Gestational Obesity and Weight Gain: What Should We Be Doing?

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Disclosures

- I have no financial disclosures to report.

Objectives

- 1990 IOM Guidelines and observations that necessitated the update in 2009
- Effect of BMI and gestational weight gain (GWG) on infant adiposity and childhood Metabolic Syndrome
- 2009 IOM Guidelines: Are they really different?
- How much weight gain is really needed in pregnancy?
- Data supporting less weight gain for higher BMI groups
- Determinants of Postpartum Weight Retention
- Antepartum Interventions to prevent excess GWG
- Postpartum Interventions to promote weight loss
- Final thoughts
**Previous IOM Guidelines**

- 1930s: Gain 15 lbs irrespective of weight status (but most women were not overweight)
- 1970: 20-27 lbs (restriction harmful to BW)
- Increasing recognition between 1970-1990 that one size weight gain may not fit all BMIs
- 1990 Guidelines: preventing SGA major priority
  - Exceedingly high costs of SGA infants and long term consequences

**Underweight Vs Overweight Trends in Pregnancy Over Time**

Centers for Disease Control and Prevention 2006

**1990 IOM Wt Gain Recommendations**

- BMI < 20: 28-40 lbs
- BMI 20-26: 25-35 lbs
- BMI 26.1-29.9: 15-25 lb
- BMI ≥ 30: At least 15 lbs
- No distinction between obese, severely, or morbidly obese e.g. ≥35 (Class II) and ≥40 (Class III)

How Big Is the Problem?

Figure 1. The percentage of women with a BMI > 30 in the USA and other countries. The data from the USA includes both overweight and underweight shaded.

Increasing Prevalence of Obesity in Children and Adolescents

Maternal Obesity

- 35% of all maternal deaths in U.K. are due to obesity
- Most common risk factor in OB practice
- Doubling of maternal obesity rates in 10 yrs
- Estimated to cost of prenatal care by 16X
- ACOG identifies obesity as the leading health risk responsible for the greatest maternal and neonatal morbidity

Risks of Obesity

- GDM 3 fold, Metabolic Syndrome, Insulin Resistance
- Hypertensive disorders, Preeclampsia (2-3 fold; 14%)
- Hyperglycemia
- Cholelithiasis, Non-Alcoholic Fatty Liver Ds (NAFLD)
- Thrombocytopenia
- Sleep Apnea (Pulm Htn, R Heart failure, inadequate O2 delivery to fetus)
- Volume overload, LVH, TCO
- Preterm delivery
- Induction of Labor (IOL), failed IOL, failed forceps
- Cesarean del Weiss JL, AM Obst Gyn 2004;190:1091
- 48% BMI 35-40
- 50% ↓ in successful VBAC
- Emergency Cesarean delivery (inability to monitor by external transducers)
- Postop wound disruptions, infections, aneulectasis, endometritis
- Anesthesia Complications
  - Failed intubations (1/3), CV, Respiratory, Narcotic/Regional anesthesia
  - Lactation Failure, difficult free latching
Fetal Risks of Maternal Obesity

- ↑ 1st trim and recurrent miscarriage (3-fold)
- ↑ birth defects
  - Neural tube (2-fold), cardiac (2-fold), GI, omphaloceles (3-fold), orofacial clefts, CNS. Animal models show ↑ free radicals that alter transcription factors
- Inability to dx fetal anomalies (suboptimal in 37%; cardiac/spine)
- Macrosomia (18%)
  - Pre-preg BMI (3-fold)
  - Shoulder dystocia with nerve palsies
  - Meconium aspiration
  - Perinatal mortality quadrupled
  - Antepartum risk 3-fold, neonatal death 2-fold
  - HR 2.3 at 28-36 wks; 3.5 at 37-39; 4.6 >40 wks Danish Nat Birth Cohort
- Insufficient oxygen for excess fetal growth


Increasing Birth Weights

- Denmark 1990-1999
  - >4000g (~9 lbs); 16.7 → 20%
- Sweden 1992-2001
  - LGA increased by 23%
- Canada Term LGA increased by 24% in 13 yrs
- Cleveland Medical Center
  - 1975-2003; B.W. ↑ 110 gms; Mat Weight 168 → 186 lbs
- Overweight/obesity in infants <6 mos ↑ 74% from 1980-2001 in Boston Gilman 2006

Birthweight vs. Relative Risk For The Metabolic Syndrome in Adulthood

- Low Birth weight =7.6% of all births
- LGA ~20%

BIRTHWEIGHT

1.0
Role of Genetics & Environment in Body Composition at Birth

Intrauterine Environment

FAT MASS

Humans born with highest % fat mass of any species

Studies in human pregnancies necessary

Genetics

FAT FREE MASS

12-15%

85-88%

12-14% yet accounts for 46% variance in

B< SGA < AGA <AGA

Macrosomia Risk; 8.3% non-obese; 13.1% obese; 14.6% morbidly obese (Weiss JL 2004)

Fat mass in humans ~12-14% yet accounts for 46% variance in

Table 1. Neonatal Body Composition of Infants of Women With Pregenatal Body Mass Index (BMI) Less Than 18 Compared With Those With BMI of 25 or More

<table>
<thead>
<tr>
<th>Prepared Body Mass Index</th>
<th>Less Than 18 or 18</th>
<th>25 or More or 18</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (g)</td>
<td>1,360.1±0.6</td>
<td>1,452.2±0.7</td>
<td>.01</td>
</tr>
<tr>
<td>Body composition (%)</td>
<td>59.3±1.0</td>
<td>59.7±1.0</td>
<td>.22</td>
</tr>
<tr>
<td>Lean body mass (g)</td>
<td>0.06±0.01</td>
<td>0.05±0.01</td>
<td>.88</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>14.0±1.0</td>
<td>14.7±1.0</td>
<td>.06</td>
</tr>
</tbody>
</table>

How Much Should We Worry About Baby Fat???
High birth weight and increased adiposity at age 12 months increases risk of metabolic syndrome at age 17 yrs old in girls. Obese infants are 2-9 times as likely to be obese as adults. 

Baird J, BMJ 2005;331:929

Predictors of 4 yr old OW/Obesity: OW/Obesity at 2 yrs (4.1) 
Kitsantas P End Hum Dev 2010;86:563
25% of obese children age 4-10 have IGT

Long Term Implications to Offspring

Heavier Baby Girls at Higher Risk for Diabetes, Heart Woes as Adults

Study found that at teens, they have larger waist size, higher blood levels of insulin, fat

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EpiGene's

How the intrauterine environment alters DNA methylation and histone modification to change gene expression

U.S. kids even fatter than believed

Study: Many face chronic health problems, shorter life spans

700,000 children and teens (2-19) in Southern California
1/3 of children are obese (>95 percentile wt)
7% boys and 5% girls extremely obese
"These kids face 10-20 years shorter life span and will develop health problems in their 20s that we typically see in 40-60 yr olds" Heaviest: Black teenage girls and Hispanic teenage boys
Poor Nutrition in Early Life
Hormonal Imbalance/Insulin Resistance
Metabolic Syndrome

Overnutrition
Changes in Gene Expression
Environmental Stimuli
Metabolic Syndrome
Epigenetic Stimuli

Fetal Origins Hypothesis
Taylor PD Exp Physiol 2007;92:287

- Metabolic factors in the intrauterine environment (gluc, FFAs, TGs, inflammatory cytokines, insulin, hormones, growth factors), have a profound effect on prenatal development and enhances susceptibility to later chronic disease.
- Early exposure: embryogenesis or placentation; alters nutrient transport by placenta and gene expression of cytokines, hormones, GFs
- Mid: Alter number, growth, and function during organogenesis
- Later: Impact regulatory energy set points on brain and neuronal-metabolic pathways feed back loops, and mitochondrial function

Risk Factors Associated with Childhood Adiposity

- Factors Associated with high BMI at 2-3 yr:
  - Maternal BMI, Gestational Wt Gain, Glucose, Lipids, Dietary fat
  - Rate of Infant Weight Gain 0-6 mo
    - Infants triple their fat mass; Rapid wt gain birth-2 yrs; Catch up-growth in IUGR
  - Feeding mode BF protective in some studies
Wt gain in overweight and obese women had strongest correlation of % neonatal body fat but NOT related in Under wt or Nl wt women

Among >8,000 low-income women, maternal obesity doubled the risk of obesity in their children at ages 2-4 years

Relationship between Maternal BMI and Childhood Obesity

Perinatal Risk Factors for Childhood Obesity and Metabolic Dysregulation

89 women with GDM or NGT; Offspring evaluated at birth and 6-11 yrs

Offspring body comp at birth by TOBEC and ~9 yrs by DXA

No correlation between BW and Child Wt; Pos correlation (r=0.29) between neonatal % body fat and 9 yr old body fat%

No differences in Wt Percentile or % Body Fat in offspring of GDM vs NGT

Strongest predictor for offspring upper tertile wt or % body fat was maternal BMI >30 (OR=3.8 and 5.5 resp). Explained 18% of variance in childhood adiposity
Need to Readdress Guidelines

- ~38% nl wt (NW), ~63% overweight (OW), and 46% Obese gained more than 1990 recs
- ~2/3 of the population of women of childbearing age were overweight in 2007 compared to ~1/3 in 1990
- LGA was increasing more quickly than SGA; the latter not due to nutritional deficiency by abnormal placentation in high risk OB mothers
- GDM, Preeclampsia, and C-section rates were increasing and related to maternal BMI
- Intrauterine Influence on the Pediatric Obesity Epidemic
- Maybe “eating for two” was no longer a good idea
Prepregnancy BMI and GWG Predict Postpartum Weight Retention

- >60% of previous normal weight gravidas become overweight with their subsequent pregnancies. Villamor E, 2006; Catalano PM, 2003; Artal R, 2010
- On average, women retain 0.5-3 kg of their GWG
- 20% retain >5 kg
- Postpartum retained fat is deposited centrally
- Women with higher pre-pregnancy BMI retain more weight postpartum
- PP wt retention at 6 mos predicts long-term excess wt gain, Type 2 DM and CVD

Patterns of Mat Wt Gain During Gestation and Postpartum by BMI Gundersen EP 2001; Int J Obes Relat Metab Disord 20:533

- Postpartum Weight Retention

- 540 women followed ~8.5 yrs Rooney BL, Obstet Gynecol 2002;100:245
  - < IOM recs; 4.1 kg heavier than pre-preg wt
  - = IOM recs; 6.5 kg
  - >IOM recs 8.4 kg
  - Wt retention at 1 yr predicts wt at 15 yrs and excessive wt gain (>19kg) in NW predicts OW at 15 yrs Linn Y Obstet Gynecol 2004;12:1166
  - Strongest predictor of 1 yr PP wt retention is GWG Phelan S
  - Excessive GWG increase risk of being OW (OR 2.2) or Obese (OR 4.5) at 21 years after pregnancy Mamum AA Am J Clin Nutr 2010;91:1336
  - 2055 women Brisbane, Aus 1981-1983 adjusted for multiple confounders
How Much Wt is Necessary to Gain? What Are The Energy Cost of Pregnancy?

19 lbs 2oz
Baby Boy; 9/2009
Mother age 41 DM
Medan, North Sumatra Indonesia
Energy Costs of Pregnancy

• Given fetal growth rate is slow and extended over 9 mos, the greatest energy cost is not in synthesizing products of conception but maintaining the pregnancy
• Estimated energy costs in well-nourished woman (England)
  ~77,000 kcal or extra 300 kcal/day
  • Energy deposited in the conceptus as new tissue (4780 kcal)
  • Energy deposited as fat (35,800 kcal)
  • Energy required to maintain the new tissue and maternal weight (35,800 kcal) estimated as 5% in BMR over pregnancy
  • Greater the BMI, greater the BMR
  • Greater the weight gain, greater the BMR
• For conceptus and energy expenditure ~ 41,000 or ~extra 160 kcal/day

Where wt gain goes

• Fetus 3400 g (7.5 lbs)
• Placenta 650 g (1.4)
• Uterus 970 (2.1 lbs)
• Mammary 405 g (0.9 lbs)
• Amniotic fluid 800g (1.8 lbs)
• Blood volume inc 1450 (3.2 lbs)
• Inc extravasc water 1480 (3.3 lbs)
• Maternal fat 3345 g (7.4 lbs)
• Obligate ~ 7800 g = 17 lbs
• Obligate + Mat fat + water = 28 lbs
• 60,000 vs 100,000 kcal or 225 kcal vs 375 kcal/day
Determinants of Weight Gain


- Prepregnancy BMI:
  - Overweight women and obese women do not gain more than NW but usually gain more than IOM guidelines
- Ethnicity
- Lower education ↑ wt gain
- Younger (adolescents) gain more weight
- Primips have larger wt gains but higher risk of SGA than Multips; Multips enter pregnancy with higher BMI (due to wt retention between pregnancies)
- Smokers and those with short inter-pregnancy interval gain less wt (higher risk of SGA but have infants with higher % fat mass)

2009 Weight Gain Recs 2009

<table>
<thead>
<tr>
<th>Pre-preg category</th>
<th>BMI</th>
<th>Total wt gain</th>
<th>Rates wt gain (lbs/wk)</th>
<th>Kcal/kg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5</td>
<td>28 - 40</td>
<td>1 (1 - 1.3)</td>
<td>36-40</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5 – 24.9</td>
<td>28 – 35</td>
<td>1 (0.8 – 1)</td>
<td>30</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0 – 29.9</td>
<td>15 – 25</td>
<td>0.6 (0.5 - 0.7)</td>
<td>24</td>
</tr>
<tr>
<td>Obese*</td>
<td>≥ 30.0</td>
<td>11 – 20</td>
<td>0.5 (0.4 –0.6)</td>
<td>12-18</td>
</tr>
</tbody>
</table>

* No distinction on grades of obesity

Twins: NW 37-54 lbs; OW 31-50; Obese 25-42 lbs Fox NS Obstet Gynecol 2010;116:100

Why So Little Change in Guidelines?

- Balance risk of low vs high GWG but “first, do no harm”
- Maternal BMI most important for infant adiposity; focus on that
- Focus on getting women to gain weight within guidelines
- SGA may be more important than LGA
- Did not include studies with preeclampsia and GDM as outcomes due to “confounders”
- Inadequate data on BMI >35 so obese range primarily based on BMI data of 30-34.9

Rasmussen K Obstet Gynecol 2010;116:1191
IOM 2009 Rationale

Based on Primip, 25-29, nonsmoker, high social status, no exercise

Preeclampsia and GDM not included as outcomes

Committee evaluated data that demonstrated good outcomes among obese women who gain below the obligatory maternal tissue accretion and products of conception (~7.5 kg or 17 lbs) but limited data

Concerns about ketonemia with wt loss and neurologic dysfunction even though data mixed

Oppositions to 2009 IOM Guidelines

Current Commentary

Weight Gain Recommendations in Pregnancy and the Obesity Epidemic

Rebuttal

Current Commentary

Recommendations for Weight Gain During Pregnancy in the Context of the Obesity Epidemic

Gestational Weight Gain and Childhood Adiposity at 3 Yrs

1044 mother-child pairs; Harvard Project Viva; 1/3 BMI >26

IOM guidelines; 51% excessive; 14% inadequate

Indep of BMI, gluc toler, and LGA; SGA not ↑ in inadequate vs adequate
Evaluation of Gestational Weight Gain Guidelines for Women with Normal Prepregnancy BMI

Missouri Birth Certificate: 84,696 (1999-2001); BMI 19.8-26; 43% gained over guidelines <25 lbs had lower odds PE, CP disproportion, failed induction, C-sect, and LGA but 5% risk in SGA (9.3% → 14.3%)

>35 lbs had higher odds of PE, fetal distress, failed induction, C-sect, and LGA but lower SGA.

Missouri Birth Certificate: 120,251 (1990-2001)

Class I BMI 30-34.9; II BMI 35-39.9; III BMI ≥ 40

Class I ~15 lb ideal; 23% gained <15 lbs; 31% 15-25; 46% >25 lbs

Evaluation of Gestational Weight Gain Guidelines for Women with Normal Prepregnancy BMI

DeVader SR Obstet Gynecol 2007;110:745

Table 2: Risk and Adjusted Odds Ratios for Women With Normal Prepregnancy Body Mass Index (18.5–24.9 kg/m²), by Gestational Weight Gain Category, Missouri Birth Certificates, 1990–2001

<table>
<thead>
<tr>
<th>Complications</th>
<th>Non-Null</th>
<th>Null</th>
<th>Adjusted OR</th>
<th>95% CI</th>
<th>Adjusted OR</th>
<th>95% CI</th>
<th>Adjusted OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnancy outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preterm</td>
<td>1.1</td>
<td>1.0</td>
<td>1.1</td>
<td>0.91</td>
<td>1.0</td>
<td>0.76</td>
<td>1.0</td>
<td>0.76</td>
</tr>
<tr>
<td>SGA</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>Labor</td>
<td>1.8</td>
<td>1.0</td>
<td>1.8</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Fetal distress</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>Failed induction</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>C-sec</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>LGA</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Gestational Weight Gain and Pregnancy Outcomes in Obese Women

DeVader SR Obstet Gynecol 2002;109:752

Class I BMI: 30-34.9; II BMI: 35-39.9; III BMI: ≥ 40

Class I ~15 lb ideal; 23% gained <15 lbs; 31% 15-25; 46% >25 lbs
BMI 35-39.9: 0-9 lbs optimal; SGA risk minimal without wt gain

BMI > 40: Wt LOSS 0-9 lbs optimal; SGA risk minimal

Optimal Gestational Weight Gain for BMI Categories

Table 1. Optimal Total Weight Gain in Pregnant Women by Prepregnancy Body Mass Index Based on Odds Ratios for Adverse Maternal and Fetal/Neonatal Outcomes for Different Maternal Weight Classes*
Optimal Gestational Weight Gain for BMI Categories

Optimal gestational weight gain ranges for the avoidance of adverse birth weight outcomes: a novel approach

Optimal Gestation Weight Gains with Avoidance of SGA/LGA

Large effect modification by Smoking and Parity
Systematic review of 35 highest quality studies drawn from report conducted for the Agency for Healthcare Research and Quality (AHRQ)

Strong support between excessive GWG and LGA

Strong support between inadequate wt gain and SGA

Only in normal or underweight women

Moderate support between GWG and postpartum weight retention

Overweight and obese women who gain below IOM recs do NOT have higher risk for SGA

AHRQ report will be used by IOM committee to reexamine guidelines


Associations of GWG with Short-and Longer-term Maternal and Child Outcomes


2012 mother-child pairs recruited 1999-2002 Project Viva

Lowest predicted prevalence of 5 adverse outcomes:

- NW GAIN 11.2 kg (+25 lbs)
- OW LOSS 1.2 kg (-3 lbs)
- Obese LOSS 7.6 kg (-17 lbs)

Optimal GWG for OW: -5 kg (<10% SGA/LGA)

Optimal GWG for Obese < 5 kg

Association of Maternal GWG with Short-and Long-term Maternal and Child Health Outcomes

Zilko CE, AJOG 2010;202:574

4496 children ages 14-22 in National Longitudinal Survey of Youth 1979

SGA, LGA, PP Wt Retention, Child Obesity, C-section according to 2009 IOM Guidelines
What Interventions are Effective to Minimize Excessive Weight Gain?

ACOG 2002: Moderate exercise (3-5 METS), ≥ 30 mins or more per day on most if not all days of week recommended for women with low risk pregnancies. Women at risk for preeclampsia or GDM should be even more active.

Diet + Physical Activity: Overall reduction in Mat Wt Gain ~1.4 kg (~3 lbs)

Diet studies alone: Reduction 3.8 kg (~8.5 lbs)
No difference in adherence to IOM Reqs.
Differences in BW, LGA, and SGA with Diet and Physical Activity in Pregnancy

Thangaratinam S, BMJ 2012;344

- Physical Activity BW by 63g
- N.S. SGA
- Trend to ↓ LGA
- Physical Activity

Differences in Maternal Outcomes with Diet and Physical Activity in Pregnancy

- Diet but not exercise ↓ Preeclampsia, GDM, Gest Htn, and PTD but not C-sec, IOL, or PP Hemorrhage

Differences in Neonatal Outcomes with Diet and Physical Activity in Pregnancy

- Diet ↓ IUD and Shoulder Dystocia

Fig 4: Mean difference in term weight gain with dietary and lifestyle interventions in pregnancy.

Fig 5: Relative risk of effects of weight management interventions in pregnancy on maternal outcomes.

Fig 6: Relative risk of effects of weight management interventions in pregnancy on birth and neonatal outcomes.
Regular Exercise During Pregnancy to Prevent Gestational Diabetes

Netherlands

555 Norwegian women (BMI ~25). Mod exercise for 45-60 mins at least 3 days/wk. Supervised 60 min training session once/wk. Only 55% of women followed the recommended protocol.

No effect of the Fitfor2 exercise programme on blood glucose, insulin sensitivity, and birthweight in pregnant women who were overweight and at risk for gestational diabetes: results of a randomised controlled trial. BMJ 2012

Conclusions from Meta-analysis and Health Technology Assessment (NIHR 2012;Vol 16: No.31)

Thangaratinam S

- Dietary Interventions are more effective than physical activity in reducing maternal weight gain, preeclampsia, GDM, gestational htn, and PTD
- Balanced diet of 18-24 cal/kg; low simple sugars, 50-55% carbohydrate, <30% fat, and 15-20% protein
- Low compliance with physical activity (30 mins walking, light intensity resistance and weight bearing exercises)
- Diet and Physical Activity does not increase SGA

Postpartum Wt Loss Interventions and Barriers Sarwer DB. J Women’s Health 2006;15:720

- Postpartum interventions slightly more effective with more weight loss
- Breastfeeding favorable in most studies but not all

Barriers
- Sleep deprivation (5 hrs vs 8 hrs) ↑ ghrelin and ↓ leptin by 15%
- Time constraints
- Lack of exercise
- Change in caloric intake, esp in women who breast feed
- Postpartum depression in 10-15%
Postpartum Weight Loss Interventions

- Lactation (exclusive/>6 mos) may ↓ PP wt but may not be sustained due to increase caloric intake. Baker JL Am J Clin Nutri 2008;88:1543; Wiltheiss GA J Acad Nutr Diet 2013;113:54
- Diet/physical activity interventions have small effect. Althuizen E BJOG 2013;120:92: Calorie reduction more effective than exercise
  - 12 wks diet and/or exercise in 68 obese or OW lactating Swedish women; 2.5 hrs behavior mod visits Berg F AM J Clin Nutr 2012;96:698
  - ↓ 8.3 kg diet; 2.4 exercise; 6.9 both; 0.7 control; sustained 1 yr
- One Iranian study (n=66 all lactating) used podometers at 6 wks-6 mos PP: 1.2 wk intervention
  - ↑ steps (3246→9960) and achieved 2 kg ↓ over 12 wks Maturi MS BMC Pregnancy and Childbirth 2011;11:103

Conclusions

- Most women do not follow IOM guidelines; ~50% gain more
- Excess wt gain correlates with PI, GDM, C-sec and postpartum weight retention
- Increasing data that infants born with excess adiposity have ↑ risk of childhood obesity and metabolic syndrome;
  - BMI, GWG, diet, TGs, glu, maternal insulin resistance are all risk factors
- B.W. and SGA related to wt gain in underwt and nl wt women but not in owert or obese women
- Obese women, especially BMI >35, do not appear to need to gain wt
- Diet interventions likely to be more successful antepartum to prevent excess GWG and postpartum to promote weight loss. Exercise safe and likely beneficial if compliance could be improved
- IOM needs to re-examine recommendations for overweight women and obese women with stratification of grades of obesity

Presenter’s Recommendations

- Lose wt before pregnancy; Pregravid BMI critical
- Bariatric surgery in mothers; ↓ risk of adverse maternal outcomes and childhood obesity in sibling pairs
- Stress Healthy Diet: ↓ fat and simple carbs
- Increasing data that high fat diet and high maternal TG and FFA is even a greater risk factor for excess fetal fat accretion and adverse metabolic offspring outcomes Catalano PM (BJOG 2011); Harmer K Diabetes Care 2011
- Exercise: Daily moderate activity
- Wt gain? Use diet to target lower range in IOM and consider no wt gain for BMI >35
  - BMI <20: No change in IOM guidelines (28-40 lbs)
  - BMI 20-25.9: 25 lbs
  - BMI 26-29.9: 15 lbs
  - BMI 30-33: No more than 10 lbs
  - BMI >35: No wt gain needed; avoid wt loss for now
- Stress long term effect of postpartum weight retention at 1 yr
Thank you