Obesity in Pregnancy

Healthy Mothers, Healthy Babies Coalition Conference
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Objectives

• Review scope of obesity epidemic in U.S.
• Review the influence of obesity on outcomes for both mother and baby in pregnancy.
• Review the incidence and sequelae of unplanned cesarean among obese women.
• Review the influence of increased BMI on patterns of labor progress.
• Provide discussion of the use of common intrapartal interventions with obese women.
• Review evidence-based recommendations for pre-conceptual, antepartal, and postpartum care of obese woman.
Obesity Epidemic in U.S.

- Obesity epidemic
  - Dramatic increase from 1990-2010

![Map of U.S. obesity rates from 1990 to 2010](image)

- Cesarean delivery among obese women associated with poor outcomes
  - Post-op infection, clotting disorder, hemorrhage, prolonged hospitalization
  - 1/3 of maternal deaths associated with obesity complications, many following cesarean delivery

Flegal et al, 2012
Grundy et al, 2008

<table>
<thead>
<tr>
<th>Year</th>
<th>No Data</th>
<th>&lt;10%</th>
<th>10%–14%</th>
<th>15%–19%</th>
<th>20%–24%</th>
<th>25%–29%</th>
<th>≥30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
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</table>
Trends in Obesity across developed world, OECD.org
Obesity in Women

2/3 of U.S. women of childbearing age are obese or overweight\(^1\)

Racial Disproportions of Obesity

• Obesity epidemic
  – Dramatic increase from 1990-2010

• Obesity disproportionate among racial/ethnic minorities in U.S.¹

³³.⁴% obese (95% CI 30.3-36.6)

⁴⁰.⁷% obese (95% CI 36.7-44.8)

⁵⁸.⁶% obese (95% CI 52.5-64.5)

¹Flegal et al, 2012
²Grundy et al, 2008
Maternal Obesity: Multiple Risks for Mom & Baby in Pregnancy

**Risks to Obese Woman**

- depression & anxiety
  - depression pregnancy OR 1.43 (1.27-1.61)
  - PPD OR 1.30 (1.20-1.42)
  - Anxiety OR 1.41 (1.10-1.80)
- GDM
  - increase by 0.82% with each 1kg/m² increase BMI (3.76X increase on avg)
- gestational HTN
  - 2.5-3.2 OR
- pre-eclampsia
  - Double risk with each increase 5-7 kg/m² in BMI
- prolonged pregnancy
  - Double risk (>41wk)

**Risks to Baby**

- ↑ risk congenital anomalies, neural tube defects especially
- 2-to 3-fold increase macrosomia
- ↑ lifetime risk of DM, heart disease, obesity
- 2 fold risk IUFD in late 3rd trimester
- 1.5-2 fold increase in risk of spontaneous extremely preterm delivery (22-27wks), dose-dependent by BMI
- 1.5-2.7 fold increased risk of induced preterm delivery, dose-dependent by BMI

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PRECONCEPTION CARE FOR THE OBESE WOMAN
Preconception

• Contraception

US Medical Eligibility Criteria: Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No restriction for the use of the contraceptive method for a woman with that medical condition</td>
</tr>
<tr>
<td>2</td>
<td>Advantages of using the method generally outweigh the theoretical or proven risks</td>
</tr>
<tr>
<td>3</td>
<td>Theoretical or proven risks of the method usually outweigh the advantages — or that there are no other methods that are available or acceptable to the women with that medical condition</td>
</tr>
<tr>
<td>4</td>
<td>Unacceptable health risk if the contraceptive method is used by a woman with that medical condition</td>
</tr>
</tbody>
</table>

US Medical Eligibility Criteria: Categories


Condition: OBESITY

Category:

- a. >30 kg/m² BMI
  - COC/P/R - 2 (details)
  - POP - 1 (details)
  - DMPA - 1 (details)
  - Implants - 1 (details)
  - LNG-IUD - 1 (details)
  - Cu-IUD - 1 (details)

- b. Menarche to <18 yrs and >30 kg/m² BMI
  - COC/P/R - 2 (details)
  - POP - 1 (details)
  - DMPA - 2 (details)
  - Implants - 1 (details)
  - LNG-IUD - 1 (details)
  - Cu-IUD - 1 (details)
Bariatric Surgery

• Most effective weight loss treatment for morbid obesity
• Incidence increased 800% from 1998-2005
• Women account for 83% of procedures among reproductive age
• Generally available to women with BMI >40 or BMI >35 with comorbidities
• Types of Surgery –
  • Restrictive Procedures (i.e., lap band/sleeve)
    • Decreases stomach capacity
  • Malabsorptive Procedures (i.e., Roux-en-Y gastric bypass)
    • Decreases absorption of calories & nutrients by shortening functional length of small intestine

Effect of Surgery on Fertility

• Rapid weight loss follows bariatric surgery
  • Improves PCOS, anovulation, irregular menses
  • Results in higher fertility rates

• Avoid pregnancy for 12-24 months after surgery
  • Patient allowed to achieve full weight loss
  • Fetus not exposed to rapid maternal weight loss environment

ANTEPARTUM CARE FOR THE OBESE WOMAN
## IOM Guidelines (2009)

**Balance risks of having LGA infants, SGA infants, preterm births, and postpartum weight retention**

<table>
<thead>
<tr>
<th>Pre-pregnancy weight category</th>
<th>BMI</th>
<th>Recommended total weight gain</th>
<th>Recommended rate of weight gain in the 2&lt;sup&gt;nd&lt;/sup&gt;/3&lt;sup&gt;rd&lt;/sup&gt; trimesters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5</td>
<td>28-40 lbs</td>
<td>1 lb (1-1.3)</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5 – 24.9</td>
<td>25-35 lbs</td>
<td>1 lb (0.8-1)</td>
</tr>
<tr>
<td>Overweight</td>
<td>25 – 29.9</td>
<td>15-25 lbs</td>
<td>0.6 lbs (0.5-0.7)</td>
</tr>
<tr>
<td>Obese (includes all classes)</td>
<td>&gt; 30</td>
<td>11-20 lbs</td>
<td>0.5 lbs (0.4-0.6)</td>
</tr>
<tr>
<td>Class I: BMI 30-34.9</td>
<td></td>
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</tr>
<tr>
<td>Class II: BMI 35-39.9</td>
<td></td>
<td></td>
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<tr>
<td>Class III: BMI &gt;40</td>
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</table>
Gestational Weight Gain

 Gestational weight gain associated with risk of C-section, HTN, GDM
Early Pregnancy

• Height/weight and calculate BMI at 1st visit
• Ultrasound in 1st tri to confirm dates (ovulatory dysfxn common in obese women)
• Aneuploidy Screening → 1st trimester options (sequential screen, NT US, NIPT)
• Depression & Anxiety screening → NOB, 28 weeks, and in 3rd trimester
• Risk factor identification
  • Risk HTN d/o’s → Baseline PET labs before 20 wks
  • Risk GDM → A1c to screen for pre-existing DM and 2hr GTT at 24 wks
• Nutritional counseling & explicit weight gain recommendations*
• Exercise encouragement & recommendations*
• Detailed fetal anatomy scan 16-20wks (earlier GA if class III obesity) with explanation of limitations
• Frequent visits in 3rd trimester for assessment of fetal growth + maternal health (BP measurements, weight gain, OSA sx’s, orthopedic difficulties)
• Strong evidence does not exist for timing of delivery and/or antenatal surveillance
Nutrition & Exercise

- Offer nutrition consultation
  - Consider having patients plot their own weight on charts
  - Additional folic acid for all obese women (4mg/day starting 2 mo prior conception thru 1st trimester)
  - Nutritional considerations for women who have had a bariatric procedure
    - Risk for protein, iron, vit B12, folate, vit D, calcium deficiencies
    - Supplement if deficient
    - Monitor CBC, iron, ferritin, calcium, vit D q trimester

- Treatment of Obese Pregnant Women (TOP) Study
  - RCT 425 obese pregnant women in Denmark
  - Goal < 5kg TWG
    - physical activity (pedometer – daily step count 11,000)
    - physical activity + diet (1200-1575kcal Mediterranean-style, nutrition f/u q 2 weeks)
    - control group w/ standard care
  - Gestational weight gain lower in 2 intervention groups
  - No difference in neo birthweights among 3 groups (TWG < 5kg did not result in SGA infants)
  - Lower rate of emergency Cesarean delivery in physical activity + diet group
INTRAPARTUM CARE FOR THE OBESE WOMAN
Obesity & Cesarean Delivery

Several meta-analysis examining link between maternal BMI & cesarean delivery.

  - N=33 cohort studies, include all parities, include co-morbidities.
- **Poobolan et al, 2008.** Obesity as an independent risk factor for elective and emergency caesarean delivery in nulliparous women – systematic review and meta-analysis of cohort studies. *Obesity Reviews, 10*(1), 28-35.
  - N=11 cohort studies, only nulliparous women, no co-morbidities, unplanned cesarean delivery.

**Odds Ratios for Cesarean Delivery (95% Confidence Intervals)**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Chu 07</td>
<td>1</td>
<td>1.46 (1.34-1.60)</td>
<td>2.05 (1.86-2.27)</td>
<td>2.89 (2.28-3.79)</td>
</tr>
<tr>
<td>Poobolan 08</td>
<td>1</td>
<td>1.64 (1.55-1.73)</td>
<td>2.23 (2.07-2.42)</td>
<td></td>
</tr>
</tbody>
</table>
Dose-Dependent Association Obesity & Cesarean Delivery

Kominiarek, et al 2011

- N=118,978 women, multi-site U.S.
- Consortium of Safe Labor

5% increase in risk of unplanned cesarean with each increase in BMI of 1 kg/m²

So What...Outcomes of Cesarean Delivery Among Obese Women

Cesarean delivery among obese women associated with poor outcomes:

- Wound infection/breakdown
- Clotting disorder (VTE)
- Hemorrhage
- Prolonged hospitalization
- Endometritis
- Respiratory/airway complications

- **2-4X increased risk of post-op complications** in women with BMI>45
  - Primary infectious outcome
  - Wound infection
  - Emergency department visit

- **1/3** of maternal deaths associated with obesity complications, many following cesarean delivery\(^2\)

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\(^2\) Flegal et al, 2012

Obesity & Cesarean Delivery

Dose-dependent association with unplanned cesarean delivery

Primarily linked to labor dystocia

Labor Dystocia

Abnormally slow progress during active phase labor resulting from abnormalities in...¹

¹ACOG, 2003
Labor Dystocia

Abnormally slow progress during active phase labor resulting from abnormalities in...¹

Labor Dystocia

Abnormally slow progress during active phase labor resulting from abnormalities in...

Passage

Obese women more likely to have larger babies

Passenger

Clinical studies reveal that higher fetal weights do not ↑ dx of labor dystocia when control for DM

Power

Labor Dystocia

Abnormally slow progress during active phase labor resulting from abnormalities in...

**Passage**

Obese women’s myometrial cells contract with less efficiency compared to normal weight women².

**Passenger**

**Power**

Myometrial Dysfunction


Leptin & Cholesterol in Obese Women

Leptin

- Elevated in obese women
- Produced by fat cells
- Also produced by placenta
- In obesity, leptin resistance

Cholesterol

- Elevated in obese women
- Positive association with BMI, especially in people between 25-35 years of age


BIOLOGY OF OBESITY IN PREGNANCY (4 MODELS)

Cholesterol causes disrupted contractility in uterus

A

![Graph A showing oxytocin and cholesterol effects on force and calcium](image)

B

![Graph B showing MCD and cholesterol effects on force and calcium](image)

Smith et al, 2005
**MODEL 1**
Cholesterol causes disrupted uterine contractility

**MODEL 2**
Leptin disrupts contractility & cervical/uterine ripening.
Wendremaire et al, 2012

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**Figure 3**  Effects of leptin on oxytocin-induced myometrial contractility in pregnant nonlaboring tissue. Representative recordings of A, oxytocin-induced myometrial contractions in control strips, B, oxytocin-induced contractions treated with vehicle only, and C, the effects of cumulative additions of leptin (1 nmoL/L–1 μmoL/L) in 20-minute intervals are shown.

From Moynihan et al, 2006
**MODEL 1**
Cholesterol disrupts uterine contractility.

**MODEL 2**
Leptin disrupts contractility & cervical/uterine ripening.

**MODEL 3**
Decreased oxytocin receptors & Connexin-43 connections between myocytes.

Garabedian et al, 2011; Elmes et al, 2011
Electrophysiologic Model of Uterus with Irregular Propagation

Intrapartum Care of Obese Women

- Intrapartum intervention choices & timing explain much of the association between obesity & unplanned cesarean delivery.\(^1\)

- Optimal intrapartum care lowered rate of unplanned cesarean in mixed weight group, primarily via decreased diagnosis of labor dystocia.\(^2\)


\(^2\) Leeman & Leeman, 2003. A Native American Community with a 7% Cesarean Delivery Rate: Does Case Mix, Ethnicity, or Labor Management Explain the Low Rate? *The Annals of Family Medicine, 1*(1), 36 -43.
Intrapartum Interventions in the U.S.

Intrapartum Management in the United States:

Frequently involves high-technology interventions, used with timing/indication against evidence-based guidelines.

1 Declercq et al, 2013.
Listening to Mothers Survey III (n=2400 women)

High-Technology Intervention in Labor

- Intervention
- No Intervention

How Many Interventions in Labor?

- 3 or more interventions
- 1-2 interventions

Declercq et al, 2013
Intrapartum Interventions Associated with Cesarean in Mixed-Weight Groups of Women

Intrapartum Interventions Associated with Increased Risk Unplanned Cesarean Delivery:

Early hospital admission¹
AROM (trend toward)²
Epidural (conflicting results)³
Induction of Labor⁴

And longer labor...

Epidural⁵

¹Jackson, 2003
²Smyth et al, 2013
³Nguyen et al, 2009
⁴Dunne et al, 2009
⁵Debiec et al, 2009
Intrapartum Interventions in the Labors of **Obese Women**

**SYSTEMATIC REVIEW OF THE LITERATURE, n=8 STUDIES:**

Obese Women more often receive intrapartum interventions including:

- Induction of labor
- Early Hospital Admission
- AROM
- Augmentation of labor
- Epidural
- Unplanned Cesarean Delivery

When compared to normal BMI referent

Interaction: Provider & Biology of Obesity

BEHAVIOR:
Intrapartum Interventions

BIOLOGY:
Myometrial Dysfunction

Labor Dystocia

Unplanned Cesarean Delivery
Induction of Labor in Obese Women

- Takes longer than spontaneous labor (which is already LONG)
- Labor duration & progress inversely related to maternal weight
- Failure to respond to prostaglandin cervical ripening
  - 54.7% failure among obese
  - 34.5% failure among normal wt women, \( p = 0.0016 \)
  - Up to 80% failure of induction rate among Obese III women who had macrosomic fetus & no previous vaginal delivery\(^2\)


Obese poorer response to oxytocin During Induction

  - Prospective Irish standardized AML trial 1015 term, nulliparous induced women
  - Linear relationship BMI increase to cesarean despite oxytocin infusion per protocol
  - Prospective IOL trial UAB 509 women, controlled for DM, etc.
  - IUPC, pitocin infusion standardized, protocol
  - Ran pitocin higher on obese women
    - Lean women pit avg @ 16 mU/min
    - Obese women pit avg @ 24 mU/min
  - Obese women higher rate labor dystocia resulting in unplanned cesarean

For each additional 10kg of maternal weight, 17% increase in risk of cesarean in this induction RCT
Obese poorer response oxytocin augmentation

N=2,143 term, nulliparous women spontaneous labor, Ireland Prospective observational study, Active Management of Labor protocol

Obese women significantly more likely to fail oxytocin augmentation (require cesarean for dystocia despite augment).

(Walsh & Foley, 2010)
Gaps in Literature: Intrapartum Interventions in the Labors of Obese Women

No Current Guidelines for Best Use of Intrapartum Interventions in Obese Women

How do intrapartum interventions interact in the unique physiology of an obese woman?
Timing of Interventions—Also Important

High-Technology Intrapartum Interventions

Liberal guidelines for hospital admission in early labor\(^2\)

&

Often applied using stringent timelines for labor progression\(^3\)


Friedman’s Curve, 1954

- Latent phase
- Acceleration phase
- Deceleration phase
- Phase of maximum slope

Cervical dilatation (cm)

Time from commencement of labour (h)
Zhang et al, 2010 Consortium for Safe Labor NICHD
Labor Curves in Multiparas by Body Mass Index Category

Kominiarek et al, 2011
## Median Duration of Labor in Hours (Slowest 5%ile) in Nulliparous Women by BMI, normal neonates

(Kominiarek et al, 2011)

<table>
<thead>
<tr>
<th>Cervical dilation, cm</th>
<th>BMI &lt;25</th>
<th>BMI 25.0-29.0</th>
<th>BMI 30-34.9</th>
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<th>BMI ≥ 40</th>
<th>P value for trend</th>
</tr>
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<tbody>
<tr>
<td>4-10 cm</td>
<td>5.4 (18.2)</td>
<td>5.7 (18.8)</td>
<td>6.0 (19.9)</td>
<td>6.7 (22.2)</td>
<td>7.7 (25.6)</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>2nd stage without epidural</td>
<td>0.61 (2.5)</td>
<td>0.44 (1.9)</td>
<td>0.50 (2.1)</td>
<td>0.44 (1.9)</td>
<td>0.65 (2.7)</td>
<td>.49</td>
</tr>
<tr>
<td>2nd stage with epidural</td>
<td>0.75 (2.6)</td>
<td>0.83 (2.8)</td>
<td>0.79 (2.7)</td>
<td>0.69 (2.4)</td>
<td>1.18 (3.7)</td>
<td>.81</td>
</tr>
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(Kominiarek et al, 2011)

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</tr>
<tr>
<td>2\textsuperscript{nd} stage without epidural</td>
<td>0.17 (1.0)</td>
<td>0.17 (1.0)</td>
<td>0.15 (0.9)</td>
<td>0.15 (0.9)</td>
<td>0.12 (0.7)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>2\textsuperscript{nd} stage with epidural</td>
<td>0.40 (1.7)</td>
<td>0.33 (1.5)</td>
<td>0.27 (1.2)</td>
<td>0.25 (1.1)</td>
<td>0.36 (1.6)</td>
<td>&lt;.0001</td>
</tr>
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</table>
Slowest Cervical Dilation/Hour in Active Phase Labor

Lowest range of normal=Need to intervene clinically

• Friedman (1954) 1cm/hr
• Zhang, 2002: 1cm/hr (mixed weight sample)
• Neal et al, 2010: 0.5 cm/hr (mixed weight sample)
• Kominiarek et al, 2011 (obese women):
  – Slowest between 4-5cm: 0.15-0.11 cm/hr
    (i.e. 6.3 to 9 hours/cm)
  – Slowest between 5-6cm: 0.25-0.2 cm/hr
  – Slowest in transition: 0.6 cm/hr
Take Away: Management of Obese Pregnant Women

**In Labor**

- If baby and mother stable, obese women average 0.5 cm/hr *in transition* (1.6 cm/hr slowest)
  - May take up to 6 hours/cm *in early active labor* for BMI 30, up to 9 hours for higher BMIs
- Delay admission to L&D until active phase labor if possible
- Allow TOL for EFW ≤ 5000g non-DM, ≤4500g DM
- Running pitocin:
  - Obese women may need higher doses, run for longer periods of time than normal-weight women
- Avoid IOL whenever possible—obese women more likely to fail IOL than normal weight women
  - Consider multi-day cervical ripening protocols
  - Consider multiple methods of cervical ripening
Monica AN24: external FHR ECG & contraction EHG
Postpartum in Obese Women

Immediate Postpartum

- Increased risk PPH (atonic)\(^1\)
- VTE prophylaxis 1 wk class III?\(^2\)
- Delayed lactogenesis\(^3\) (>60-72 hours)
- Reduced duration of lactation\(^2\)
- PPD and anxiety\(^4\)

Long-term Postpartum

- PPD & Anxiety
- Need to decrease weight (antenatal lifestyle & dietary)\(^5\)
- Testing for DM
- Follow-up for HTN
- Referrals—weight reduction specialist, endocrine, etc. (ACOG #549)


Thank you!