0: 12.4% > 29.0: 17.6% G2: < 19.8: 5.1% 19.8-24.9: 51.2% 25.0-29.0: 16.6% > 29.0: 27.1% G3: < 19.8: 10.1% 19.8-24.9: 50.0% 25.0-29.0: 17.1% > 29.0: 22.9% G4: < 19.8: 13.9% 19.8-24.9: 57.9% 25.0-29.0: 13.2% > 29.0: 57.1%</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: < 25 years: 22.1% 25-29: 24.2% 30-34: 33.6% ≥ 35: 20.1% G2: < 25 years: 15.9% 25-29: 28.0% 30-34: 31.7% ≥ 35: 24.3% G3: < 25 years: 24.1% 25-29: 25.3% 30-34: 26.8% ≥ 35: 23.8% G4: < 25 years: 17.1% 25-29: 29.4% 30-34: 32.6% ≥ 35: 20.8%</p> <p>Parity: % primiparous: G1: 56.9 G2: 31.2 G3: 50.0 G4: 59.3</p>	<p>Race, %: White G1: 54.0 G2: 67.8 G3: 47.6 G4: 42.6 Black G1: 10.0 G2: 5.1 G3: 11.3 G4: 4.4 Hispanic G1: 17.2 G2: 15.1 G3: 20.4 G4: 15.5 Asian/Pacific Islander G1: 8.1 G2: 3.6 G3: 6.7 G4: 20.1 Other G1: 10.7 G2: 8.4 G3: 14.0 G4: 17.4</p> <p>Smoking, %: G1: %nonsmoking during pregnancy: 92.0; %smoked but quit: 4.2; %smoked 3.9 G2: %nonsmoking during pregnancy: 90.8; %smoked but quit: 5.3; %smoked 4.0 G3: %nonsmoking during pregnancy: 92.6; %smoked but quit: 1.5; %smoked 5.8 G4: %nonsmoking during pregnancy: 94.2; %smoked but quit: 4.9; %smoked 1.0</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Screening glucose value less than 140: G1: 85.0%: > 140: 15.0% G2: 81.6%: > 140: 18.4% G3: 81.4%: > 140: 18.6% G4: 83.3%: > 140: 16.7%</p>

Evidence Table 48. Gestational weight gain with reference to IOM recommendations and neonatal hypoglycemia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records; rate of maternal weight gain was calculated as total pregnancy weight gain minus infant birth weight divided by weeks of gestation when last weight was measured; rate of maternal weight gain before the third trimester was calculated using the weight measured at or before the screening test for GDM (24-28 wks of gestation) minus prepregnancy weight divided by weeks of gestation Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between final recorded weight at last prenatal visit (within 2 weeks of delivery date) and prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> AOR for neonatal hypoglycemia (95% CI) Groups: G1: Rate of maternal weight gain (kg/wk): -0.26-0.21 G2: Rate of maternal weight gain (kg/wk): 0.22-0.31 G3: Rate of maternal weight gain (kg/wk): 0.32-0.39 G4: Rate of maternal weight gain (kg/wk): 0.40-1.03 Results: G1: 0.87 (0.57-1.32) G2: 1.00 G3: 0.74 (0.49-1.14) G4: 1.91 (1.33-2.82) Below IOM recommendations 0.91 (0.59-1.41) Within IOM recommendations 1.00 Above IOM recommendations 1.39 (1.02-1.90) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Screening glucose value from 1 hour after 50g oral glucose challenge test Difference between age at delivery and gestational age at last weight measured Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 5 Good, 4 Fair, 0 Poor Final Quality Score: Good

Evidence Table 48. Gestational weight gain with reference to IOM recommendations and neonatal hypoglycemia (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stotland et al., 2006</p> <p>Country and setting: USA, university hospital</p> <p>Enrollment Period: 1980 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more)</p> <p>Time frame: 1980 to 2001</p> <p>Duration of the study: Entry into PN care up till delivery</p> <p>Quality: Fair</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 20465</p> <p>Group Description:</p> <p>G1: Gain below IOM recommendations</p> <p>G2: Gain within IOM recommendations</p> <p>G3: Gain above IOM recommendations</p> <p>Group N:</p> <p>G1: 4,114</p> <p>G2: 7,490</p> <p>G3: 8,861</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>G1: < 19.8: 25.8% 19.8-26.0: 19.4% 26.1-29.0: 9.2% > 29.0: 20.6%</p> <p>G2: < 19.8: 49.1% 19.8-26.0: 34.8% 26.1-29.0: 23.3% > 29.0: 25.5%</p> <p>G3: < 19.8: 25.0% 19.8-26.0: 45.8% 26.1-29.0: 67.5% > 29.0: 53.9% $P < 0.001$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs):</p> <p>G1: < 20 years: 23.4% 20-29 years: 19.3% 30-39 years: 19.9% > 40 years: 25.3%</p> <p>G2: < 20 years: 31.3% 20-29 years: 36.6% 30-39 years: 37.6% > 40 years: 36.3%</p> <p>G3: < 20 years: 45.4% 20-29 years: 44.0% 30-39 years: 42.5% > 40 years: 38.4% $P < 0.001$</p> <p>Parity:</p> <p>% Nulliparous:</p> <p>G1: 17.3</p> <p>G2: 36.2</p> <p>G3: 46.6 $P < 0.001$</p>	<p>Race, %:</p> <p>White</p> <p>G1: 16.2</p> <p>G2: 35.8</p> <p>G3: 48.0</p> <p>Black</p> <p>G1: 25.5</p> <p>G2: 29.4</p> <p>G3: 45.1</p> <p>Hispanic</p> <p>G1: 19.2</p> <p>G2: 34.8</p> <p>G3: 46.0</p> <p>Asian/Pacific Islander</p> <p>G1: 24.3</p> <p>G2: 43.3</p> <p>G3: 32.4</p> <p>Other</p> <p>G1: 21.7</p> <p>G2: 37.9</p> <p>G3: 40.4</p> <p>P for all race categories < 0.001</p> <p>Smoking, %:</p> <p>G1: 23.5</p> <p>G2: 30.8</p> <p>G3: 45.8 $P < 0.001$</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 48. Gestational weight gain with reference to IOM recommendations and neonatal hypoglycemia (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM percentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 $P < 0.001$ Gestational diabetes, %: NR Cesarean delivery, %: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery, %: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 Assisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: AOR for neonatal hypoglycemia (95% CI) Groups: G1: Below IOM guidelines G2: Within IOM guidelines G3: Above IOM guidelines Results Hypoglycemia G1: 1.02 (0.64–1.62) G2: 1.0 G3: 1.52 (1.06–2.16) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 49. Gestational weight gain with reference to IOM recommendations and admission to neonatal intensive care

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stevens-Simon and McAnarney, 1992</p> <p>Country and setting: USA, adolescent maternity program</p> <p>Enrollment Period: 1986 to 1989</p> <p>Funding: Grant from Bureau of Maternal and Child Health</p> <p>Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents</p> <p>Time frame: 1986 to 1989</p> <p>Duration of the study: Entry into prenatal care through 6 weeks PP check up</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 141 (107 included in postpartum analyses)</p> <p>Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers</p> <p>Group N: G1: 28 G2: 66 G3: 47</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5)</p> <p>Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 49. Gestational weight gain with reference to IOM recommendations and admission to neonatal intensive care (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOM slow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) $P < 0.0001$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Admission to NICU (%) Groups: Maternal weight gain categories (kg/wk): G1: < 0.23 (slow gainers) G2: 0.23-0.40 (average gainers) G3: > 0.40 (rapid gainers) Results: G1: 28.6 G2: 15.2 G3: 8.5 $P = 0.1$ for infants of slow gainers vs. all other infants Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 49. Gestational weight gain with reference to IOM recommendations and admission to neonatal intensive care (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stotland et al., 2006</p> <p>Country and setting: USA, university hospital</p> <p>Enrollment Period: 1980 to 2001</p> <p>Funding: NR</p> <p>Study Objective: To examine relationship between gestational weight gain and adverse neonatal outcomes among infants born at term (37 weeks or more)</p> <p>Time frame: 1980 to 2001</p> <p>Duration of the study: Entry into PN care up till delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 20465</p> <p>Group Description:</p> <p>G1: Gain below IOM recommendations</p> <p>G2: Gain within IOM recommendations</p> <p>G3: Gain above IOM recommendations</p> <p>Group N:</p> <p>G1: 4,114</p> <p>G2: 7,490</p> <p>G3: 8,861</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Singleton <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Pregnancies complicated by multiple gestations, congenital anomalies, chronic hypertension, gestational or pregestational diabetes Birth before 37 weeks Maternal transport Missing data on any of variables considered in multivariable analysis 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>G1: < 19.8: 25.8%</p> <p>19.8-26.0: 19.4%</p> <p>26.1-29.0: 9.2%</p> <p>> 29.0: 20.6%</p> <p>G2: < 19.8: 49.1%</p> <p>19.8-26.0: 34.8%</p> <p>26.1-29.0: 23.3%</p> <p>> 29.0: 25.5%</p> <p>G3: < 19.8: 25.0%</p> <p>19.8-26.0: 45.8%</p> <p>26.1-29.0: 67.5%</p> <p>> 29.0: 53.9%</p> <p>$P < 0.001$</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs):</p> <p>G1: < 20 years: 23.4%</p> <p>20-29 years: 19.3%</p> <p>30-39 years: 19.9%</p> <p>> 40 years: 25.3%</p> <p>G2: < 20 years: 31.3%</p> <p>20-29 years: 36.6%</p> <p>30-39 years: 37.6%</p> <p>> 40 years: 36.3%</p> <p>G3: < 20 years: 45.4%</p> <p>20-29 years: 44.0%</p> <p>30-39 years: 42.5%</p> <p>> 40 years: 38.4%</p> <p>$P < 0.001$</p> <p>Parity:</p> <p>% Nulliparous:</p> <p>G1: 17.3</p> <p>G2: 36.2</p> <p>G3: 46.6</p> <p>$P < 0.001$</p>	<p>Race, %:</p> <p>White</p> <p>G1: 16.2</p> <p>G2: 35.8</p> <p>G3: 48.0</p> <p>Black</p> <p>G1: 25.5</p> <p>G2: 29.4</p> <p>G3: 45.1</p> <p>Hispanic</p> <p>G1: 19.2</p> <p>G2: 34.8</p> <p>G3: 46.0</p> <p>Asian/Pacific Islander</p> <p>G1: 24.3</p> <p>G2: 43.3</p> <p>G3: 32.4</p> <p>Other</p> <p>G1: 21.7</p> <p>G2: 37.9</p> <p>G3: 40.4</p> <p>P for all race categories < 0.001</p> <p>Smoking, %:</p> <p>G1: 23.5</p> <p>G2: 30.8</p> <p>G3: 45.8 $P < 0.001$</p> <p>Diabetes mellitus, %:</p> <p>NR</p> <p>Hypertension, %:</p> <p>NR</p> <p>Additional characteristics:</p> <p>NR</p>

Evidence Table 49. Gestational weight gain with reference to IOM recommendations and admission to neonatal intensive care (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 4114 G2: 7490 G3: 8861 Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOMpercentiles and dichotomous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: %SGA: 36.1; %AGA: 20.2; %LGA: 8.5 G2: %SGA: 39.4; %AGA: 37.5; %LGA: 26.5 G3: %SGA: 24.5; %AGA: 42.4; %LGA: 65.1 $P < 0.001$ Gestational diabetes,%: NR Cesarean delivery,%: G1: 14.7 G2: 32.1 G3: 53.2 Instrumental delivery,%: Operative vaginal delivery: G1: 18.0% G2: 37.5% G3: 44.5% Episiotomy,%: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth trauma 5 min Apgar score less than 7 , Aassisted ventilation SGA LGA NICU admission SCN admission Neonatal infection Seizure Hypoglycemia Polycythemia MAS RDS Tachypnea Hospital stay > 5 days Hospital stay > 10 days 	Outcomes Description: <ul style="list-style-type: none"> Risk of adverse neonatal outcomes by gestational weight gain by IOM guidelines, adjusted ORs compared to women with GWG within IOM guidelines and risk of adverse neonatal outcomes by extremes of GWG compared to women with weight gain 11.5-16.0kg Groups: G1: < IOM G2: Within IOM G3: > IOM G4: < 7kg G5: > 18kg Results: AOR (95% CI) for NICU admission: G1: 0.66 (0.46-0.96) G2: 1.03 (0.79-1.35) G3: 0.50 (0.23-1.12) G4: 0.66 (0.46-0.96) G5: 1.03 (0.79-1.35) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Pregnancy induced hypertension Date of delivery Mode of delivery Length of first stage of labor Length of second stage of labor Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age Birth weight 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and childhood weight status

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Oken et al., 2007</p> <p>Country and setting: Reported elsewhere</p> <p>Enrollment period: NR</p> <p>Funding: Supported by grants from US National Institutes of Health (HD 34568, HL 64925, HL68041, HD 44807), the Robert Wood Johnson Foundation, Harvard Medical School, and Harvard Pilgrim Health Care Foundation</p> <p>Study Objective: Purpose of study to examine associations of gestational weight gain with child adiposity</p> <p>Time frame: NR</p> <p>Duration of the study: Entry to prenatal care thru delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 1,044</p> <p>Group Description: G1: Total</p> <p>Group N: G1: 1,044</p> <p>Inclusion criteria: Women delivering live singleton infant and enrolled for continuation of study beyond 6 months after delivery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing information on prepregnancy weight, parental BMI, or infant birthweight, or who did not have a weight recorded within 4 weeks preceding delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 24.6 (SD 5.0)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 15-24: 6% 25-34: 62% 35-44: 32%</p> <p>Parity: G1: Nulliparous: 48% Parous: 52%</p>	<p>Race,%: White G1: 74%</p> <p>Black G1: 11%</p> <p>Hispanic G1: 6%</p> <p>Other G1: 10%</p> <p>Smoking,%: G1: Never: 67% Quit before pregnancy 20% Smoked in early pregnancy 10%</p> <p>Diabetes mellitus,%: G1: 4%</p>

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and childhood weight status (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: NR	Outcomes Description: <ul style="list-style-type: none"> Association of MWG with child adiposity-related outcomes at age 3 years, before and after adjustment for potential confounding and pathway variables. Effect increments are for IOM weight gain categories 	Background: Good
Total weight gain: G1: 15.6 kg (5.4)	Gestational diabetes, %: G1: 4%		Sample selection: Fair
Categorized: <ul style="list-style-type: none"> Continuous According to IOM 	Cesarean delivery, %: G1: 23% G2: 12% G3: 35% G4: 53%		Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 		Groups: G1: Inadequate gestational weight gain G2: Adequate weight gain G3: Excessive weight gain	Definition of outcomes: Good
Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Instrumental delivery, %: NR	Results: AOR of having overweight (< 95th percentile) child G1: 1.0 G2: 3.77 (1.38, 10.27) G3: 4.35 (1.69, 11.24)	Source of information on exposure, outcomes, and confounders: Good
	Episiotomy, %: NR		Followup: Fair
	Other maternal outcomes: NR		Analysis comparability: Fair
	Other infant outcomes: NR	AOR of having child between 85-94th percentile G1: 1.0 G2: 2.09 (1.12, 3.92) G3: 2.03 (1.11, 3.72)	Analysis of outcomes: Fair
		AOR of having child between 50th-84th percentile G1: 1.0 G2: 1.85 (1.17, 2.92) G3: 1.84 (1.17, 2.88)	Interpretation: Good
		Characteristic: Adjusted mean BMI z-score G1: 0.17 (95% CI, 0.01, 0.33) G2: (0.47 units, 95% CI, 0.37, 0.57) G3: (0.52 units, 95% CI, 0.44, 0.61)	Sum of Good/Fair/Poor: 4 Good, 5 Fair, 0 Poor
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Breastfeeding Education Time between last pregnancy weight and delivery Household income Marital status Paternal BMI Smoking 	Final Quality Score: Fair

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and childhood weight status (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Oken et al., 2007
continued

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and childhood weight status (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Birth length • Sex • Child diet • Child television viewing 	

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Baker et al, 2007</p> <p>Country and setting: Denmark, birth registry</p> <p>Enrollment period: 4 years - 1999 to 2002</p> <p>Funding: Data analysis supported by Hatch grantNYC399405 (to KMR) and a grant from the Einaudi Center at CornellUniversity (to JLB). JLB was supported by National Institutes of Healthtraining grant HD07331 (to KMR).</p> <p>Study Objective: To determine whether this association was stronger with increasing maternal obesity, was modified by gestational weight gain, and still existed when there was greater social support for breastfeeding</p> <p>Time frame: 4 years - 1999 to 2002</p> <p>Duration of the study: Entry into prenatal care through 18 months postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 37,459</p> <p>Group Description: NR</p> <p>Group N: G1: 37,459</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Delivered of liveborn, singleton infant <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Subjects who were aged 18 y or 45 y (n 40) Preexisting or gestational diabetes (n: 554) Chose to not breastfeed (n: 745) Used alternative breastfeeding method (e.g., breast pump only or feeding infant banked human milk; n: 14), whose infant was born preterm (gestation 259 d; n: 1,316) or at a very low birth weight (2000 g; n: 29) Infant had birth defect, severe illness, or other condition that might preclude successful breastfeeding (as determined by KFM; n: 420) Excluded women (n 529) for whom duration of breastfeeding could not be determined; most of these women had extreme inconsistencies in answers to infant feeding questions 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <ul style="list-style-type: none"> G1: 23.6 +/- 4.2 <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> WHO International Taskforce <p>Age (mean, yrs): G1: 30.5 (4.22)</p> <p>Parity: G1: 46.7 % primiparous (37,429)</p>	<p>Race,%: NR</p> <p>Smoking,%: G1: 18.0 (37,430)</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p>

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 37 459 Total weight gain: G1: 15.1kg +/- 6.0 Categorized: <ul style="list-style-type: none"> < 8 kg 8-15.9 kg ≥ 16 kg Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: 3.64 +/- 0.49 Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes <ul style="list-style-type: none"> GWG increased odds of termination of breastfeeding inconsistently. Significant for termination of full breastfeeding at 1 ($P < 0.0001$), 16 ($P < 0.05$), and 20 ($P < 0.05$) wk. Significant for termination of any breastfeeding only at 16 and 20 wk ($P < 0.0001$ for both) Other infant outcomes NR	Outcomes Description: Any breastfeeding or full breastfeeding Groups G1: <8 kg G2: 8-15.9 kg G3: ≥16 kg Results Overall higher risk of terminating full or any breastfeeding with higher pregravid BMI. Unadjusted RR full BF G1: 1.13 (95% 1.08, 1.18) G2: NR G3: 1.05 (1.03, 1.08) Any BF G1: RR 1.16 (1.11, 1.22) G2: NR G3: 1.05 (1.03, 1.08). GWG not a predictor of full or any when BMI was in the model. Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Pre-gravid BMI Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NR 	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Good Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 7 Good, 1 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Li et al., 2003</p> <p>Country and setting: USA, WIC clinics</p> <p>Enrollment Period: 1996 to 1998</p> <p>Funding: Conducted by staff at CDC</p> <p>Study Objective: To test hypothesis that women who are obese before pregnancy or who gain excessive weight during pregnancy are less likely to initiate and maintain breast-feeding than are their normal-weight counterparts</p> <p>Time frame: 1996 to 1998</p> <p>Duration of the study: From entry into WIC for mom until 1 yr postpartum or she stops BF</p>	<p>Design:</p> <ul style="list-style-type: none"> WIC mother and child data sets that were linked Retrospective <p>Total Study N: 51,329</p> <p>Group Description: G1: Total Group (multiple logistic regression) G2: NR</p> <p>Group N: G1: 51329 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Low income US women and children participating in federally funded public health programs such as WIC <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple births Records with missing data for pregravid BMI, gestational weight gain, characteristics of children, characteristics of mother, breastfeeding initiation information Biologically implausible values for BW, gestational age, maternal BMI, maternal age, parity 	<p>Pregravid weight: Self-reported</p> <p>Pregravid BMI: G1: BMI before pregnancy (in kg/m²) Underweight (< 19.8) 7591 (14.8%) Normal (19.8-C26.0) 24417 (47.6%) Overweight (> 26.0-C29.0) 6836 (13.3%) Obese (> 29.0) 12485 (24.3%) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: Maternal age < 20 y 9631 (18.8%) 20-C24 y 18 256 (35.6%) 25-C29 y 13 251 (25.8%) ≥30 y 10 191 (19.9%) G2: NR</p> <p>Parity: G1: Multiparous 27897 (54.3%) Primiparous 23432 (45.7%) G2: NR</p>	<p>Race, %: White G1: 69.9% G2: NR</p> <p>Black G1: 17.9 G2: NR</p> <p>Hispanic G1: 9.7 G2: NR</p> <p>Asian/Pacific Islander NR</p> <p>Other G1: 2.5 G2: NR</p> <p>Smoking, %: G1: 27.1 G2: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 51329 G2: NR Total weight gain: G1: Gestational weight gain Below IOM 15888 (31.0%) Within IOM 13634 (26.6%) Above IOM 21 807 (42.5%) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Self-reportedself-reported by subjects at the postpartum visit Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: Low (< 2500 g) 3432 (6.7%) Normal (≥2500 g) 47897 (93.3%) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Adjusted OR for failure to initiate breast feeding by BMI Groups G1: <IOM G2: within IOM G3: >IOM BMI before pregnancy: Underweight < 19.8 Results Under, normal and overweight G1 groups had a significant increased odds of failure to initiate BF compared to G2 within BMI strata. Obese women regardless of weight gain had increased odds of failure to initiate compared to normal wt G2 . Adjusted mean duration of BF (p<0.01)* G1: 12.9 wk* G2: 13.6 wk (ref) G3: 12.8wk* Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Race Parity Pre-gravid BMI Maternal education Marital status Prenatal care Poverty-income ratio Gestational weight gain Smoking Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age, Birth weight 	Background: Good Sample selection: Fair Definition of maternal weight gain: Poor Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Good Sum of Good/Fair/Poor: 4 Good, 3 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rasmussen et al., 2002</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Jan 1988 to Dec 1997</p> <p>Funding: NR</p> <p>Study Objective: To examine how gestational weight gain might modify association between prepregnant bmi and lactational performance</p> <p>Time frame: Jan 1988 to Dec 1997</p> <p>Duration of the study: Entry into prenatal care through child's second year</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 2,494</p> <p>Group Description:</p> <p>Group N:</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 19 to 40 year old women delivering singleton infants at Mary Imogene Bassett Hospital in Cooperstown, NY who attempted to BF at delivery and for whom complete data were available <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Contraindications for BF, gestational DM, underweight (BMI < 19.8) at conception or lost weight during pregnancy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: weight at delivery minus prepregnancy weight 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: OR unsuccessful initiation of BF (normal wt G2 ref) Groups G1: <IOM G2 within IOM G3: >IOM Results Underweight: no significant diff Normal wt: G3 1.66 (1.05,2.63) Overwt: no significant diff Obese: G3 2.89 (1.78, 4.69) Hazard OR discontinuing exclusive BF (normal wt G2 ref) Underwt G3 1.39 (1.01, 1.92) Normal wt-no signif differences Overwt G3 1.27 (1.03, 1.56) Obese G1: 1.37 (1.01, 1.84), G2 1.50 (1.11, 2.03), G3: 1.78 (1.48, 2.14) Hazard OR discontinuing any BF (normal wt G2 ref) Underwt-no sign difference Normal wt-no sign difference Overwt- no sign difference Obese G2 1.57 (1.14, 2.18), G3: 1.99 (1.64, 2.43) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Parity Participation in WIC/PCAP Type of delivery Mother attended college Smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Poor Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 2 Good, 5 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 51. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Hilson et al., 2006</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: Jan 1988 to Dec 1997</p> <p>Funding: NIH and USDA-Hatch</p> <p>Study Objective: To determine whether GWG was independently associated with initiation and continuation of BF and whether GWG modified previously observed association between high prepregnant BMI and these outcomes</p> <p>Time frame: Jan 1988 to Dec 1997</p> <p>Duration of the study: From entry into PNC through 1 year of life but all based on medical record info</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 2,783</p> <p>Group Description: G1: Underweight BMI < 19.8 G2: Normal BMI 19.8-26.0 G3: Overweight 26.1-29.0 G4: Obese > 29.0 G5: < IOM/ Within IOM G6: > IOM</p> <p>Group N: G1: 364 G2: 1522 G3: 354 G4: 543 G5: 520/ 877 G6: 1386</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Mother-infant dyads in which BF was ever attempted and to those thought to have a low potential for contraindications to BF Mothers also had to be 19–49 y old and free of gestational diabetes Singleton births Had information for all key variables analysed in present study <p>Exclusion criteria: See above</p>	<p>Pregravid weight: Self-reported G1: 51.2 +/-4.9 G2: 61.5 +/-6.8 G3: 73.9 +/- 6.5 G4: 90.4 +/-13.6 G5: 66.8(17.9)/ 63.2(13.1) G6: 70.2(14.7)</p> <p>Pregravid BMI: G1: 18.6 +/- 0.9 G2: 22.7 +/-1.7 G3: 27.4 +/- 0.9 G4: 33.7 +/- 4.1 G5: 24.9(6.4) / 23.4(4.5) G6: 25.8(5.2)</p> <p>Imputed: <ul style="list-style-type: none"> No </p> <p>Categorized: <ul style="list-style-type: none"> IOM guidelines </p> <p>Age (mean, yrs): G1: 27.3 +/- 5.1 G2: 28.5 +/- 5.1 G3: 28.0 +/-4.8 G4: 27.9 +/-4.9 G5: 27.8(5.0) / 28.9 (5.0) G6: 27.9 (5.0)</p> <p>Parity: G1: Nulliparous (%) 44.6 G2: Nulliparous (%) 37.6 G3: Nulliparous (%) 39.4 G4: Nulliparous (%) 34.1 G5: 29.1%/33.9% G6: 44.1%</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: Before pg: G1: 22.2% G2: 18.5 G3: 20.3 G4: 19.9 G5: 24.0/18.8 G6: 18.4</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: Vaginal delivery: G1: 93.1% G2: 90.2% G3: 85.9% G4: 80.5% G5: 91.7/89.7 G6: 85.8</p> <p>Additional characteristics: NR</p>

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 364 G2: 1,522 G3: 354 G4: 543 G5: 520/877 G6: 1,386 Total weight gain: G1: 15.7 +/-4.7 G2: 15.8 +/- 3.4 G3: 15.0 +/- 6.1 G4: 11.6 +/-7.2 $P < 0.01$ from underweight group; $P < 0.01$ from normal; $P < 0.01$ from overweight group G5: 7.5 (4.1)/13.1 (2.6) $P < 0.01$ G6: 18.7 (5.0) $P < 0.01$ Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3469 g (SD 462) G2: 3602 $P < 0.01$ from underweight group G3: 3662 $P < 0.01$ from underweight G4: 3703 $P < 0.01$ from underweight group; $P < 0.01$ from normal G5: 3413 g(462)/ 3571 g(455) $P < 0.01$ G6: 3713 (Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Initiated BF,%: Underweight 89, Normal 90.1, Overweight 88.4, Obese 82.58 ($P < .05$, $P < 0.01$ from normal weight group), < IOM 87.9, Within IOM 91.1, > IOM 86.7 $P < 0.01$ from women who gained within IOM Other infant outcomes: Macrosomic, %: <ul style="list-style-type: none"> Underweight 11.5 Normal 20.08 ($P < 0.01$ from underweight group) Overweight 23.48 ($P < 0.01$ from underweight group) 	Outcomes Description: <ul style="list-style-type: none"> The predicted duration of EBF was 1 wk shorter for underweight and overweight women whose GWG was above IOM recommendations and 3 wk shorter for obese women whose GWG was above IOM recommendation (Fig. 2) For obese women, predicted duration of ABF was 17 wk shorter among those who gained within IOM recommendation and 20 wk shorter among those who gained above IOM recommendation than among women in reference group (Fig. 2) Groups: G1: Underweight BMI < 19.8 G2: Normal BMI 19.8-26.0 G3: Overweight 26.1-29.0 G4: Obese > 29.0 G5: < IOM/ Within IOM G6: > IOM Results: Underweight BMI G1: 1.21 (0.53, 2.76) G2: 1.59 (0.82, 3.07) G3: 1.88 (0.91, 3.92) G4: 1.31 (0.995, 1.71) G5: 1.04 (0.82, 1.31) G6: 1.39 (1.01, 1.92) Normal weight BMI G1: 1.69 (0.99, 2.88) G2: 1.0 G3: 1.66 (1.05, 2.63) $P < 0.05$ G4: 1.19 (0.981, 1.44) G5: 1.0 G6: 1.14 (0.969, 1.33) Overweight G1: 2.96 (0.90, 9.79) G2: 1.47 (0.61, 3.53) G3: 1.62 (0.90, 2.91) G4: 1.59 (0.94, 2.68) G5: 1.13 (0.81, 1.58) G6: 1.27 (1.03, 1.56) $P < 0.05$ Obese G1: 1.81 (0.86, 3.83) G2: 1.84 (0.83, 4.11) G3: 2.89 (1.78, 4.69) $P < 0.01$ G4: 1.37 (1.01, 1.84) $P < 0.05$ G5: 1.50 (1.11, 2.03) $P < 0.01$ G6: 1.78 (1.48, 2.14) $P < 0.01$	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Good Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor Final Quality Score: Good

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Hilson et al., 2006
(continued)

Evidence Table 50. Gestational weight gain with reference to IOM recommendations and lactation performance (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
	<ul style="list-style-type: none"> Overweight 23.48 ($P < 0.01$ from underweight group) Obese 28.08 ($P < 0.01$ from underweight group, $P < 0.01$ from normal weight group, $< 10.0\%$ IOM) Within IOM 17.4 ($P < 0.01$), $> 10.0\%$ IOM 27.4% $P < 0.01$ 	<p>G1: Hazard ratio (HR) of discontinuing Any BF: $< 10.0\%$ IOM</p> <p>G2: Hazard ratio (HR) of discontinuing Any BF: Within IOM</p> <p>G3: Hazard ratio (HR) of discontinuing Any BF: $> 10.0\%$ IOM</p> <p>Underweight BMI</p> <p>G1: 1.21 (0.89, 1.64)</p> <p>G2: 0.95 (0.73, 1.24)</p> <p>G3: 1.34 (0.95, 1.88)</p> <p>Normal Weight</p> <p>G1: 1.09 (0.88, 1.35)</p> <p>G2: 1.0</p> <p>G3: 1.09 (0.92, 1.30)</p> <p>Overweight</p> <p>G1: 0.84 (0.43, 1.64)</p> <p>G2: 1.16 (0.82, 1.64)</p> <p>G3: 1.24 (0.989, 1.55)</p> <p>Obese</p> <p>G1: 1.33 (0.963, 1.85)</p> <p>G2: 1.57 (1.14, 2.18) $P < 0.01$</p> <p>G3: 1.99 (1.64, 2.43) $P < 0.01$</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> Age Parity Participation in WIC/PCAP Type of delivery Mother attended college Smoking <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NR</p>	

Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Butte et al., 2003</p> <p>Country and setting: USA, children's nutrition center</p> <p>Enrollment Period: NR</p> <p>Funding: US Department of Army and US Department of Agriculture/Agriculture Research Service</p> <p>Study Objective: To evaluate how changes in gestational weight and body composition affect infant birth weight and maternal fat retention after delivery in underweight, normal weight and overweight women</p> <p>Time frame: NR</p> <p>Duration of the study: Prior to preg through pp</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 63</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 63 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Nonsmokers 18-40 years parity ≤ 4 Physically active (20 to 30 minutes of moderate exercise at least 3 times/week) No long term medicine use No alcohol/drug abuse <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiparous Preterm deliveries Miscarriage Preeclampsia 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured by study investigators <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 31 (4) G2: NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 77 G2: NR</p> <p>Black G1: 10 G2: NR</p> <p>Hispanic G1: 10 G2: NR</p> <p>Asian/Pacific Islander G1: 3 G2: NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: G1: 15.0 (3.8) kg G2: 14.5 (4.5) kg G3: 17.9 (5.4) kg Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth weight 	Outcomes Description: Fat retention Groups: BMI groups, low, normal, high Results: <ul style="list-style-type: none"> After adjustment for gestational duration, gravidity, and ethnicity, gestational weight gain and net gestational weight gain (GWG-birth weight) were significantly lower in normal BMI group than in high BMI group ($P = 0.04$) - GWG and net GWG in low BMI group was not significantly different from women in normal and high BMI groups On average weight gain was 42% fat mass and 58% fat free mass Weight gain was linearly correlated with gains in TBW ($r = 0.39$, $P = 0.003$), TBK ($r = 0.49$, $P = 0.001$), protein ($r = 0.49$, $P = 0.001$), Fat free mass ($r = 0.50$, $P = 0.001$), and FM ($r = 0.76$, $P = 0.001$) Mean gestational weight gain (14.4kg) of women who gained within IOM recommendations was associated with gains of 7.1kg TBW, 5.0g TBK, 370g protein, 8.4 kg FFM, and 4.1 kg FM and a mean birth weight of 3.44kg Changes in body weight differed among BMI groups in first trimester (normal BMI < high BMI group, $P = 0.004$) and third trimester (low BMI < normal and high BMI group, $P < 0.01$) No effect of breast feeding on body weight and composition Birth weight correlated significantly with GWG ($r = 0.35$, $P = 0.006$), net GWG ($r = 0.26$, $P = 0.04$), and rate of weight gain ($r = 0.28$, $P = 0.03$), FFM ($r = 0.39$, $P = 0.003$) but not with FM Partitioning GWG into FFM and FM showed that FFM gain accounted for effect on birth weight (not FM) Maternal FFM gains in first ($P = 0.008$), second ($P = 0.005$), and third trimesters ($P = 0.005$) were shown to make independent contributions to birth weight Total gestational gains in maternal weight, TBW, TBK, FFM and FM were not shown to have an effect on infant FFM, FM, or percentage of FM at 2 weeks of age Postpartum weight retention was correlated positively with GWG ($r = 0.67$, $P = 0.001$), total FM gain ($r = 0.61$, $P = 0.001$) but not with FFM gain Postpartum fat retention was correlated positively with GWG ($r = 0.56$, $P = 0.001$) and total FM gain ($r = 0.57$, $P = 0.001$) Maternal fat retention at 27 weeks after delivery (5.3kg) was significantly higher in women who gained above IOM recommendations for weight gain compared to those women who gained within (2.3kg) or below (-0.5kg) recommendations 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Poor Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention
(continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Butte et al., 2003
(continued)

**Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Race • Pre-gravid BMI <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age 	

Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Lederman et al., 1997</p> <p>Country and setting: USA, clinics</p> <p>Enrollment Period: Jan 1991-Aug 1993</p> <p>Funding: Grant from Maternal and Child Health Bureau and Department of Health and Human Services</p> <p>Study Objective: To determine fat deposited during pregnancy in women according to recommendations of IOM and relationship of weight gain to fat gain in women of different starting weights classified by BMI</p> <p>Time frame: Jan 1991 to Aug 1993</p> <p>Duration of the study: From first visit through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 196</p> <p>Group Description: G1: study cohort G2: NR</p> <p>Group N: G1: 196 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 18 to 35 years of age Non-smokers Self-identified as Hispanic, black, or white Expecting singleton birth Able to schedule their first body composition laboratory visit before 16th week of gestation Free of medical illnesses requiring regular medication Not knowingly infected with HIV Not a regular user of drugs or alcohol according to mother's report <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA they had to have a 37 week measurement and medical record available 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.4 (12.9) G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> NR <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26.0 (4.8) G2: NR</p> <p>Parity: G1: 0.8 (1.0) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention
(continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 196 G2: NR Total weight gain: G1: 13.6 (6.1) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM %: Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between measurement at week 37+ and prepregnancy 	Birth weight: G1: 3,449 (433) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Study investigators measured body weight, body density by hydrodensitometry, and deuterium dilution volume twice during pregnancy (at weeks 12-16 and at 37+ weeks) Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Fat gain between pregnancy weeks 14-37 Groups: < IOM, within IOM, > IOM, for BMI groups for three outcomes: G1: Body weight gain G2: Body water gain G3: Fat gain Results: BMI < 19.8: all women (n = 21) G1: 12.6 (4.4) G2: 6.1 (2.4) G3: 4.8 (3.8) BMI < 19.8: less than recommended; recommended; more than recommended G1: 7.9 (1.6); 12.6 (2.4); 16.1 (3.9) G2: 6.4 (3.7); 5.9 (1.6); 6.1 (2.2) G3: 0.6 (1.9); 6.0 (2.6); 6.9 (3.5) BMI 19.8-26.0: all women (n = 118) G1: 12.2 (4.0) G2: 7.0 (2.7) G3: 3.9 (3.7) BMI 19.8-26.0: less than recommended; recommended; more than recommended G1: 8.6 (1.9); 12.1 (3.4); 15.2 (3.4) G2: 6.2 (2.1); 6.9 (2.7); 7.6 (3.0) G3: 1.3 (3.0); 3.8 (3.5); 6.0 (3.1) BMI > 26.0-29.0: all women (n = 29) G1: 11.0 (4.6) G2: 7.8 (3.5) G3: 2.8 (5.4)	Background: Good Sample selection: Good Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Poor Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

**Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention
(continued)**

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Lederman et al., 1997
(continued)

**Evidence Table 52. Gestational weight gain with reference to IOM recommendations and fat retention
(continued)**

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
		<p>BMI > 26.0-29.0: less than recommended; recommended; more than recommended G1: 8.5 (3.2); 9.1 (3.1); 13.6 (5.1) G2: 6.9 (3.0); 5.7 (3.0); 9.7 (3.2) G3: 0.3 (2.5); 2.8 (4.1); 4.2 (6.9)</p> <p>BMI > 29.0: all women (n = 28) G1: 8.7 (5.6) G2: 7.3 (2.9) G3: 0.2 (5.0)</p> <p>BMI > 29.0: less than recommended; recommended; more than recommended G1: 3.2 (2.7); 6.9 (4.4); 12.0 (4.6) G2: 7.8 (3.5); 6.0 (2.9); 7.6 (2.7) G3: -5.2 (1.5); -0.6 (4.6); 3.1 (3.9)</p> <p>Results for BMI and IOM recommendations over time: G1: BMI < 19.8 and gained within IOM recommendations G2: BMI 19.8-26.0 and gained within IOM recommendations G3: BMI > 26.0-29.0 and gained within IOM recommendations G4: BMI > 29.0 and gained within IOM recommendations G1: 7 G2: 46 G3: 9 G4: 6</p> <p>Total body fat at week 14 G1: 12.2 (2.3) G2: 18.2 (2.8)</p> <p>Total body fat at week 37+ G1: 17.9 (5.4) G2: 21.7 (5.8)</p> <p>Characteristics: G1: 25.1 (4.5) G2: 28.0 (3.8)</p> <p>Group G1: 33.1 (8.3) G2: 32.5 (5.7)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NR</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Luke et al., 1996</p> <p>Country and setting: USA, clinic</p> <p>Enrollment Period: March 1, 1974 to June 15, 1979</p> <p>Funding: NR</p> <p>Study Objective: Reanalysis of original data to examine contribution of maternal weight gain to infant birth weight and retained maternal weight in immediate postpartum period, and effect of weight gains below, at, and above IOM guidelines on both infant birth</p> <p>Time frame: March 1, 1974 to June 15, 1979</p> <p>Duration of the study: Prenatal visit through 2 days postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 487</p> <p>Group Description: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI > 26.0</p> <p>Group N: G1: 104 G2: 268 G3: 115</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Referred for nutrition counseling > 37- < 43 weeks gestation Singleton pregnancy <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women with history of or concurrent metabolic disease, such as diabetes, seizure disorder, hypertension, cardiac disease, asthma, or drug dependence Women developing antepartum complications such as preeclampsia, GDM, or multiple gestation 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 47.9 (5.1) G2: 58.7 (6.3) G3: 83.9 (16.9)</p> <p>Pregravid BMI: G1: 18.3 (1.0) G2: 22.6 (1.7) G3: 31.7 (5.3)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 23.1 (5.5) G2: 23.8 (5.5) G3: 27.4 (6.2)</p> <p>Parity: % primipara: G1: 60.6 G2: 48.1 G3: 27.0</p>	<p>Race, %: White NR Black G1: 48.1 G2: 48.8 G3: 63.5 Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 17.3 G2: 15.3 G3: 13.0</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 104 G2: 268 G3: 115 Total weight gain: G1: 12.6 (0.7) G2: 13.2 (0.4) G3: 11.7 (0.7) <i>Significantly different from mean for normal BMI group at $P < 0.05$</i> <i>Categorized:</i> <ul style="list-style-type: none"> According to IOM <i>Collected from:</i> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <i>Ascertained by:</i> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: total weight gain: difference between last measurement and pregravid weight; net weight gain: difference between pregravid weight and last measured weight minus infant birth weight 	Birth weight: G1: 3,067 (44) $P < 0.05$ significantly different from mean for normal BMI G2: 3308 (27) G3: 3300 (43) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Net gain (kg): 9.5 (0.6), 9.9 (0.4), 7.8 (0.6) significantly different from mean for normal BMI group at $P < 0.05$ Retained weight (kg): 6.6 (0.6), 6.6 (0.4), 4.2 (0.6) significantly different from mean for normal BMI group at $P < 0.05$ Percent retained weight (%): 11.4 (0.9), 9.4 (0.5), 4.4 (0.8) significantly different from mean for normal BMI group at $P < 0.05$ Other infant outcomes: NA	Outcomes Description: Mean retained weight Groups Maternal weight gain < IOM recommendations: G1: BMI < 19.8 G2: BMI 19.8-26.0 G3: BMI > 26.0 Maternal weight gain within IOM recommendations: G4: BMI < 19.8 G5: BMI 19.8-26.0 G6: BMI > 26.0 Maternal weight gain > IOM recommendations: G7: BMI < 19.8 G8: BMI 19.8-26.0 G9: BMI > 26.0 Results Mean (SEM) retained weight (defined as 2-day postpartum weight minus pregravid weight, kg): G1: 3.2 (0.5) $P < 0.05$ compared to G4 G2: 0.8 (0.4) $P < 0.05$ compared to G5 G3: -5.0 (0.7) $P < 0.05$ compared to G6 G4: 8.2 (0.7) G5: 7.0 (0.4) G6: 1.4 (0.8) G7: 15.5 (0.9) $P < 0.05$ compared to G4 G8: 12.9 (0.4) $P < 0.05$ compared to G5 G9: 9.5 (0.5) $P < 0.05$ compared to G6 Maternal confounders and effect modifiers accounted for in analysis: Age, parity, race, smoking, gestation duration, fetal sex Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Good Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 5 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Scholl et al., 1995</p> <p>Country and setting: USA, Camden Study</p> <p>Enrollment Period: September 1985 to May 1990</p> <p>Funding: NIH</p> <p>Study Objective: To determine whether risk of maternal overweight associated with an excessive rate of gestational weight gain needs to be balanced against risk of impaired fetal growth associated with low rate of gain</p> <p>Time frame: September 1985 to May 1990</p> <p>Duration of the study: During pregnancy through 6 months postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 274</p> <p>Group Description: G1: Low rate of GWG G2: Moderate rate of GWG G3: Excessive rate of GWG</p> <p>Group N: G1: 59 G2: 138 G3: 77</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with pregravid BMI 19.8-26.0 Enrolled before January 1988 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Missing information from delivery to 6 months postpartum Pregravid under or over weight 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White G1: 8.5 G2: 10.9 G3: 10.4 Black G1: 61.0 G2: 59.4 G3: 62.3 Hispanic G1: 30.5 G2: 29.7 G3: 27.3 Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: G1: 30.5 G2: 26.8 G3: 26.9</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 59 G2: 138 G3: 77 Total weight gain: G1: Gestation duration (wk)38.5 (0.28) <i>P</i> < 0.05, low vs. moderate plus excessive weight gain G2: 39.2 (0.17) G3: 39.4 (0.24) Categorized: <ul style="list-style-type: none"> According to IOM rate of gestational weight gain measured between 20 to 36 weeks: low GWG = < 0.34kg/wk; moderate GWG = 0.34-0.68 kg/wk; excessive GWG = > 0.68 kg/wk Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3,049 (56.94) <i>P</i> < 0.05, low vs. moderate plus excessive weight gain G2: 3,208 (36.33) G3: 39.4 (0.24) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Mean change in weight Groups Maternal weight gain categories (kg/wk): G1: ≤ 0.34 G2: > 0.34-0.68 G3: > 0.68 Results Mean (SEM) change in weight (kg) from pregravid to 6 weeks postpartum: G1: 3.1 (0.80) G2: 3.9 (0.51) G3: 9.4 (0.70) <i>P</i> < 0.001, G3 vs. G1,G2 Maternal confounders and effect modifiers accounted for in analysis: Age, parity, race, height, lactation status, smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Stevens-Simon and McAnarney, 1992</p> <p>Country and setting: USA, adolescent maternity program</p> <p>Enrollment Period: 1986 to 1989</p> <p>Funding: Grant from Bureau of Maternal and Child Health</p> <p>Study Objective: To clarify advantages and disadvantages of large gestational weight gain among pregnant adolescents</p> <p>Time frame: 1986 to 1989</p> <p>Duration of the study: Entry into prenatal care through 6 weeks PP check up</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 141 (107 included in postpartum analyses)</p> <p>Group Description: G1: Slow gainers G2: Average gainers G3: Rapid gainers</p> <p>Group N: G1: 28 G2: 66 G3: 47</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Consecutively enrolled poor, black, 12-19 year olds Prenatal care prior to 2third week gestation No chronic disease No regular medications No known uterine anomalies Live birth Singletons <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 58.6 (11.1) G2: 160.9 (7.0) G3: 163.9 (5.5)</p> <p>Pregravid BMI: G1: 23.1 (3.5) G2: 23.5 (4.4) G3: 23.5 (4.2)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 16.9 G2: 16.6 G3: 16.2</p> <p>Parity: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 28 G2: 66 G3: 47 Total weight gain: G1: 7.7 (average rate 0.2 kg/wk) G2: 12.4 (average rate 0.3 kg/wk) G3: 19.8 (average rate 0.5 kg/wk) Categorized: <ul style="list-style-type: none"> According to IOM slow gain: < 0.23kg/wk; average gain: 0.23-0.4kg/week; rapid gain: > 0.4kg/week Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 2745 (694) G2: 3097 (457) G3: 3351 (482) $P < 0.0001$ Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Short-term weight retention; adjusted odds ratio for subsequent maternal obesity Groups Maternal weight gain categories (kg/wk): G1: < 0.23 G2: 0.23-0.40 G3: > 0.40 Results Short term weight retention (2-11 weeks postpartum), total kg: G1: -1.7 (SD 2.9) G2: 2.9 (SD 2.9) G3: 9.6 (SD 5.6) $P < 0.0001$ AOR (95% CI) for subsequent maternal obesity (> 120% ideal weight for height): G3: 190.94 (7.55-4,779.02) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Age Pregavid BMI Level of physical activity Timing of first prenatal and postpartum visits Substance use Body habitus Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Poor Sum of Good/Fair/Poor: 3 Good, 4 Fair, 2 Poor Final Quality Score: Fair

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Walker et al., 2004</p> <p>Country and setting: USA, Austin New Mothers Study</p> <p>Enrollment Period: 1999-2001</p> <p>Funding: National Institute of Nursing Research grant</p> <p>Study Objective: To assess proportion of women attaining prepregnant weight and to ascertain predictors of amount of retained weight at 6 weeks postpartum in a tri-ethnic low income population</p> <p>Time frame: 1999 to 2001</p> <p>Duration of the study: Delivery to 6 weeks was prospective nature-retrospectively they obtained info from medical record</p>	<p>Design:</p> <ul style="list-style-type: none"> Cross-sectional Combination: recruited at delivery-they filled out questionnaires and then got some info from medical records <p>Total Study N: 419</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 419 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Low income women Term infants Singletons Low-risk pregnancies At least 18 years Perinatal care funded by Medicaid <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women who reported weighing less at end of pregnancy than before (n = 4) Missing weight data (n = 137) 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 66.9 (15.1) G2: NR</p> <p>Pregravid BMI: G1: 25.6 (6.0) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines since few underweight and overweight women 2 groups were made: underweight/normal and overweight/obese <p>Age (mean, yrs): G1: 22.2 (3.8) G2: NR</p> <p>Parity: G1: 1.0 (0.0) G2: NR</p>	<p>Race,%: White G1: 30.3 G2: NR</p> <p>Black G1: 24.1 G2: NR</p> <p>Hispanic G1: 45.6 G2: NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 53. Gestational weight gain with reference to IOM recommendations and short-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 419 G2: NR Total weight gain: G1: 15.8 (7.1) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 3377 (424) G2: NR Gestational diabetes,%: NR Cesarean delivery,%: G1: 14.3 G2: NR Instrumental delivery,%: Episiotomy,%: Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Mean weight retention; percentage of women with retained weight, correlation and multiple regression analysis Groups Maternal weight gain categories: G1: < IOM G2: Within IOM G3: > IOM Mean (SD) weight (kg) retained at 6 weeks postpartum: G1: -0.34 (3.44) G2: 3.86 (3.45) G3: 10.55 (6.14) $P = 0.000$ % Women who attained pregravid weight at 6 weeks postpartum: G1: 48.8 G2: 14.3 G3: 2.3 Correlation of gestational weight gain, excluding infant weight, (continuous variable) and weight retained at 6 weeks postpartum: $r = 0.90$ $P = 0.000$ Multiple regression analysis predicted a mean increase in retained weight of 0.88 kg for each 1 kg increase in maternal weight gain ($B = 0.88$, $SE = 0.02$, $P = 0.000$) Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Race Parity Pregravid BMI Gestational weight gain Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> Gestational age 	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 3 Good, 6 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Amorim et al., 2007</p> <p>Country and setting: Sweden, hospital</p> <p>Enrollment period: Study comprised follow-up period from delivery (1984 to 1985) to 15 years postpartum (1999 to 2000).</p> <p>Funding: Study supported by Brazilian Foundation for training of researchers in Doctoral Exchange Programme (CAPES) (to A.R.A.) and by Arbeitsmarknadens Forsakrings-och Aktiebolag(AFA) (to M.N.)</p> <p>Study Objective: Explore effect of GWG according to IOM recommendations on long-term BMI, accounting for several potentially confounding factors, including postpartum weight changes and pre-pregnancy BMI</p> <p>Time frame: Study comprised follow-up period from delivery (1984 to 1985) to 15 years postpartum (1999 to 2000).</p> <p>Duration of the study: Entry into prenatal care through 15 years after childbirth</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: In maternity unit, staff invited women to take part in study at first control visit after delivery. Up to that point, study was retrospective in that information about weight development during pregnancy was collected from obstetrics records. Women were then prospectively monitored up to 1 year postpartum and 15 years later <p>Total Study N: 483</p> <p>Group Description: G1: Total</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who delivered children in 1984 to 1985 in 14 maternity units in Stockholm, Sweden <p>Exclusion criteria: NR</p>	<p>Pregravid weight: Self-reported</p> <p>Pregravid BMI: G1: 21.5 (2.4)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 30.0 (4.6)</p> <p>Parity: G1: Primiparous 52%</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: 3506 (470) g	Outcomes Description: Time and weight gain interaction	Background: Good
Total weight gain: G1: 14.2 (4.1) kg	Gestational diabetes, %: NR	Groups Maternal weight gain categories: < IOM Within IOM >IOM	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results A mixed ANOVA with one repeated measures factor (weight before pregnancy, 6 months, 1, and 15 years) and one between-subjects factor (< IOM, within IOM, > IOM) showed a main effect of time [$F(9,024) = 113.7, P = 0.000$] and a significant time group interaction [$F(6,12) = 77.23, P = 0.000$]	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	The weight of women who gained excessive during pregnancy was significantly greater at each time-point [main effect of group: $F(10,55) = 870.0, P = 0.000$]	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Maternal confounders and effect modifiers accounted for in analysis: Pre-gravid BMI	Source of information on exposure, outcomes, and confounders: Poor
	Other maternal outcomes: NR	Infant and child confounders and effect modifiers accounted for in analysis: NR	Followup: Good
	Other infant outcomes: NR		Analysis comparability: Fair
			Analysis of outcomes: Good
			Interpretation: Good
			Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor
			Final Quality Score: Fair

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Keppel and Taffel, 1993</p> <p>Country and setting: USA, 1988 National Maternal and Infant Health Survey</p> <p>Enrollment Period: 1988</p> <p>Funding: National Center for Health Statistics</p> <p>Study Objective: To examine implications of compliance with IOM guidelines for postpartum weight retention</p> <p>Time frame: 1988</p> <p>Duration of the study: NA, cross-sectional</p>	<p>Design:</p> <ul style="list-style-type: none"> • Cross-sectional • Retrospective <p>Total Study N: 2,944</p> <p>Group Description: NR</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> • Live births • Singletons • Women interviewed 10-18 months following delivery • Births at ≥ 37 weeks gestation • White or black women • ≥ 15 years of age <p>Exclusion criteria:</p> <ul style="list-style-type: none"> • Obese women, BMI > 29.0 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> • Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> • No <p>Categorized:</p> <ul style="list-style-type: none"> • IOM guidelines <p>Age (mean, yrs): NR</p> <p>Parity: NR</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Weight retention by postpartum time Groups Categories of amount of weight retained (lbs) at 10-18 months postpartum: G1: Lost weight G2: 0-3 G3: 4-8 G4: 9-13 G5: ≥ 14 Results The percent distribution of women in G1-G5 stratified by maternal weight gain categories showed that both black and white women who gained < IOM or within the IOM guidelines retained less weight (10-18 months postpartum) than women who gained > IOM recommendations. Irrespective of maternal weight gain, black women retained more weight than white women Maternal confounders and effect modifiers accounted for in analysis: None Infant and child confounders and effect modifiers accounted for in analysis: None	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Poor Analysis of outcomes: Fair Interpretation: Poor Sum of Good/Fair/Poor: : 3 Good, 3 Fair, 3 Poor Final Quality Score: Poor

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued) (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Olson et al., 2003</p> <p>Country and setting: USA, hospital and primary care clinic system</p> <p>Enrollment Period: Mid 1990s</p> <p>Funding: NIH grants</p> <p>Study Objective: To describe importance of GWG, postpartum exercise, food intake and breastfeeding to weight change from early pregnancy to 1 year post partum and to identify subgroups of women at greatest risk for major weight gain surrounding child bearing</p> <p>Time frame: Mid 1990s</p> <p>Duration of the study: Women were followed from early pregnancy to one year postpartum (specific dates are not mentioned)</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 540</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 540 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> ≥ 18 years Singleton infants <p>Exclusion criteria:</p> <ul style="list-style-type: none"> No 1 year weight available Invalid 1 year weight Pregnant at 1 year Serious postpartum illness affecting body weight Last prenatal weight taken more than 6 weeks prior to delivery 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured at first prenatal visit <p>Pregravid BMI: G1: < 19.8: 8.9%; 19.8-26.0: 50.6%; > 29.0: 25.2% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: < 20y: 3.9% 20-40y: 93.5% > 40y: 2.6% G2: NR</p> <p>Parity: G1: Nulliparous: 41.2% G2: NR</p>	<p>Race, %: White G1: 96 G2: NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: % married: G1: 92.8% G2: NR</p>

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N): G1: 540 G2: NR</p> <p>Total weight gain: G1: Less than recommended: 20.4%; recommended: 37.8%; more than recommended: 41.9% G2: NR</p> <p>Categorized: <ul style="list-style-type: none"> According to IOM </p> <p>Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records </p> <p>Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between first trimesters weight and last weight measured (usually within 1 week of delivery) </p>	<p>Birth weight: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <ul style="list-style-type: none"> At 1 year postpartum, women were on average 1.51 (5.95) kg heavier than they were in early pregnancy <p>Other infant outcomes: NR</p>	<p>Outcomes Description: Pregnancy weight versus postpartum weight</p> <p>Groups Maternal weight gain categories: G1: < IOM G2: Within IOM G3: > IOM G4: Interaction for > IOM and income ≤ 185% federal poverty line</p> <p>Results Regression coefficient (SE) for weight change from early pregnancy to 1 year postpartum (kg): G1: -1.50 (0.62) $P = 0.016$ G2: reference G3: 0.32 (0.65) $P = 0.621$ G4: 3.41 (0.91) $P < 0.001$</p> <p>AOR (95% CI) for major weight gain (≥ 10 lbs) at 1 year postpartum: G1: 0.33 (0.13-0.83) G2: 1.00 (reference) G3: 1.47 (0.73-2.94) G4: 3.23 (1.25-9.08)</p> <p>Compared to normal-weight women (BMI 19.8-26.0) in G2, normal weight, overweight (BMI 26.1-29.0) and obese (BMI > 29.0) women in G3 retained significantly more weight at 1 year postpartum (all $P < 0.01$)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Exercise, food intake, breastfeeding, pregravid BMI, age, marital status, income, postpartum month that weight was measured</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rooney et al., 2002</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 10 year followup of study from Apr 1989 to March 1990</p> <p>Funding: Gundersen Lutheran Medical Center</p> <p>Study Objective: To estimate impact of excess pregnancy weight gain and failure to lose weight by 6 months postpartum on excess weight 8 to 10 years later</p> <p>Time frame: 10 year followup of study from Apr 1989 to March 1990</p> <p>Duration of the study: April 1, 1989 to 1999 (10 years) Entry into prenatal care up to 10 years postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 540</p> <p>Group Description: G1: Group Studied (Continued Care) G2: NR</p> <p>Group N: G1: 540 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Convenience sample of women with uncomplicated pregnancies receiving care at Gundersen Clinic from April first 1989 to March 30 1990 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women who discontinued care at clinic or did not have a weight available 5-10 years after their study pregnancy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> weight at first pn visit <p>Pregravid BMI: G1: 25.0 G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 28.6 G2: NR</p> <p>Parity: NR</p>	<p>Race,%: White G1: 97% G2: NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 540 G2: NR Total weight gain: G1: 13.1 kg (mean) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: Study investigators measured weight at delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Mean retained maternal weight (kg) was 1.7kg 66% retained pregnancy weight at 6 months follow up 26% gained less than recommended (IOM) amount of weight during pregnancy, 50% gained recommended amount, and 24% gained more than recommended Other infant outcomes: NR	Outcomes Description: Weight change Groups Maternal weight gain categories: G1: < IOM G2: Within IOM G3: > IOM BMI IOM Results Average weight change between prepregnancy and 6 months postpartum (kg): G1: -0.61 G2: 1.8 G3: 4.2 <i>P</i> = 0.01 Regression coefficient (95% CI) for weight at 6 months postpartum: G1: -1.53 (-3.36–0.30) G2: Reference G3: 1.24 (-0.63–3.11) Maternal confounders and effect modifiers accounted for in analysis: Duration of breastfeeding, postpartum aerobic exercise, weight loss by 6 months Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Poor Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Scholl et al., 1995 Country and setting: USA, Camden Study Enrollment Period: September 1985 to May 1990 Funding: NIH Study Objective: To determine whether risk of maternal overweight associated with an excessive rate of gestational weight gain needs to be balanced against risk of impaired fetal growth associated with low rate of gain Time frame: September 1985 to May 1990 Duration of the study: During pregnancy through 6 months postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 274 Group Description: G1: Low rate of GWG G2: Moderate rate of GWG G3: Excessive rate of GWG Group N: G1: 59 G2: 138 G3: 77 Inclusion criteria: <ul style="list-style-type: none"> Women with pregravid BMI 19.8-26.0 Enrolled before January 1988 Exclusion criteria: <ul style="list-style-type: none"> Missing information from delivery to 6 months postpartum Pregravid under or over weight 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): NR Parity: NR	Race, %: White G1: 8.5 G2: 10.9 G3: 10.4 Black G1: 61.0 G2: 59.4 G3: 62.3 Hispanic G1: 30.5 G2: 29.7 G3: 27.3 Asian/Pacific Islander NR Other NR Smoking, %: G1: 30.5 G2: 26.8 G3: 26.9 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: NR

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 59 G2: 138 G3: 77 Total weight gain: G1: Gestation duration (wk)38.5 (0.28) $P < 0.05$, low vs. moderate plus excessive weight gain G2: 39.2 (0.17) G3: 39.4 (0.24) Categorized: <ul style="list-style-type: none"> According to IOM rate of gestational weight gain measured between 20 to 36 weeks: low GWG = < 0.34kg/wk; moderate GWG = 0.34-0.68 kg/wk; excessive GWG = > 0.68 kg/wk Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3,049 (56.94) $P < 0.05$, low vs. moderate plus excessive weight gain G2: 3,208 (36.33) G3: 39.4 (0.24) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Change in weight, risk for becoming overweight Groups Maternal weight gain categories (kg/wk): G1: ≤ 0.34 G2: > 0.34 - 0.68 G3: > 0.68 Results Mean (SEM) change in weight (kg) from pregravid to 6 months postpartum: G1: 3.2 (0.95) G2: 3.8 (0.61) G3: 7.9 (0.83) $P < 0.001$, G3 vs. G1, G2 Mean (SEM) change in weight (kg) from 6 weeks to 6 months postpartum: G1: 0.13 (0.64) G2: -0.05 (0.41) G3: -1.48 (0.56) $P < 0.05$, G3 vs. G1, G2 AOR (95% CI) for becoming overweight (BMI > 26.0) at 6 months postpartum: G1, G2: 1.0 (reference) G3: 2.89 (1.36-6.00) Maternal confounders and effect modifiers accounted for in analysis: Age, race, parity, pregravid BMI, lactation, height, smoking Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Fair Followup: Fair Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 2 Good, 7 Fair, 0 Poor Final Quality Score: Fair

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Walker, 1996</p> <p>Country and setting: USA, multicounty community</p> <p>Enrollment Period: NR</p> <p>Funding: Biomedical Research Support Grant; Luci B. Johnson Centennial Professorship in Nursing</p> <p>Study Objective: To test contributions of life-style and stress to postpartum weight gain after controlling for sociodemographic and reproductive influences</p> <p>Time frame: NR</p> <p>Duration of the study: Pregravid (retrospective) through 18 months postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: Prospective on outcomes, retrospective on pregravid weight <p>Total Study N: 88</p> <p>Group Description: G1: Total G2: NR</p> <p>Group N: G1: 88 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women identified through newspaper birth announcements were sent questionnaires in mail <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Hypertensive or bleeding complications during pregnancy Illnesses between delivery and 6 months Pregnant or may be pregnant at time of survey Missing prenatal or postpartum weight data Extensive missing predictor data for 6-month follow-up Obese women 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26.4 G2: NR</p> <p>Parity: G1: 41% primiparae G2: NR</p>	<p>Race,%: White G1: 98% G2: NR</p> <p>Black G1: NR G2: NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 54. Gestational weight gain with reference to IOM recommendations and weight retention during the first year postpartum (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 88 G2: NR Total weight gain: G1: 16.4 kg (SD 7.2) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Self-reported Ascertained by: <ul style="list-style-type: none"> Self-reported 	Birth weight: G1: 3544 G2: NR Gestational diabetes,%: NR Cesarean delivery,%: G1: 81% vaginal births G2: NR Instrumental delivery,%: Episiotomy,%: Other maternal outcomes: GWG was significantly related to weight gain at 6 (r[86] = 0.60, $P < 0.001$) and 18 months (r[73] = 0.49, $P < 0.001$) Other infant outcomes: NR	Outcomes Description: Maternal weight gain and postpartum weight Groups Maternal weight gain categories: G1: < IOM G2: Within IOM G3: > IOM Results Mean weight retention at 6 months postpartum, lbs: G1: 0.4 G2: 3.7 G3: 13.5 $P < 0.001$ Maternal weight gain was significantly related to weight at 6 months postpartum: $r = 0.60$, $P < 0.001$ Mean weight retention at 18 months postpartum, lbs: G1, G2: 0.7 G3: 11.0 $P < 0.01$ Maternal weight gain was significantly related to weight at 18 months postpartum: $r = 0.49$, $P < 0.001$ Maternal confounders and effect modifiers accounted for in analysis: Mode of delivery, infant sex, breastfeeding, infant birth weight, pregravid BMI Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Poor Followup: Good Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Amorim et al., 2007</p> <p>Country and setting: Sweden, hospital</p> <p>Enrollment period: Study comprised follow-up period from delivery (1984 to 1985) to 15 years postpartum (1999 to 2000).</p> <p>Funding: Study supported by Brazilian Foundation for training of researchers in Doctoral Exchange Programme (CAPES) (to A.R.A.) and by Arbeitsmarknadens Forsakrings-och Aktiebolag(AFA) (to M.N.)</p> <p>Study Objective: Explore effect of GWG according to IOM recommendations on long-term BMI, accounting for several potentially confounding factors, including postpartum weight changes and pre-pregnancy BMI</p> <p>Time frame: Study comprised follow-up period from delivery (1984 to 1985) to 15 years postpartum (1999 to 2000).</p> <p>Duration of the study: Entry into prenatal care through 15 years after childbirth</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Combination: In maternity unit, staff invited women to take part in study at first control visit after delivery. Up to that point, study was retrospective in that information about weight development during pregnancy was collected from obstetrics records. Women were then prospectively monitored up to 1 year postpartum and 15 years later <p>Total Study N: 483</p> <p>Group Description: G1: Total</p> <p>Group N: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women who delivered children in 1984 to 1985 in 14 maternity units in Stockholm, Sweden <p>Exclusion criteria: NR</p>	<p>Pregravid weight: Self-reported</p> <p>Pregravid BMI: G1: 21.5 (2.4)</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 30.0 (4.6)</p> <p>Parity: G1: Primiparous 52%</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): NR	Birth weight: G1: 3506 (470) g	Outcomes Description: Weight change across postpartum years	Background: Good
Total weight gain: G1: 14.2 (4.1) kg	Gestational diabetes, %: NR	Groups G1: < IOM G2: Within IOM G3: > IOM	Sample selection: Fair
Categorized: <ul style="list-style-type: none"> According to IOM 	Cesarean delivery, %: NR	Results Mean (SD) change in weight at 15 years postpartum, kg: G1: 6.2 (6.8) G2: 6.7 (6.8) G3: 10.3 (8.5) <i>P</i> = 0.000	Definition of maternal weight gain: Fair
Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records 	Instrumental delivery, %: NR	Mean (SD) BMI at 15 years postpartum: G1: 23.5 (3.7) G2: 23.6 (3.0) G3: 25.9 (3.9) <i>P</i> = 0.000	Definition of outcomes: Good
Ascertained by: NR	Episiotomy, %: NR	Multiple regression coefficient, B (95% CI) for 15 year BMI status: G1: 0.01 (-0.56-0.59) G2: Reference G3: 0.72 (0.15-1.30) <i>P</i> = 0.033	Source of information on exposure, outcomes, and confounders: Poor
	Other maternal outcomes: NR	Multiple regression coefficient (95% CI) for change in BMI status between pregravid and 15 years postpartum: G1: 0.02 (-0.56-0.59) G2: Reference G3: 0.68 (0.11-1.24) <i>P</i> = 0.042	Followup: Good
	Other infant outcomes: NR	Maternal confounders and effect modifiers accounted for in analysis: Education, lactation, weight retention at 6 months postpartum, weight gain between 6 months and 1 year postpartum, pregravid BMI	Analysis comparability: Fair
		Infant and child confounders and effect modifiers accounted for in analysis: NR	Analysis of outcomes: Good
			Interpretation: Good
			Sum of Good/Fair/Poor: 5 Good, 3 Fair, 1 Poor
			Final Quality Score: Fair

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Gunderson et al., 2000</p> <p>Country and setting: USA, university hospital</p> <p>Enrollment Period: 1980-1990</p> <p>Funding: Grants from California Dietetic Association, Zellmer Grant, Dowdle Endowment and Grossman Medical Research Funds, NIH, University at California, Berkeley</p> <p>Study Objective: To assess relationships between gestational weight gain, race/ethnicity, reproductive history, age, education, and risk of becoming overweight after pregnancy</p> <p>Time frame: 1980 to 1990</p> <p>Duration of the study: 2 pregnancies; weight gain in first up to second pregnancy</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Retrospective <p>Total Study N: 1,300</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 1300 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> White, black, Hispanic, and Asian adult women who delivered two consecutive singleton births <p>Exclusion criteria:</p> <ul style="list-style-type: none"> < 18 years Adoptions Pregnancy complications Medical conditions which could modify gestational weight gain or retention 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: < 19.8: 28.3% 19.8-26.0: 59.5% > 26-29.0: 6.6% > 29.0: 5.6% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 27 (5) G2: NR</p> <p>Parity: G1: % nulliparous: 72.4 G2: NR</p>	<p>Race, %: White G1: 53.3 G2: NR</p> <p>Black G1: 10.5 G2: NR</p> <p>Hispanic G1: 12.4 G2: NR</p> <p>Asian/Pacific Islander G1: 23.8 G2: NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: G1: % married: 77% G2: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
<p>Groups (N):</p> <p>Total weight gain: G1: 16.1kg G2: NR</p> <p>Categorized:</p> <ul style="list-style-type: none"> According to IOM <p>Collected from:</p> <ul style="list-style-type: none"> Routine pre-natal care or maternity records <p>Ascertained by:</p> <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between self reported weight and weight at last prenatal visit (average of 0.9 weeks prior to delivery) 	<p>Birth weight: NR</p> <p>Gestational diabetes, %: NR</p> <p>Cesarean delivery, %: NR</p> <p>Instrumental delivery, %: NR</p> <p>Episiotomy, %: NR</p> <p>Other maternal outcomes:</p> <ul style="list-style-type: none"> 6.4% (n = 72) of women became overweight by second pregnancy (all previously normal weight except for 1 underweight woman) Mean weight increase from baseline (pregravid weight at index pregnancy) until start of second pregnancy = 10.4 (5.2) kg among women who became overweight compared with 1.6 (3.6) kg among women who did not become overweight ($P < 0.001$) <p>Other infant outcomes: NA</p>	<p>Outcomes Description: Adjusted odds ratio (95% CI) for becoming overweight between baseline (pregravid weight at start of index pregnancy) and start of second study pregnancy (median interval time = 1.5 years):</p> <p>Groups G1: < IOM/ within IOM G2: > IOM</p> <p>Results G1: Reference G2: 2.95 (1.67-5.24)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: Smoking, PIH, education, parity, marital status, age at menarche, interval to first birth</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>	<p>Background: Good</p> <p>Sample selection: Fair</p> <p>Definition of maternal weight gain: Fair</p> <p>Definition of outcomes: Good</p> <p>Source of information on exposure, outcomes, and confounders: Fair</p> <p>Followup: Good</p> <p>Analysis comparability: Good</p> <p>Analysis of outcomes: Good</p> <p>Interpretation: Good</p> <p>Sum of Good/Fair/Poor: 6 Good, 3 Fair, 0 Poor</p> <p>Final Quality Score: Good</p>

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rooney et al., 2002</p> <p>Country and setting: USA, hospital</p> <p>Enrollment Period: 10 year followup of study from Apr 1989 to March 1990</p> <p>Funding: Gundersen Lutheran Medical Center</p> <p>Study Objective: To estimate impact of excess pregnancy weight gain and failure to lose weight by 6 months postpartum on excess weight 8 to 10 years later</p> <p>Time frame: 10 year followup of study from Apr 1989 to March 1990</p> <p>Duration of the study: April 1, 1989 to 1999 (10 years) Entry into prenatal care up to 10 years postpartum</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 540</p> <p>Group Description: G1: Group Studied (Continued Care) G2: NR</p> <p>Group N: G1: 540 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Convenience sample of women with uncomplicated pregnancies receiving care at Gundersen Clinic from April first 1989 to March 30 1990 <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women who discontinued care at clinic or did not have a weight available 5-10 years after their study pregnancy 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> weight at first pn visit <p>Pregravid BMI: G1: 25.0 G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 28.6 G2: NR</p> <p>Parity: NR</p>	<p>Race,%: White G1: 97% G2: NR</p> <p>Black NR</p> <p>Hispanic NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 540 G2: NR Total weight gain: G1: 13.1 kg (mean) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: Study investigators measured weight at delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Mean retained maternal weight (kg) was 1.7kg 66% retained pregnancy weight at 6 months follow up 26% gained less than recommended (IOM) amount of weight during pregnancy, 50% gained recommended amount, and 24% gained more than recommended Other infant outcomes: NR	Outcomes Description: Change in weight or BMI across postpartum time Groups G1: < IOM G2: within IOM G3: > IOM Results Average weight change between prepregnancy and ~8.5 years postpartum (kg): G1: 4.1 G2: 6.5 G3: 8.4 <i>P</i> = 0.01 Regression coefficients (95% CI) for BMI at ~8.5 years postpartum: G1: -3.86 (-5.56 - -2.16) G2: Reference G3: -0.70 (-2.13-0.74) Maternal confounders and effect modifiers accounted for in analysis: Duration of breastfeeding, postpartum aerobic exercise, weight loss by 6 months Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Fair Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Poor Analysis comparability: Fair Analysis of outcomes: Good Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Rooney et al., 2005</p> <p>Country and setting: USA, medical center</p> <p>Enrollment Period: 1988 to 2004</p> <p>Funding: Gundersen Luterhan Medical Foundation</p> <p>Study Objective: To estimate impact of perinatal weight change on obesity, weight gain, and development of obesity related illnesses 15 years after pregnancy</p> <p>Time frame: 1988 to 2004</p> <p>Duration of the study: Original study conducted April 12, 1988 to October 12, 1990 followed up until 15 years later (2004)</p> <p>Quality: Fair</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 484</p> <p>Group Description: G1: Cohort (at beginning of study) G2: NR</p> <p>Group N: G1: 484 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> NA <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiple births Missing weight measurements Deceased 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured at first prenatal visit (average of 10.3 weeks gestation) <p>Pregravid BMI: G1: 24.2 G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 28.6 G2: NR</p> <p>Parity: % primiparous: G1: 39% G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: Retained weight at 6 months postpartum: G1: 1.7kg G2: NR</p> <p>% married: G1: 90 G2: NR</p>

Evidence Table 55. Gestational weight gain with reference to IOM recommendations and long-term weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis	Quality Rating
Groups (N): G1: 484 G2: NR Total weight gain: Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: G1: 13.0 kg G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: NA	Outcomes Description: Change in weight or BMI Groups G1: < IOM G2: within IOM G3: > IOM Results Multivariable regression coefficient (95% CI) for BMI at 15 years postpartum: G1: -0.57 (-0.57-1.21) G2: reference G3: 1.69 (0.79-2.58) Multivariable regression coefficient (95% CI) for change in weight between baseline and 15 years postpartum: G1: 0.43 (-1.87-2.73) G2: reference G3: 4.19 (1.88-6.51) Maternal confounders and effect modifiers accounted for in analysis: Marital status at delivery, change in marital status, current parity, insurance status at delivery, current insurance status, baseline BMI, weight gain at index pregnancy, retained weight at 6 months postpartum, participation in postpartum aerobic exercise, duration of breastfeeding Infant and child confounders and effect modifiers accounted for in analysis: NR	Background: Good Sample selection: Poor Definition of maternal weight gain: Fair Definition of outcomes: Good Source of information on exposure, outcomes, and confounders: Good Followup: Good Analysis comparability: Fair Analysis of outcomes: Fair Interpretation: Fair Sum of Good/Fair/Poor: 4 Good, 4 Fair, 1 Poor Final Quality Score: Fair

Evidence Table 56. Anthropometrics of maternal weight retention

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bartha, 2007</p> <p>Country and setting: Spain, tertiary referral university center</p> <p>Enrollment Period: NR</p> <p>Funding: Consejería de Salud</p> <p>Study Objective: to study the relationships between ultrasound estimated visceral fat and metabolic risk factors during early pregnancy.</p> <p>Time frame: NA</p> <p>Duration of the study: NR</p> <p>Quality:</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 30</p> <p>Group Description: NA</p> <p>Group N: 30</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 11-14 weeks of gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NR 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> 64.01 kg <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> Yes 24.4 <p>Categorized:</p> <p>10 women were overweight BMI > 25</p> <p>Age (mean, yrs): 29.07 years</p> <p>Parity: NR</p>	<p>Race,%: NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NA</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): Total weight gain: <ul style="list-style-type: none"> NR 	Birth weight: Gestational diabetes, %: Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Descriptions Metabolic risk factors as a function of visceral fat thickness (VFT) versus subcutaneous fat thickness (SFT) Groups NA Results VFT significantly correlated with <ul style="list-style-type: none"> Diastolic blood pressure ($r = 0.37$, $p = 0.04$) Glycemia ($r = 0.37$, $p = 0.04$) Insulinemia ($r = 0.59$, $p = 0.001$) Insulin sensitivity (HOMA; $r = 0.59$, $p = 0.001$), Triglycerides ($r = 0.58$, $p = 0.03$) HDL-C ($r = 0.39$, $p = 0.03$) Total cholesterol/HDL-C ratio ($p = 0.002$) SFT significantly correlated with <ul style="list-style-type: none"> Diastolic blood pressure ($p = 0.03$). VFT better significantly correlated with the metabolic risk factors than pre-gestational BMI Maternal confounders and effect modifiers accounted for in analysis: NA Infant and child confounders and effect modifiers accounted for in analysis: NA

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Bo et al., 2003</p> <p>Country and setting: Italy, university clinic</p> <p>Enrollment Period: April 1999 to February 2001</p> <p>Funding: NR</p> <p>Study Objective: To evaluate pregnancy outcomes in cohort of caucasian pregnant women in relation to BMI and glucose toleranc status; role of central fat distribution, as indicated by waist to hip circumference ratio also considered</p> <p>Time frame: April 1999 to February 2001</p> <p>Duration of the study: Screened during pregnancy at 24 to 28 weeks, recall data on pregravid weight</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 700</p> <p>Group Description: G1: Normal weight, normal OGTT G2: Overweight/Obese, normal OGTT G3: Normal Weight, IGT/GDM G4: Overweight/Obese, IGT/GDM</p> <p>Group N: G1: 333 G2: 117 G3: 133 G4: 117</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Caucasian pregnant women attending Gynecological and Obstetrical Department of University of Torino screened with 50g oral glucose test at 24 to 28 weeks gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Women known to have preexistent diabetes mellitus, a disease affecting glucose metabolism, or hypertension 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>Pregravid BMI: G1: 21.2 G2: 29.9 G3: 21.5 G4: 29.9</p> <p>Imputed: <ul style="list-style-type: none"> No </p> <p>Categorized: NR</p> <p>Age (mean, yrs): G1: 31.7 G2: 31.1 G3: 32.9 G4: 32.6</p> <p>Parity: G1: Nulliparous (%): 63.7 G2: 53.0 G3: 62.4 G4: 51.3</p>	<p>Race, %: White G1: 100 G2: 100 G3: 100 G4: 100 Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: G1: 11.4 G2: 15.4 G3: 15.0 G4: 18.8</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: G1: 1.2 G2: 10.3 G3: 4.5 G4: 11.1</p> <p>Additional characteristics: Waist-to-hip ratio: G1: 0.86 G2: 0.87 G3: 0.89 G4: 0.90</p> <p>Additional characteristics: Preterm delivery (%): G1: 6.9 G2: 6.7 G3: 9.2 G4: 8.5</p> <p>Additional characteristics: LGA (%): G1: 13.1 G2: 27.6 G3: 13.3 G4: 27.4</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 333 G2: 117 G3: 133 G4: 117 Total weight gain: G1: 13.2+/-4.1 <i>(P < 0.01 vs. G2)</i> G2: 10.5+/-6.1 G3: 11.8+/-5.7 <i>(P < 0.05 vs. G2, P < 0.05 vs. G4)</i> G4: 9.5+/-6.8 <i>(P < 0.01 vs. G1)</i> <i>(overall P < 0.0001)</i> Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Gains during pregnancy not collected Ascertained by: <ul style="list-style-type: none"> Not explained by researchers, may be difference between prepregnancy weight and weight measured at 24 to 28 weeks gestation 	Birth weight: G1: 3271+/-446 <i>(P < 0.05 vs. G2)</i> G2: 3413+/-589 <i>(P < 0.01 vs. G3)</i> G3: 3186+/-578 <i>(P < 0.01 vs. G4)</i> G4: 3389+/-447 <i>(P < 0.05 vs. G1)</i> <i>(overall P = 0.001)</i> Gestational diabetes, %: NR Cesarean delivery, %: G1: 30.5 G2: 38.1 G3: 39.2 G4: 44.3 <i>(P < 0.01 vs. G1)</i> <i>(overall P = 0.044)</i> Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Height Parental diabetes Waist Systolic bp Diastolic bp Hypertension Triglycerides HDL Other infant outcomes: <ul style="list-style-type: none"> Weeks of delivery SGA Neonatal pathologies 	Outcomes Description: Explanation of multivariate models: <ul style="list-style-type: none"> OR for hypertension in pregnancy and obesity - adjusted for age, gestational age, weight gain, and gestational hyperglycemia OR for cesarean sections included gestational hyperglycemia, gestational weight gain, age, obesity OR for LGA included obesity (BMI ≥ 30), gestational weight gain, age, gestational hyperglycemia, and smoking OR for LGA/cesarean sections and WHR adjusted for age, gestational age, weight gain, gestational hyperglycemia, obesity, smoking habits Prepregnancy weight was not associated with adverse outcomes, also height and parity not significantly associated with any pregnancy outcomes Groups: G1: Normal weight, normal OGTT G2: Overweight/Obese, normal OGTT G3: Normal Weight, IGT/GDM G4: Overweight/Obese, IGT/GDM Results: Per kg increase in gestational weight gain G1: 1.06 (1.02 - 1.10) G2: 1.08 (1.03 - 1.12) Gestational hyperglycemia G1: 1.78 (1.21 - 2.62) G2: ns Age G1: NS G2: NS Obesity G1: NS G2: 4.48 (2.30 - 8.71) Smoking G1: NR G2: NS Waist to hip ratio > .90 G1: 1.51 (1.02 - 2.24) G2: 1.81 (1.12- 2.93) Height G1: ns G2: ns Parity G1: ns G2: ns

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<i>Author, year:</i> <i>Bo et al., 2003</i> <i>(continued)</i>			

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		<p>Prepregnancy overweight</p> <p>G1: ns</p> <p>G2: ns</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <p>NR</p> <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Butte et al., 2003</p> <p>Country and setting: USA, children's nutrition center</p> <p>Enrollment Period: NR</p> <p>Funding: US Department of Army and US Department of Agriculture/Agriculture Research Service</p> <p>Study Objective: To evaluate how changes in gestational weight and body composition affect infant birth weight and maternal fat retention after delivery in underweight, normal weight and overweight women</p> <p>Time frame: NR</p> <p>Duration of the study: Prior to preg through pp</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 63</p> <p>Group Description: G1: Total cohort G2: NR</p> <p>Group N: G1: 63 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Nonsmokers 18-40 years parity ≤ 4 Physically active (20 to 30 minutes of moderate exercise at least 3 times/week) No long term medicine use No alcohol/drug abuse <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Multiparous Preterm deliveries Miscarriage Preeclampsia 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Measured by study investigators <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 31 (4) G2: NR</p> <p>Parity: NR</p>	<p>Race, %: White G1: 77 G2: NR</p> <p>Black G1: 10 G2: NR</p> <p>Hispanic G1: 10 G2: NR</p> <p>Asian/Pacific Islander G1: 3 G2: NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): Total weight gain: G1: 15.0 (3.8) kg G2: 14.5 (4.5) kg G3: 17.9 (5.4) kg Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NA Other infant outcomes: <ul style="list-style-type: none"> Birth weight 	Outcomes Description: Fat retention Groups: BMI groups, low, normal, high Results: <ul style="list-style-type: none"> After adjustment for gestational duration, gravidity, and ethnicity, gestational weight gain and net gestational weight gain (GWG-birth weight) were significantly lower in normal BMI group than in high BMI group ($P = 0.04$) - GWG and net GWG in low BMI group was not significantly different from women in normal and high BMI groups On average weight gain was 42% fat mass and 58% fat free mass Weight gain was linearly correlated with gains in TBW ($r = 0.39$, $P = 0.003$), TBK ($r = 0.49$, $P = 0.001$), protein ($r = 0.49$, $P = 0.001$), Fat free mass ($r = 0.50$, $P = 0.001$), and FM ($r = 0.76$, $P = 0.001$) Mean gestational weight gain (14.4kg) of women who gained within IOM recommendations was associated with gains of 7.1kg TBW, 5.0g TBK, 370g protein, 8.4 kg FFM, and 4.1 kg FM and a mean birth weight of 3.44kg Changes in body weight differed among BMI groups in first trimester (normal BMI < high BMI group, $P = 0.004$) and third trimester (low BMI < normal and high BMI group, $P < 0.01$) No effect of breast feeding on body weight and composition Birth weight correlated significantly with GWG ($r = 0.35$, $P = 0.006$), net GWG ($r = 0.26$, $P = 0.04$), and rate of weight gain ($r = 0.28$, $P = 0.03$), FFM ($r = 0.39$, $P = 0.003$) but not with FM Partitioning GWG into FFM and FM showed that FFM gain accounted for effect on birth weight (not FM) Maternal FFM gains in first ($P = 0.008$), second ($P = 0.005$), and third trimesters ($P = 0.005$) were shown to make independent contributions to birth weight Total gestational gains in maternal weight, TBW, TBK, FFM and FM were not shown to have an effect on infant FFM, FM, or percentage of FM at 2 weeks of age Postpartum weight retention was correlated positively with GWG ($r = 0.67$, $P = 0.001$), total FM gain ($r = 0.61$, $P = 0.001$) but not with FFM gain Postpartum fat retention was correlated positively with GWG ($r = 0.56$, $P = 0.001$) and total FM gain ($r = 0.57$, $P = 0.001$) Maternal fat retention at 27 weeks after delivery (5.3kg) was significantly higher in women who gained above IOM recommendations for weight gain compared to those women who gained within (2.3kg) or below (-0.5kg) recommendations

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Butte et al., 2003
(continued)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		<p>Maternal confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Race • Pre-gravid BMI <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <ul style="list-style-type: none"> • Gestational age

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Hediger et al., 1994 Country and setting: USA, setting NR Enrollment Period: 1985 Funding: NICHD grant Study Objective: To study relationship between changes in maternal subcutaneous fat and infant birth weight Time frame: 1985 Duration of the study: Initiation of prenatal care to 4 to 6 weeks postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 608 Group Description: G1: Teenagers 13-15 years G2: Teenagers 16-18 years G3: Adults 19-29 Group N: G1: 197 G2: 207 G3: 204 Inclusion criteria: <ul style="list-style-type: none"> Primigravid and multigravid teenagers (< 19 years) with first pregnancy at < 16 y Older women ages 18 to 29 years at first pregnancy Exclusion criteria: <ul style="list-style-type: none"> History of serious nonobstetric problems (seizure disorders, leukemia or drug or alcohol abuse) Fetal demise Multiple pregnancy Missing data on study variables Women who breast fed after delivery or who were still breastfeeding at 4 to 6 weeks postpartum 	Pregravid weight: <ul style="list-style-type: none"> Self-reported G1: 56.00 (0.84) kg G2: 59.95 (0.82) G3: 60.91 (0.82) Pregravid BMI: G1: 21.81 (0.30) G2: 23.02 (0.29) G3: 23.18 (0.29) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 14.49 (0.14) G2: 17.41 (0.13) G3: 22.63 (0.14) Parity: % primiparous: G1: 93.9 G2: 37.2 G3: 36.3	Race, %: White G1: 7.6 G2: 9.2 G3: 8.8 Black G1: 69.5 G2: 57.5 G3: 61.8 Hispanic G1: 22.8 G2: 33.3 G3: 29.4 Asian/Pacific Islander NR Other NR Smoking, %: G1: 20.8 G2: 34.8 G3: 40.2 Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Mean change in arm muscle area, cm ² : G1: 2.19 (0.44) G2: 1.78 (0.38) G3: 2.00 (0.39) Change in arm fat area, cm ² : G1: -0.46 (0.48) G2: -1.18 (0.43) G3: -1.26 (0.44) Change in triceps skinfold, mm Change in subscapular skinfold, mm: G1: -0.85 (0.38) -1.13 (0.38) G2: 1.22 (0.33) -0.87 (0.33) G3: -1.25 (0.34) -1.53 (0.34)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 197 G2: 207 G3: 204 Total weight gain: G1: 14.85 (0.54) kg G2: 13.82 (0.47) G3: 14.12 (0.48) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Routine pre-natal care or maternity records Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery 	Birth weight: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Anthropometric measurements taken were: mid-upper arm circumference, triceps, and subscapular skinfold thickness from left side of body - upper arm muscle and fat area Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> $r = 0.21$, $P < 0.001$ for infant birth weight and arm fat area at 28 wk gestation $r = 0.16$, $P < 0.001$ for infant birth weight and arm muscle area at 28 wk gestation Question 54: Shows multiple linear regression analysis of infant birth weight (g) - model included: gestation (wk), maternal age (y), low pregravid weight, maternal height, prior poor outcome, primiparity, infant sex, race, smoking Question 67: Shows pattern of pregnancy weight gain, birth weight, and weight retention by arm fat area changes (28 weeks to the postpartum period) * designates model was adjusted for maternal age, parity, ethnicity, low pregravid weight, height, smoking, length of gestation or interval (wk) to the 4-6 wk postpartum visit ** designates model was adjusted for length of gestation, maternal age, parity, ethnicity, low pregravid weight, height, smoking, total weight gain, prior poor outcome, infant sex *** designates model was adjusted for length of gestation, maternal age, parity, ethnicity, low pregravid weight, height, smoking, total weight gain, prior poor outcome, infant sex - but not significantly different from zero Groups: G1: Teenagers 13 to 15 years G2: Teenagers 16 to 18 years G3: Adults 19-29 Results: Total weight gain (kg) G1: 16.7 (2.5) $P = 0.001$ G2: NR Fat loss > 6.4 cm ² G1: 144.3 (51.9) $P = 0.006$ G2: NR Fat loss and low weight (< 25th percentile for chronological age) G1: -339.5 (130.9) $P = 0.010$ G2: NR Fat accretion > 5 cm ² G1: -123.3 (49.5) $P = 0.013$ G2: NR

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<i>Author, year:</i> <i>Hediger et al., 1994</i> <i>(continued)</i>			

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		Confounders and effect modifiers G1: < 1fifth percentile arm fat area loss G2: 1fifth-50th percentile arm fat area loss G3: 50th-8fifth percentile arm fat area loss G4: > 8fifth percentile arm fat area loss G1: 89 G2: 214 G3: 223 G4: 82 Weight gain at 28 wk, kg G1: 9.77 (0.60) G2: 9.02 (0.38) G3: 8.74 (0.37) G4: 10.63 (0.62) * $P < 0.05$ significantly different from means for other arm fat area change percentile groups by analysis of covariance Weight gain in third trimester, kg G1: 4.44 (0.36) G2: 4.74 (0.23) G3: 5.01 (0.23) G4: 6.33 (0.38) * $P < 0.05$ significantly different from means for other arm fat area change percentile groups by analysis of covariance Total gain, kg G1: 14.06 (0.70) G2: 13.73 (0.44) G3: 13.90 (0.44) G4: 16.81 (0.72) * $P < 0.05$ significantly different from means for other arm fat area change percentile groups by analysis of covariance Change in arm muscle area, cm ² G1: 6.71 (0.52) ** $P < 0.05$ significantly different from means for other arm fat area change percentile groups by analysis of covariance G2: 2.24 (0.33) G3: 0.92 (0.33) G4: -0.89 (0.54) *** $P < 0.05$ si infant birth weight, g G1: 3247.2 (43.5) ** $P < 0.05$ significantly different from means for other arm fat area change percentile groups by analysis of covariance G2: 3146.4 (27.7) G3: 3163.1 (27.2) G4: 3026.7 (45.3) ** $P < 0.05$ sign Gestation, wk G1: 39.2 (0.2) G2: 39.0 (0.1) G3: 38.7 (0.1) G4: 39.1 (0.2)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
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Author, year:
Hediger et al., 1994
(continued)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		Interval 28 wk to 4 to 6 wk postpartum, wk G1: 16.4 (0.4) G2: 15.8 (0.2) G3: 15.8 (0.2) G4: 16.7 (0.4)
		Retained weight, kg G1: 3.72 (0.38) G2: 4.40 (0.25) G3: 5.25 (0.24) * $P < 0.05$ significantly different from means for other arm fat area change percentile groups by analysis of covariance G4: 7.08 (0.40) * $P < 0.05$ significantly dif
		Small for gestational age, % G1: 7.9% G2: 6.1% G3: 9.4% G4: 11.0%
		Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Age • Race • Parity • Pregravid weight • Height • Length of gestation/interval to delivery • Total weight gain prior poor outcome • Fat loss • Fat loss & low weight • Fat accretion • Smoking
		Infant and child confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> • Infant sex

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Javanovic-Peterson 1993 Country and setting: USA, hospitals affiliated with medical schools Enrollment Period: 1959 to 1966 Funding: NR Study Objective: to investigate with MRI the relationship between maternal weight, fat distribution, and glucose levels and neonatal birthweight ratio, percent fat, and infant outcome in pregnancies complicated by gestational diabetes. Time frame: NR Duration of the study: NA	Design: <ul style="list-style-type: none"> Observational Prospective Total Study N: 20 Group Description: NA Group N: 20 Inclusion criteria: <ul style="list-style-type: none"> Women with GDM at 36 to 38 weeks' gestation Exclusion criteria: <ul style="list-style-type: none"> NR 	Pregravid weight: <ul style="list-style-type: none"> Self-reported Pregravid BMI: Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> No Age (mean, yrs): 28.8 years Parity: NR	Race, %: NR Smoking, %: NR Diabetes mellitus, %: 100% Hypertension, %: NR Additional characteristics: NR

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): Total weight gain: <ul style="list-style-type: none"> NR 	Birth weight: Gestational diabetes, %: 0% Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: Maternal body composition measures, infant birthweight and neonatal morbidity Groups: NA Results: <ul style="list-style-type: none"> Maternal body composition was related to maternal weight ($p=0.012$, $r=0.54$) Maternal arm fat was related to maternal weight ($p=0.05$, $r=0.60$) Maternal arm fat correlated with trunk fat Maternal trunk fat not correlated with weight (NS) Maternal hemoglobin correlated with maternal weight ($p=0.05$, $r=0.43$) Maternal hemoglobin not correlated with infant birth weight Infant birth weight ratio predicted by MRI ($p<0.001$, $r=0.88$) Mother's arm $> 50\text{mm}^2$ risk or fetus more than 4.0 mm mean thickness of maximal abdominal fat, risk of macrosomia and neonatal glycemia increased Maternal confounders and effect modifiers accounted for in analysis: <ul style="list-style-type: none"> NA Infant and child confounders and effect modifiers accounted for in analysis: NA

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Larciprete et al., 2003</p> <p>Country and setting: Italy, obstetrics ambulatory clinic</p> <p>Enrollment period: NR</p> <p>Funding: NR</p> <p>Study Objective: To evaluate changes in maternal body composition and normal ranges of maternal body components during various periods of pregnancy</p> <p>Time frame: NR</p> <p>Duration of the study: First prenatal visit to delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 170</p> <p>Group Description: G1: Total sample G2: NR</p> <p>Group N: G1: 170 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Women with singleton healthy pregnancy were consecutively recruited for a longitudinal study at early gestation <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Did not complete study program Premature rupture of membranes at 24 to 26 weeks gestation Spontaneous miscarriage Incomplete prenatal data Gestational diabetes that required insulin Gestational hypertension treated with nifedipine 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Routine pre-natal care <p>G1: 66.73 (1.39) kg G2: NR</p> <p>Pregravid BMI: G1: 24.15 (0.48) G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> Continuous <p>Age (mean, yrs): G1: 32.06 (0.50) G2: NR</p> <p>Parity:</p>	<p>Race,%: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking,%: NR</p> <p>Diabetes mellitus,%: NR</p> <p>Hypertension,%: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 170 G2: NR Total weight gain: Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3472.75 (42.35) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> analysis of correlations TBW and ECW significantly increase during second and third trimester of gestation - progressive decrease in resistance provides indirect proof of TBW and ECW expansion at mid-gestation and term gestation, since inverse relationship between first and last 2 parameters is well known Reactance undergoes a progressive rise during entire gestation, following maternal weight gain - this result demonstrates that even fat mass deposition and not only fluid retention is responsible for GWG, since reactance is an indirect parameter in estimating fat mass amount Intracellular water slightly enhances during course of gestation with a peak in late third trimester - this observation may be explained by water filling need of some tissues, occurring at term gestation to guarantee correct development of labor, delivery, and puerperium Groups: G1: Total sample G2: NR Results: Extracellular water G1: 0.146 $P = 0.116$ G2: NR Intracellular water G1: 0.151 $P = 0.108$ G2: 0.398 $P = 0.000$ Total body water G1: 0.147 $P = 0.116$ G2: 1.00 $P = 0.000$ G3: 0.998 $P = 0.000$ Reactance G1: 0.105 $P = 0.251$ G2: 0.315 $P = 0.001$ G3: 0.302 $P = 0.002$ G4: 0.313 $P = 0.002$ Resistance G1: -0.538 $P = 0.000$ G2: -0.135 $P = 0.144$ G3: -0.146 $P = 0.118$ G4: -0.135 $P = 0.149$ Outcomes Set 2: NR Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Lederman et al., 1997</p> <p>Country and setting: USA, clinics</p> <p>Enrollment Period: Jan 1991-Aug 1993</p> <p>Funding: Grant from Maternal and Child Health Bureau and Department of Health and Human Services</p> <p>Study Objective: To determine fat deposited during pregnancy in women according to recommendations of IOM and relationship of weight gain to fat gain in women of different starting weights classified by BMI</p> <p>Time frame: Jan 1991 to Aug 1993</p> <p>Duration of the study: From first visit through delivery</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 196</p> <p>Group Description: G1: study cohort G2: NR</p> <p>Group N: G1: 196 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> 18 to 35 years of age Non-smokers Self-identified as Hispanic, black, or white Expecting singleton birth Able to schedule their first body composition laboratory visit before 16th week of gestation Free of medical illnesses requiring regular medication Not knowingly infected with HIV Not a regular user of drugs or alcohol according to mother's report <p>Exclusion criteria:</p> <ul style="list-style-type: none"> NA they had to have a 37 week measurement and medical record available 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.4 (12.9) G2: NR</p> <p>Pregravid BMI:</p> <p>Imputed:</p> <ul style="list-style-type: none"> NR <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26.0 (4.8) G2: NR</p> <p>Parity: G1: 0.8 (1.0) G2: NR</p>	<p>Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 196 G2: NR Total weight gain: G1: 13.6 (6.1) G2: NR Categorized: <ul style="list-style-type: none"> According to IOM Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> Based on last clinically measured weight prior to delivery: difference between measurement at week 37+ and prepregnancy 	Birth weight: G1: 3,449 (433) G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: Study investigators measured body weight, body density by hydrodensitometry, and deuterium dilution volume twice during pregnancy (at weeks 12-16 and at 37+ weeks) Other infant outcomes: NA	Outcomes Description: <ul style="list-style-type: none"> Fat gain between pregnancy weeks 14-37 Groups: < IOM, within IOM, > IOM, for BMI groups for three outcomes: G1: Body weight gain G2: Body water gain G3: Fat gain Results: BMI < 19.8: all women (n = 21) G1: 12.6 (4.4) G2: 6.1 (2.4) G3: 4.8 (3.8) BMI < 19.8: less than recommended; recommended; more than recommended G1: 7.9 (1.6); 12.6 (2.4); 16.1 (3.9) G2: 6.4 (3.7); 5.9 (1.6); 6.1 (2.2) G3: 0.6 (1.9); 6.0 (2.6); 6.9 (3.5) BMI 19.8-26.0: all women (n = 118) G1: 12.2 (4.0) G2: 7.0 (2.7) G3: 3.9 (3.7) BMI 19.8-26.0: less than recommended; recommended; more than recommended G1: 8.6 (1.9); 12.1 (3.4); 15.2 (3.4) G2: 6.2 (2.1); 6.9 (2.7); 7.6 (3.0) G3: 1.3 (3.0); 3.8 (3.5); 6.0 (3.1) BMI > 26.0-29.0: all women (n = 29) G1: 11.0 (4.6) G2: 7.8 (3.5) G3: 2.8 (5.4)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<i>Author, year:</i> <i>Lederman et al., 1997</i> <i>(continued)</i>			

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		<p>BMI > 26.0-29.0: less than recommended; recommended; more than recommended G1: 8.5 (3.2); 9.1 (3.1); 13.6 (5.1) G2: 6.9 (3.0); 5.7 (3.0); 9.7 (3.2) G3: 0.3 (2.5); 2.8 (4.1); 4.2 (6.9)</p> <p>BMI > 29.0: all women (n = 28) G1: 8.7 (5.6) G2: 7.3 (2.9) G3: 0.2 (5.0)</p> <p>BMI > 29.0: less than recommended; recommended; more than recommended G1: 3.2 (2.7); 6.9 (4.4); 12.0 (4.6) G2: 7.8 (3.5); 6.0 (2.9); 7.6 (2.7) G3: -5.2 (1.5); -0.6 (4.6); 3.1 (3.9)</p> <p>Results for BMI and IOM recommendations over time: G1: BMI < 19.8 and gained within IOM recommendations G2: BMI 19.8-26.0 and gained within IOM recommendations G3: BMI > 26.0-29.0 and gained within IOM recommendations G4: BMI > 29.0 and gained within IOM recommendations G1: 7 G2: 46 G3: 9 G4: 6</p> <p>Total body fat at week 14 G1: 12.2 (2.3) G2: 18.2 (2.8)</p> <p>Total body fat at week 37+ G1: 17.9 (5.4) G2: 21.7 (5.8)</p> <p>Characteristics: G1: 25.1 (4.5) G2: 28.0 (3.8)</p> <p>Group G1: 33.1 (8.3) G2: 32.5 (5.7)</p> <p>Maternal confounders and effect modifiers accounted for in analysis: NR</p> <p>Infant and child confounders and effect modifiers accounted for in analysis: NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<p>Author, year: Paxton et al., 1998</p> <p>Country and setting: USA, prenatal clinics</p> <p>Enrollment Period: Jan 1991 to Jan 1994</p> <p>Funding: Supported by grant MCJ-360601 from Maternal and Child Health Bureau (Title V, SSA), HRSA, DHHS</p> <p>Study Objective: To accurately estimate fat without making extensive assumptions regarding composition of lean tissue in pregnant women, authors developed a 4-compartment model (weight, water, bone mineral mass, and body density) as standard, tested 4 exist</p> <p>Time frame: Jan 1991 to Jan 1994</p> <p>Duration of the study: From week 14 to week 37 of pregnancy</p>	<p>Design:</p> <ul style="list-style-type: none"> Cohort Prospective <p>Total Study N: 200</p> <p>Group Description: G1: All G2: NR</p> <p>Group N: G1: 200 G2: NR</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> Black, Hispanic, and white women 18-35 years of age with singleton pregnancy, free of major illness <p>Exclusion criteria:</p> <ul style="list-style-type: none"> Smoker during pregnancy Regular drug or alcohol use during pregnancy Delivered before second measurement visit 	<p>Pregravid weight:</p> <ul style="list-style-type: none"> Self-reported <p>G1: 63.2 ± 12.8 G2: NR</p> <p>Pregravid BMI: G1: Maternal prepregnancy weight classification: Underweight (BMI < 19.8) 10.5% Normal weight (BMI 19.8–26.0) 61.5% Overweight (BMI > 26 to 29.0) 14.5% Obese (BMI > 29) 13.5% G2: NR</p> <p>Imputed:</p> <ul style="list-style-type: none"> No <p>Categorized:</p> <ul style="list-style-type: none"> IOM guidelines <p>Age (mean, yrs): G1: 26 ± 4.8 G2: NR</p> <p>Parity: G1: 0.8 ± 1.0 G2: NR</p>	<p>Race, %: White G1: 21% G2: NR</p> <p>Black G1: 25% G2: NR</p> <p>Hispanic G1: 55% G2: NR</p> <p>Asian/Pacific Islander NR</p> <p>Other NR</p> <p>Smoking, %: NR</p> <p>Diabetes mellitus, %: NR</p> <p>Hypertension, %: NR</p> <p>Additional characteristics: NR</p>

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 200 G2: NR Total weight gain: G1: 13.6 kg \pm 4.5 G2: NR Categorized: <ul style="list-style-type: none"> (classified as < 5, 5 to < 10, 10 to < 15, and ³ 15 kg), Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3451 \pm 439g G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: <ul style="list-style-type: none"> Existing anthropometric measures varied from each other, with 4-compartment model providing lowest estimate of weight gain Change in fat and fat mass estimate from weeks 14 to 37 or at week 37 from new anthropometric model was not significantly different from estimate from 4-compartment model (weight, water, bone mineral mass, and body density) Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> Traditional anthropometric measures Comparisons between new anthropometric model and 4-compartment model Groups: G1: Anthropometric equation for fat at 37 weeks G2: Four compartment model for fat at 37 weeks G3: Anthropometric equation for change in fat mass from 14- 37 weeks G4: Four-compartment model for change in fat mass from 14- 37 weeks G5: Weight and body-composition changes during gestation Results: GWG (wks 14 to 37) < 5 kg G1: 27.83 \pm 13.51 G2: 23.55 \pm 13.00 G3: - 4.17 \pm 1.99 G4: - 5.66 \pm 4.01 (no significant differences based on repeated-measures) GWG (wks 14 to 37) 5 to < 10 kg G1: 22.00 \pm 6.96 G2: 21.46 \pm 7.69 G3: 0.24 \pm 1.16 G4: 0.96 \pm 2.36 (no significant differences based on repeated-measures) GWG (wks 14 to 37) 10 to < 15 kg G1: 23.14 \pm 6.09 G2: 22.90 \pm 6.91 G3: 3.87 \pm 1.38 G4: 4.36 \pm 2.80 (no significant differences based on repeated-measures) GWG (wks 14 to 37) \geq 15 kg G1: 30.93 \pm 10.08 G2: 31.55 \pm 10.33 G3: 9.73 \pm 2.17 G4: 8.70 \pm 2.73 (no significant differences based on repeated-measures) Change in weight (prepregnancy to week 14) Prepregnancy to week 14) G5: 2.1 \pm 4.5 (-9.5, 26.9) Change in weight (week 14 to 37) G5: 11.5 \pm 4.5 (-0.9, 23.8) Change in total body water (week 14 to 37) G5: 7.0 \pm 2.9 (-2.5, 16.1) Change in fat (week 14 to 37) G5: 3.3 \pm 4.3 (-9.2, 14.1)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<i>Author, year:</i> <i>Paxton et al., 1998</i> <i>(continued)</i>			

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		Hydration of fat-free mass (%) at week 14 G5: 73.84 ± 3.43 (64.88, 82.37)
		Hydration of fat-free mass (%) at week 37 G5: 75.66 ± 3.58 (60.81, 87.87)
		Density of fat-free mass (g/L) at week 14 G5: 1100 ± 12 (1074, 1128)
		Density of fat-free mass (g/L) at week 37 G5: 1091 ± 12 (1054, 1135)
		Maternal confounders and effect modifiers accounted for in analysis: NR
		Infant and child confounders and effect modifiers accounted for in analysis: NR

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Sohlstrom et al., 1993 Country and setting: Sweden, setting NR Enrollment Period: not stated Funding: NR Study Objective: To validate and assess precision of MRI method; to estimate changes in amount of TBF and FF body weight during pregnancy and throughout first year post partum in a group of healthy Swedish women; to study how distribution of TBF is affected during pregnancy and throughout the first year post partum Time frame: Not stated Duration of the study: First visit during pregnancy to 1 year postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 10 Group Description: G1: Total sample G2: NR Group N: G1: 10 G2: NR Inclusion criteria: NR Exclusion criteria: NR	Pregravid weight: <ul style="list-style-type: none"> NR G1: 62.6 (9.7) kg G2: NR Pregravid BMI: G1: 22.4 (2.7) G2: NR Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> Continuous Age (mean, yrs): G1: 28 (5) G2: NR Parity: NR	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: % total body fat prepregnancy: G1: 25.7 (4.8) G2: NR

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 10 G2: NR Total weight gain: G1: 19.0 (7.9) kg G2: NR Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3700 (620) g G2: NR Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: net weight gain during pregnancy: 9.8 (6.3)kg - 5.5 (3.2)kg was TBF and 4.3 (3.7)kg was fat free body weight Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> During first 6 and 12 months postpartum women mobilized 2.6 (3.6) and 3.2 (3.2)kg body fat, respectively Correlations - indicates that women who retained more fat during pregnancy also were those who mobilized more fat post partum On average, 84% of fat retained during pregnancy was placed subcutaneously - amount of subcutaneous fat decreased during whole year post partum while non subcutaneous fat did not change or even tended to increase during this period of time 44% of fat retained during pregnancy was place in lower trunk, 30% in upper trunk, 1% in thighs, 4% in upper arms, 2% in calves, and 1% in forearms During first 2 months postpartum fat was mainly mobilized from lower trunk, most of fat retained in thighs was mobilized during first year post partum while fat which still remained after 1 year mainly was found in upper and lower trunk Groups: G1: Total sample Results: Fat mobilized at 6 months postpartum G1: $r = -0.66$ $P < 0.05$ Fat mobilized at 12 months postpartum G1: $r = -0.83$ $P < 0.01$ Maternal confounders and effect modifiers accounted for in analysis: NR Infant and child confounders and effect modifiers accounted for in analysis: NR

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
Author, year: Soltani and Fraser, 2000 Country and setting: UK, hospital Enrollment Period: NR Funding: NR Study Objective: To investigate pattern of changes in weight gain and fat distribution during pregnancy and postpartum and whether this differed by maternal BMI measured in first trimester Time frame: NR Duration of the study: First prenatal visit to 6 months postpartum	Design: <ul style="list-style-type: none"> Cohort Prospective Total Study N: 77 Group Description: G1: Total sample G2: Normal weight G3: Overweight G4: Obese Group N: G1: 77 G2: 29 G3: 23 G4: 25 Inclusion criteria: <ul style="list-style-type: none"> Women attending first prenatal visit at Northern General Hospital Exclusion criteria: NR	Pregravid weight: <ul style="list-style-type: none"> Measured during first prenatal visit G1: 73.0 (16.8) G2: 60.8 (5.6) G3: 72.0 (5.9) G4: 93.0 (10.6) Pregravid BMI: G1: 27.4 (5.9) G2: 22.7 (1.3) G3: 27.7 (1.4) G4: 34.5 (3.54) Imputed: <ul style="list-style-type: none"> No Categorized: <ul style="list-style-type: none"> IOM guidelines Age (mean, yrs): G1: 26.71 (4.77) G2: 26.44 (5.32) G3: 26.91 (4.50) G4: 27.68 (3.83) Parity: G1: 0.78 (0.86) G2: 0.55 (0.87) G3: 0.81 (0.75) G4: 1.00 (0.96)	Race, %: White NR Black NR Hispanic NR Asian/Pacific Islander NR Other NR Smoking, %: G1: 24% G2: NR Diabetes mellitus, %: NR Hypertension, %: NR Additional characteristics: Fat mass (kg) at first visit: G1: 24.5 (9.9) G2: 16.5 (3.6) G3: 24.6 (3.9) G4: 36.1 (5.9) Waist:hip ratio: G1: 0.92 (0.08) G2: 0.88 (0.06) G3: 0.92 (0.08) G4: 0.96 (0.08) Total Skinfold Thickness (mm): G1: 117.09 (40.19) G2: 84.3 (25.31) G3: 125.02 (22.76) G4: 158.74 (21.52)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
Groups (N): G1: 77 G2: 29 G3: 25 Total weight gain: G1: 13-36 weeks: 10.8 (4.7) G2: 11.0 (3.2) G3: 11.9 (6.4) G4: 9.7 (4.3) Categorized: <ul style="list-style-type: none"> Continuous Collected from: <ul style="list-style-type: none"> Collected by study investigators Ascertained by: <ul style="list-style-type: none"> NR 	Birth weight: G1: 3443.0 (589.60) G2: 3331.5 (481.7) G3: 3423.7 (543.2) G4: 3670.4 (489.5) Gestational diabetes, %: NR Cesarean delivery, %: NR Instrumental delivery, %: NR Episiotomy, %: NR Other maternal outcomes: NR Other infant outcomes: NR	Outcomes Description: <ul style="list-style-type: none"> Pattern of weight changes during pregnancy and up to 6 months postpartum follow a monotonous trend in normal weight women, all seem to increase weight during pregnancy and a considerable weight loss is observed at 6 weeks post partum - from then until 6 months postpartum, they either tend to reduce slightly or stay at the same level Normal weight women follow a comparatively monotonous pattern of changes in fat mass Overweight women show a divergent pattern - women with maximum weight gain and also maximum weight loss are seen in this - overweight women show a very scattered pattern of changes in fat mass Majority of obese women seem to be considerably heavier at 6 months postpartum in comparison with 13 weeks gestation Obese women mostly have higher values of fat mass at 6 months postpartum than early pregnancy Underweight women showed a similar trend of change as normal weight women Groups: G1: Total sample G2: Normal weight G3: Overweight G4: Obese G1: 29 G2: 23 G3: 25 G4: 77 Results: Change in fat mass 13 weeks gestation - 36 weeks gestation G1: 4.9 (2.7) G2: 5.3 (4.5) G3: 3.7 (2.8) G4: 4.6 (3.4) Change in fat mass: 13 weeks gestation - 6 months postpartum (n = 47; normal wt n = 18; overwt n = 12; obese n = 17) G1: 1.1 (2.7) G2: 3.9 (6.5) G3: 3.2 (4.1) G4: 2.6 (4.5) Change in fat mass: 36 weeks gestation - 6 months postpartum (n = 47; normal wt n = 18; overwt n = 12; obese n = 17) G1: -4.1 (2.1) G2: -1.1 (4.3) G3: -0.9 (3.9) $P < 0.05$ G4: -2.4 (3.8)

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Study Description	Study Design, Patient Population, Inclusion/ Exclusion Criteria	Baseline Characteristics	Baseline Characteristics (continued)
<i>Author, year:</i> <i>Soltani and Fraser, 2000</i> <i>(continued)</i>			

Evidence Table 56. Anthropometrics of maternal weight retention (continued)

Maternal Weight Gain	Outcomes from Bivariate Analysis	Outcomes from Multivariate Analysis
		<p>Change in body weight 13 weeks gestation - 36 weeks gestation</p> <p>G1: 11.0 (3.2)</p> <p>G2: 11.9 (6.4)</p> <p>G3: 9.7 (4.3)</p> <p>G4: 10.8 (4.7)</p> <p>Change in body weight: 13 weeks gestation - 6 months postpartum (n = 47; normal wt n = 18; overwt n = 12; obese n = 17)</p> <p>G1: 0.4 (3.2)</p> <p>G2: 2.8 (8.4)</p> <p>G3: 0.6 (6.4)</p> <p>G4: 1.1 (6.0)</p> <p>Change in body weight: 13 weeks gestation - 6 months postpartum (n = 47; normal wt n = 18; overwt n = 12; obese n = 17)</p> <p>G1: -10.7 (2.5)</p> <p>G2: -8.8 (5.0)</p> <p>G3: -9.7 (5.4)</p> <p>G4: -9.9 (4.4)</p> <p>Change in TSF(mm): 13-36 weeks gestation</p> <p>G1: 30.26 (18.61)</p> <p>G2: 28.82 (24.97)</p> <p>G3: 22.20 (17.86)</p> <p>Change in TSF (mm): 13 weeks gestation - 6 months postpartum (n = 47; normal wt n = 18; overwt n = 12; obese n = 17)</p> <p>G1: 8.74 (15.77)</p> <p>G2: 24.10 (38.68)</p> <p>G3: 28.04 (19.18)</p> <p>Change in TSF (mm): 36 weeks gestation - 6 months postpartum (n = 47; normal wt n = 18; overwt n = 12; obese n = 17)</p> <p>G1: -23.96 (14.85)</p> <p>G2: -9.48 (28.49)</p> <p>G3: 3.93 (22.05) $P < 0.05$</p> <p>Change in waist to hip ratio 6 weeks to 6 months postpartum</p> <p>G1: -0.02 (0.05)</p> <p>G2: 0.01 (0.03)</p> <p>G3: 0.02 (0.03) $P < 0.05$</p> <p>Maternal confounders and effect modifiers accounted for in analysis:</p> <p>NR</p> <p>Infant and child confounders and effect modifiers accounted for in analysis:</p> <p>NR</p>

Appendix D. List of Excluded Studies

Exclusion Codes

Code	Criteria	N
X-1	Article is not concerned with topics relevant to maternal weight gain or the measurement of body fat	80
X-2	Wrong publication type (e.g. letter, commentary or editorial)	32
X-4	n < 40 for comparisons including cohort studies	10
X-5	n < 100 for case-series	2
X-6	Not published in english	0
X-7	Wrong publication type (e.g. letter, commentary or editorial)	2
X-8	Wrong design - please explain	23
X-9	Includes only a population w/ a pre-existing condition - please list condition	18
X-10	100% multi-fetal	2
X-12	Study not conducted in a developed nation?	21
X-14	Not related to key questions	74
X-17	Pre-pregnancy weight or BMI is not in article	36

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Appendix E. Acknowledgments

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Technical Expert Panel

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