Maternal Obesity
Impact on Pregnancy, Labor and Birth, Postpartum and Child Health

Nancy O’Brien-Abel, MN, RNC
Perinatal Clinical Nurse Specialist
Seattle, Washington

Obesity Epidemic

- 37.9% Adults in US are obese
- 70.7% Either overweight or obese

NHANES, NCHS, 2015

Body Mass Index

- Normal weight BMI 18.5-24.9
- Overweight BMI 25-29.9
- Class/Grade I BMI 30-34.9
- Class/Grade II BMI 35-39.9
- Class/Grade III BMI > 40

Obese

Prevalence Adult Obesity
1990-2010

Prevalence of obesity, by sex and race, among adults >20, 2011-2014

NHANES, NCHS 2015
Obesity among children/adolescents aged 2-19, by age and race, 2011-2014

CDC/NCHS 2015

Overweight and Obesity, adults ≥20, 1999-2014

CDC/NCHS 2015

Prevalence of obesity, by sex and age among adults ≥20, 2011-2012

CDC/NCHS 2015

Obesity in Pregnancy

Risk Overview

- Weight gain
- Pregnancy loss
- Congenital anomalies
- Gest. diabetes
- Hypertension
- Labor dystocia
- Cesarean birth
- Anesth. difficulties
- Infections, VTEs, OSA

IOM Weight Gain Recommendations

Singleton Pregnancy

Prepregnancy Weight | BMI (kg/m2) (WHO) | Total Weight Gain (lbs) | Rate of Gain (lbs/week) |
--- | --- | --- | --- |
Underweight | <18.5 | 28-40 | 1 |
Normal weight | 18.5-24.9 | 25-35 | 1 |
Overweight | 25.0-29.9 | 15-25 | 0.6 |
Obese (all classes) | ≥30 | 11-20 | 0.5 |

ACOG Committee Opinion, 2013; IOM: Weight Gain During Pregnancy, 2009

IOM Weight Gain Recommendations

Single Standard for Obese Women

- Some concern IOM guidelines do not differentiate degrees of obesity, especially in women with class III obesity
- Providers should encourage healthy behaviors
- Dietary counseling to establish lifelong healthy eating
  - Limit calorically dense foods
  - Improve food choices
  - Develop active lifestyle

http://healthandcare.in/healthy-food_importance/
**Weight Gain and Perinatal Outcome**

- **Weight Gain During Pregnancy**
  - ABSTRACT: The updated guidelines by the Institute of Medicine regarding postnatal weight gain propose dietary and activity guidelines for women who are pregnant. Women who gain weight on the upper end of the recommended amount of weight gain should be counseled to modify their diet and activity to achieve weight loss. The purpose of this document is to provide information about the association between weight gain and perinatal outcomes. Women who gain weight on the lower end of the recommended amount of weight gain should be counseled to modify their diet and activity to achieve weight gain. The purpose of this document is to provide information about the association between weight gain and perinatal outcomes.

- **Obesity and Pregnancy Loss**
  - Early miscarriage: OR 2.0, 95% CI (1.2-3.3)
  - Recurrent early miscarriage: OR 3.3, 95% CI (1.0-10.0)
  - Controlled for pre-gestational diabetes

- **Obesity and Twins**
  - Dizygotic twins: OR 2.0, 95% CI (1.5-2.5)
  - Adjusted for race, age, parity, height

- **Obesity and Congenital Anomalies**
  - Population based-case control (Atlanta):
    - Risk of NTDs: OR 2.0, 95% CI (1.2-3.3)

- **Conclusion**
  - Women with diabetes excluded
  - Risk of NTDs: OR 3.1, 95% CI (1.7-5.46)

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**Pregnancy Outcomes With Weight Gain Above or Below the 2009 Institute of Medicine Guidelines**

- Johnson et al., NICHD MFMU Network, Obstet Gynecol, May 2013
- Secondary analysis, preeclampsia prevention trial
- 8,293 nulliparous women, singleton
- EWG, all BMI categories: ↑ hypertensive disorders, CD, LGA

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**Abbreviations**

- BMI: Body Mass Index
- CD: Cesarean Delivery
- LGA: Large-For-Gestational-Age
- EWG: Early Weight Gain
- NTD: Neural Tube Defects
- DM: Diabetes Mellitus
Obesity and Congenital Anomalies

- ↑ Omphalocele
  - OR 3.3 (1.0-10.3)
  - Watkins, Pediatrics, 2003

- ↑ Cardiac Malformations
  - OR 2.0 (1.2-3.4)
  - African American women
    - OR 6.5 (1.2-3.4)
  - Watkins, 2003; Mikhail, 2002

Obesity and Gestational Diabetes

- Meta-analysis (20 studies)
- Compared to normal weight women

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<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Overweight</td>
<td>2.14</td>
<td>1.82-2.53</td>
</tr>
<tr>
<td>Obese</td>
<td>3.56</td>
<td>3.05-4.21</td>
</tr>
<tr>
<td>Severely Obese</td>
<td>8.56</td>
<td>5.07-16.04</td>
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Chu, Diabetes Care, 2007

Obesity Screening for Gestational Diabetes

- ALL pregnant women should be screened based on medical history, clinical risk factors, or lab. screening to determine blood glucose levels
  - Routine screening generally 24-28 wks. gest.

- EARLY screening for glucose intolerance should be based on risk factors, including maternal BMI >30, known impaired glucose metabolism, or previous gest. diabetes
  - If initial early screening is negative, a repeat screen is generally performed 24-28 wks. gest.

ACOG Practice Bulletin, 2015

Obesity and Macrosomia

- ↑ Macrosomia > 4000 gms
  - OR 1.4-2.7
  - Large cohorts controlling or excluding HTN and/or diabetes
  - Baeten, 2001; Shenkin, 2004; Jensen, 2003; Lacoursiere, 2005; Mazouni, 2006

- Obesity predisposes to macrosomia
  - ↑ Risk shoulder dystocia, inherent birth trauma
  - Perinatal lacerations, fetal injury, hemorrhage

Obesity and Hypertension

- Prospective multicenter database (n=16,102)

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<thead>
<tr>
<th></th>
<th>BMI 30-34.9 (Adj. OR)</th>
<th>BMI &gt;35 (Adj. OR)</th>
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<tbody>
<tr>
<td>Gest. Hypertension</td>
<td>2.5</td>
<td>3.2</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>1.6</td>
<td>3.3</td>
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Weiss et al., AJOG, 2004

Obesity and Spontaneous PTB

- Preterm Prediction Study
- 2910 women @ 23 wks GA
- Obese women ↓ rates of spontaneous PTB <37 wks
  - OR 0.57 (0.4-0.8)
- Cervical length greater

Hendler et al, NICHD, MFM Units Network, 2005
Obesity and Labor Progression

Contemporary labor patterns: the impact of maternal body mass index
Michelle A. Kominiarek, MD; Sun Hung, MD; PhD; Paul Y. Valsangkar, MD; James Thrower, MD; Sheila J. Rosen, MD; Judith L. Hobbins, MD

Objectives: We sought to compare labor patterns by body mass index (BMI).

Study design: A total of 116,029 women with a singleton term singleton gestation were studied. Important risk factors in each trimester of pregnancy were stratified labor course to partly determine the impact of obesity on labor. The median onset time was 15 cm, internal (10 cm) and was determined using the cesarean section rate. Adjusting for cesarean section time and maternal factors, cesarean section rates were 10.7% for women with BMI < 30; 15.6% for BMI 30-34.9; and 19.7% for BMI > 35. These rates were similar among women with BMI < 30 and BMI 30-34.9. However, the cesarean section rate for BMI > 35 was significantly higher than that for BMI < 30.

Data from Consortium on Safe Labor (19 hospitals; NICHD)
118,978 women, singleton, cephalic

Kominiarek, et al., AJOG, 2011

Obesity and Labor Progression

- Fat as a hormonally active organ?
- Mechanical issue?
- Dilution of oxytocin?

- Need greater patience in labor process
- Allow for slower progression prior to CD

Obesity and Cesarean

- ↑ Risk Cesarean with obesity
- Positive correlation with:
  - Excessive gest. weight gain
  - Prepregnancy ↑ BMI

ACOG, 2013

<table>
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<tr>
<th>BMI</th>
<th>Cesarean (%)</th>
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<tr>
<td>&lt;30</td>
<td>20.7%</td>
</tr>
<tr>
<td>30-34.9</td>
<td>33.8%</td>
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<tr>
<td>&gt;35</td>
<td>47.4%</td>
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Weiss et al., AJOG, 2004

Adjusted Risk Ratios for Cesarean by BMI

- Low risk, singleton, vtx., no prior CD, 37-41 wks., 38 states, 2012
- Adjusted for mat. age, race, education, trimester prenatal care began, nativity, payment method, prepreg. / gest. diabetes, hypertension

Declercq et al., Birth, 2015

Obesity and Cesarean

- ↑ Operative time > 2 hrs.
- ↑ Surgical site infections
  - Overweight    OR 1.6 (1.2-2.2)
  - Obesity class I OR 2.4 (1.7-3.4)
  - Class II and III OR 3.7 (2.6-5.2)
- Subcutaneous drains ↑ risk of postpartum wound complications
- In obese women, consideration may be given to higher preoperative antibiotic dose for surgical prophylaxis

ACOG Practice Bulletin 2015; ACOG Committee Opinion, 2013
**Obesity and Cesarean Antibiotic Prophylaxis**

- Some recommendations (based on general surgery procedures) suggest:
  - 2-g prophylactic cefazolin >80 kg
  - 3-g for those weighing >120 kg

  *Brazier et al, Am J Health Syst Pharm, 2011*

- However, a recent RCT did not support the use of 3 g cefazolin for women with a BMI >30. Adipose tissue concentrations did not significantly differ between the two dosage strategies (2 g vs. 3 g cefazolin).

  *Maggio et al, Obstet Gynecol, 2015*

**Obesity and Anesthesia Complications**

- Antenatal anesthesia consultation (esp., class III obesity)
- ↑ Epidural failure (consider early placement)
- ↑ Difficult/failed endotracheal intubation
- Video laryngoscopes, intubating LMA’s, emergency cricothyroidotomy kit
- Limited resources, consider maternal transport
- ↑ Obstructive sleep apnea (anesthetic mgmt., post-op care)

**Pregnancy and OSA Intrapartum Considerations**

- Greatest intrapartum risk is anesthesia
- ↑ Risk postpartum hypoxemia, hypercapnia, sudden death
- AASM and ASA post-op protocol considerations:
  - Early placement of epidural
  - SpO2 during labor with pulse ox
  - Screening immed. pp for respiratory events. When present, continuous monitoring until O2 sat. maintained
  - CPAP/oral appliance
  - Supplemental oxygen (hypoxemia vs. airway collapse)
    - until able to maintain baseline SpO2 on room air
  - Semi-upright or lateral position
  - Avoid PCA/systemic opioids; prefer ketorolac or NSAIDs
  - Consult MD with expertise in pul. med., crit. care and sleep

  *Louis et al, Obstet Gynecol, 2012*

**Thromboembolism in Pregnancy**

- Pregnant women have 4 to 5-fold ↑ risk vs. non-pregnant women
- 80% of thromboembolic events in pregnancy are venous
- Venous thromboembolism (including PE) account for 1.1 deaths per 100,000 births or 9% of all maternal deaths in US
- Obesity independent risk

- Placement of pneumatic compression devices before CD; early mobilization for women without additional risks
- Very-high-risk groups, additional pharmacologic thromboprophylaxis (low-molecular-weight LMW heparin)

  *ACOG, 2015, 2013, 2011; Bates et al, 2004; Liston et al, 2011*

**Extremely Obese Pregnant Woman Advanced Preparations in Hospital**

- Evaluation of unit(s) capabilities
- Pre-admission planning
- Equipment and supplies needs and evaluation
- Role of additional personnel

Extremely Obese Pregnant Woman
Advanced Preparations in Hospital
- Panniculus retraction

Fetal Heart Rate Tracings
Appropriately Interpreting and Managing
- Position chg – maternal HR

BMI and Duration of Breastfeeding

Obesity and Duration of Breastfeeding
- Biological, physiologic factors
- Pregnancy complications (prolonged labor, anesthesia, Cesarean birth, wound infection, postpartum complications)
- Mechanical difficulties
- Psychosocial issues
- Delayed lactogenesis II
- ↓ Prolactin response to suckling

Obesity Postpartum Complications/Long-Term Outcomes
- Early termination of breastfeeding
- Postpartum anemia
- Depression
- Postpartum weight retention

Postpartum Weight Retention
Strategies to Lose Weight
- Compared with women who gained weight within the IOM recommendations, women who gained more than recommended retained:
  - 6.75 pounds after 3 yrs.
  - 10.41 pounds after 15 yrs.
- Diet alone or diet plus exercise (but not exercise alone) helped women lose postpartum weight (however, exercise may have other beneficial effects)
- Exclusive breastfeeding for >3 months has a small, positive influence on weight loss

ACOG Practice Bulletin, 2015
Baker et al., Am J Clin Nutr, 2007
Boahor et al., Obes Rev, 2004
Malyneaux et al., Obstet Gynecol, 2014
 Assessin et al, Cochrane Database Reviews, 2013

Dewey et al., Pediatrics, 2003;
Hauff et al., Am J Clin Nutr, 2014;
Hilton et al, J Hum Lact, 2004;
Molyneaux et al, Obstet Gynecol, 2014;
Rasmussen & Kjolhede, Pediatrics, 2004;
Rasmussen, Annu Rev Nutr, 2007;
Li et al., Am J Clin Nutr, 2003;
Rasmussen, Annu Rev Nutr, 2007

Hobomama, Flickr, Creative Commons Attribution
Amorim et al, Cochrane Database Reviews, 2013
Neonatal Considerations
Short and Long-Term
- Congenital anomalies
- Birth trauma
- Prematurity
- Breastfeeding
- Stillbirth/Fetal Death
- Adverse neonatal outcome
- LGA/childhood obesity
- Bariatric Surgery and SGA
- Developmental Programming

Obesity and Stillbirth
- 3-fold increased risk ↑ stillbirth
- Cohort 24,000 Danish women with singleton pregnancy
- Exclusion of women with DM or hypertensive disorders did not alter conclusions
  
  Kristensen et al., BJOG, 2005

- Although the absolute risk of stillbirth is low, ↑ in maternal BMI were associated with ↑ risk of fetal death, stillbirth, neonatal death, perinatal death, and infant death
  
  Aune et al., JAMA, 2014; ACOG Practice Bulletin, 2015

BMI and Fetal Death

Aune et al., JAMA, 2014

BMI and Adverse Neonatal Outcome

Maternal Obesity, Mode of Delivery, and Neonatal Outcome

Blomberg, Obstet Gynecol, 2013

Population-based cohort study
- Neonates born to morbidly obese women:
  - 2-fold ↑ skeletal injuries and RDS
  - 3-fold ↑ bacterial sepsis, convulsions, birth asphyxia, feeding issues
  - 4-fold ↑ peripheral nervous injuries and hypoglycemia

Fetal Origins of Adult Disease
LGA and Metabolic Syndrome

- High birth weight/LGA or in-utero exposure to maternal obesity
- ↑ Risk for childhood/adult obesity, lipid abnormalities, metabolic complications

Shin et al., Obstet Gynecol, 2014

Developmental Origins of Obesity

**Programmed Adipogenesis**

- **Maternal:**
  - Diet
  - Weight Gain
  - Metabolites
  - Hormones

- **Low Birth Wt. Newborn**

- **High Birth Wt. Newborn**

- **Continued Growth Trajectory**

- **Childhood and Adult OBESITY**

- **Insulin Resistance**

- **Inflammation**

Adapted from: Desai et al, Curr Diab Rep, 2013

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Bariatric Surgery and Perinatal Outcomes

- 2562 mothers with hx. of bariatric surg. (matched 1:5)
  - ↑ risk SGA infant (OR 2.0, 1.5-2.5; P<0.001)
  - ↑ risk PTB (OR 1.7, 1.4-2.0; P<0.001) (BMI<35)
  - ↓ risk LGA birth (OR 0.6, 0.4-0.7, p<0.001)

Roos et al., BMJ, 2013

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Bariatric Surgery and Perinatal Outcomes

- 339 mothers with hx. of bariatric surgery (84.4% RYGB) (matched cohort 1:4)
  - Significant ↓ birth weight and gestational age
  - 2.3X ↑ risk SGA infant
  - 3.3X ↓ risk LGA birth

Kjaer et al., AJOG, 2013

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Fetal Origins of Adult Disease

Vol. 176, No. 14, October 4, 2010

Early 1990’s researchers linked nutritional insufficiency during embryonic and fetal development to latent diseases in adulthood


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Fetal Origins of Adult Disease

Minimizing Programming of Obesity

- There may well be an optimal newborn weight (potentially specific to an individual mother) at which the programming of obesity potential is minimized