



Disclosures

- I have no financial relationships to disclose

Learning Objectives

1. Apply knowledge on the hormonal changes during pregnancy to effects on pregnancy weight gain
2. Describe the short and long term consequences of extremes of pregnancy weight gain to the mother and fetus
3. Identify clinical approaches to optimize appropriate pregnancy weight gain



Section 1
PHYSIOLOGY AND COMPOSITION OF PREGNANCY WEIGHT GAIN (PWG)

Physiology and Composition of Pregnancy Weight Gain (PWG)

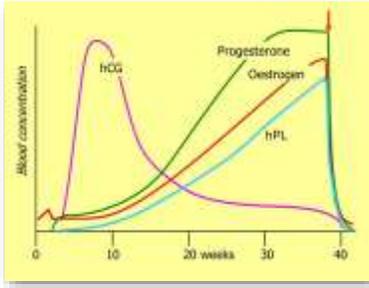
Hormonal Changes in Pregnancy and PWG

HCG, estrogen, and progesterone

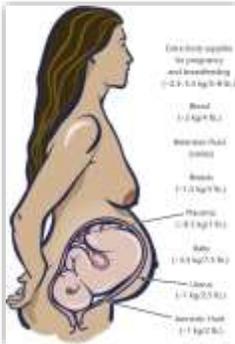
- Hyperemesis gravidarum
- Pyrosis (heartburn)

HPL – anti-insulin

- Increases insulin resistance and carbohydrate intolerance to ensure sufficient substrate for fetus
- Secretion parallels placental growth
- During starvation
 - chronic hypoglycemia → HPL → lipolysis and release of free fatty acids
 - ketones formed from free fatty acids can cross the placenta and be used by the fetus



How much is “baby weight”?



Appropriate PWG

1. Products of conception (placenta, amniotic fluid, and fetus) = 1/3 of GWG
2. Maternal tissue (Blood, uterus, mammary gland, fluid)
 - Water gain most highly variable - usually 7-8 liters
3. Fat deposition occurs mostly in first 20 weeks, mostly over abdomen, back, and upper thighs
 - Amount of fat gained dependent on pre-pregnancy BMI; obese women gain less fat
4. Protein for fetus depends on maternal intake (not from maternal stores)

Will I ever have my pre-baby body back?

Longitudinal changes in adiposity associated with pregnancy. The CARDIA Study. Coronary Artery Risk Development in Young Adults Study.

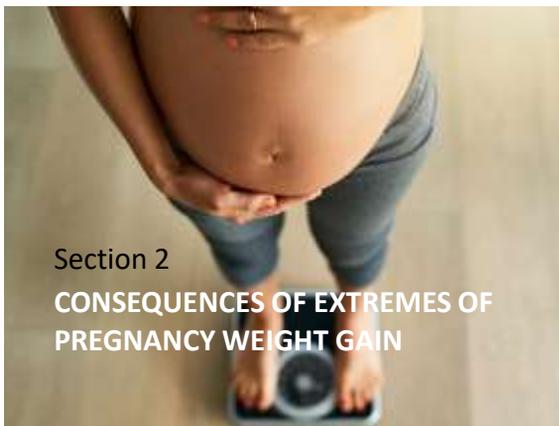
Conclusions:
The first pregnancy results in increases in body weight and fat distribution and these changes are persistent



(Smith, et. al., 1994)

Metabolic adjustments

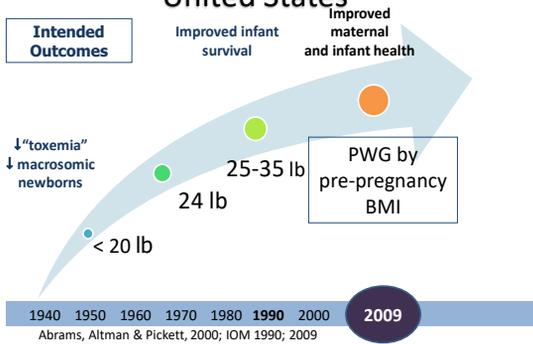
- Increased energy requirement most profound in second, third trimesters (300-400 kcal/day) and during lactation (400-500 kcal/day)
 - Women do not need to increase food intake in first trimester but need prenatal vitamins (that have folic acid)
- Increased need for rest – body is working!
- Increased total body fat overall but depends on TWG
 - ↑total plasma lipids in second half pregnancy
 - Overall pregnancy is associated with insulin resistance to ensure energy to fetus
- However, many women sustain a pregnancy with a successful outcome on less than the recommended energy intake



How much should she gain?



Pregnancy Weight Gain (PWG) in United States



IOM Total Weight Gain Guidelines During Pregnancy (2009)

Prepregnancy Body Mass Index (BMI)	TWG (pounds) for Singleton Pregnancies
Underweight Less than 18.5	28 - 40
Normal 18.5 – 24.9	25 - 35
Overweight 25- 29.9	15 - 25
Obese ≥ 30.0	≥ 11- 20

Definitions – Prepregnancy weight status

Measured with **pre-pregnancy body mass index (BMI)(kg/m²)**
 Calculated ratio of maternal height and weight **prior to pregnancy** in order to classify a woman as underweight, normal, overweight, or obese

Class	BMI
Underweight	<18.5
Healthy weight	18.5-24.9
Overweight	25-29.9
Obese Class I	30-34.9
Obese Class II	35-39.9
Obese Class III, Extreme obesity	40-50
“Superobese”	>50

Prepregnancy extreme obesity

- **Problem:** 2009 IOM Guidelines not stratified by the severity of obesity and pregnancy and newborn complications increase further in higher categories of obesity
- 10 such studies (n=740,000) obese women from three countries (United States, Sweden, and Germany) looked at outcomes of SGA, LGA, and CD
 - concluded that that PWG guidelines may need modification for the severity of obesity
 - lowest combined risk was with weight gain of:
 - 5–9 kg in women with class I obesity
 - 1 to less than 5 kg for class II obesity
 - no pregnancy weight gain for women with class III obesity

Faucher & Barger, 2015

Prepregnancy extreme obesity

- **Problem:** 2009 IOM Guidelines not stratified by the severity of obesity and pregnancy and newborn complications increase further in higher categories of obesity
- Another review and meta-analysis (n=18) reported that women in higher obese categories who gained less than the IOM guidelines were less likely to have
 - GHTN, pre-eclampsia, cesarean delivery, and fewer LGA infants than obese women who gained within the guidelines
- **In summary, it appears that women in more severely obese categories can safely gain less than the IOM guidelines or even gain minimally overall**

Kapadia et. al, 2015

Effects of PWG: Fetal Impact

Inadequate GWG

- Increased PTB and LBW esp. in UW and normal BMI
- Possible ↑ stillbirth in women with UW pre-pregnancy BMI
- NND - UW and normal BMI women, 3-4 X risk than if higher GWG
 - OW women, 2X greater risk
- Childhood asthma – possible association
- ↑ central obesity, insulin resistance, metabolic syndrome as adults

Excessive GWG

- More LGA infants (>4000 or > 4500)
- Childhood OW and obesity
- Possible association with acute lymphocytic leukemia, breast CA, and ADHD

Chen, et al., 2009; IOM, 2009; Oken et al., 2007; Oken et al., 2008; Wrotniak, et al. 2008

Effects of PWG: Maternal Impact

Inadequate PWG

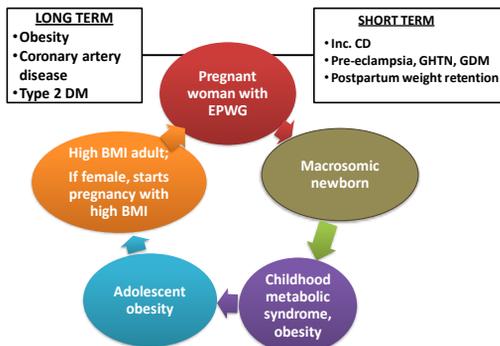
- More failure to initiate breastfeeding and if initiated, shorter duration

Excessive PWG

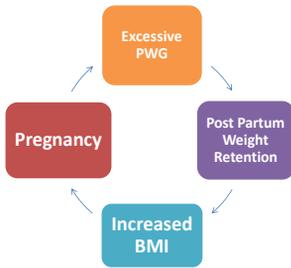
- ↑ CD (strong association)
- Strong association with PP weight retention in immediate and longer term PP periods
- ? Longer labor duration
- ? Association with GHTN
- ? Association with GDM; possibly more so if high PWG in first trimester

IOM, 2009; Hedderson, et al., 2010

Intergenerational Effects of Excessive PWG



Contribution of Pregnancy to Obesity in Women



The most important predictors of long-term weight gain and higher BMIs 10-15 yr after pregnancy were:

1. Excess weight gain during pregnancy
2. Failure to lose pregnancy weight gain in first 6 months postpartum
 - Low-income Afr-Am & Latinas > whites

Rooney & Schauburger, 2002; Rooney, et al, 2005

Factors Associated with Postpartum Weight Retention

SES → built environment, access to services and resources

- Pre-pregnancy BMI
- PWG
- Pregnancy complications
- Mode of delivery
- Delivery complications
- Infant feeding
- Maternal diet
- Physical activity
- Sleep
- Contraception
- Pregnancy spacing
- Cultural beliefs
- Social support
- Mental health

Postpartum Weight Retention

- Women of higher SES retain less PP weight than of lower SES (Shrewsbury, et al, 2009)
- Hispanic and AA less likely to lose pregnancy-related weight than NHW (Boardley, 1995; Walker, et al 2004)
- Hispanic women may even be more likely to gain weight gain beginning after 6 weeks PP (Walker, 2004)

Does the Pattern of Postpartum Weight Change Differ According to Pregravid Body Size?

OBJECTIVES: To examine differences in the pattern of weight changes during and after pregnancy among four pregravid body mass index (BMI) groups

STUDY DESIGN: Prospective cohort study of multi-ethnic women (n=985) who had **two consecutive births** at the UCSF between 1980 and 1990

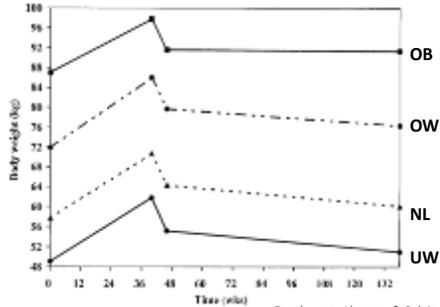
Gunderson, Abrams, & Selvin, 2001

Does the Pattern of Postpartum Weight Change Differ According to Pregravid Body Size?

MEASUREMENTS:

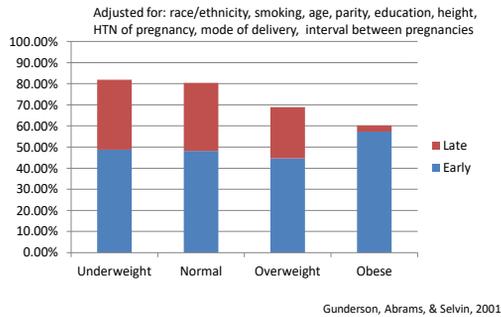
1. Net gestational gain
2. Early net postpartum weight change (6-week PP)
3. Late postpartum weight change (pregravid weight at the second pregnancy minus 6-week PP weight)

Patterns of Maternal Weight Changes from Preconception Through Gestation and Early and Late Postpartum Periods According to Pregravid BMI



Gunderson, Abrams, & Selvin, 2001

Percentage of Net Gestational Gain Lost During Early & Late PP Periods by Pregravid BMI



Results

- **Obese women**
 - Lowest net gain during pregnancy - 11.5 vs. 14.0 kg for the overweight women
 - Smallest (-0.3 kg) late PP weight loss compared with other BMI groups.
- **Early** net postpartum weight loss was similar for all groups; (13.9 -14.5 lb)
- Pattern of weight changes during and after the index pregnancy differed according to pregravid body size
 - UW and normal women gained more weight during pregnancy and **continued to lose weight** over the late postpartum period,
 - OW and obese women had **diminished late PP weight loss**

Gunderson, Abrams, & Selvin, 2001

Conclusions

- Early net PP weight changes do not differ by pregravid BMI group
 - Early wt loss is determined by reversal of physiological processes of pregnancy and represents mostly loss of non-adipose tissue
- Late PP weight changes varied greatly by pregravid BMI group
 - Late PP wt loss represents an alteration in body fat stores

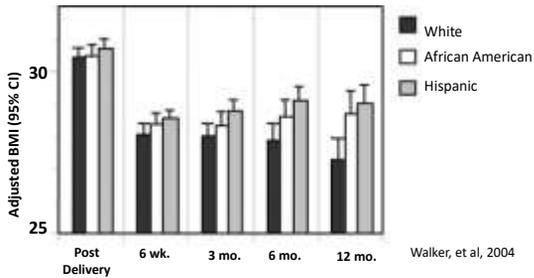
Gunderson, Abrams, & Selvin, 2001

Weight and Behavioral and Psychosocial Factors Among Ethnically Diverse, Low-Income Women After Childbirth

- Austin New Mothers Study - longitudinal study of low-income, tri-ethnic sample of PP women that incorporated serial assessment of weight and behavioral and psychosocial variables
- **Method:** Postpartum BMI was measured prospectively (post-delivery, 6 weeks, and 3, 6, and 12 months postpartum).
- 382 White, African American, and Hispanic women

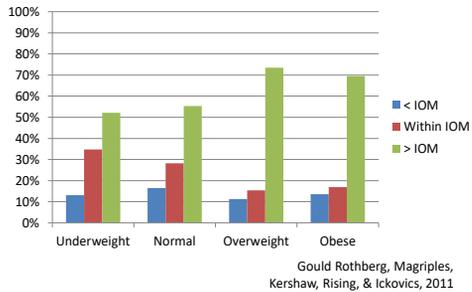
Walker, et al. 2004

Results



Walker, et al, 2004
 What is the postpartum weight change for White women?
 What is the postpartum weight change for AA women? For Hispanic women?

Pregnancy Weight Gain among young, low-income, ethnic minority women (n=427)



Gould Rothberg, Magriples, Kershaw, Rising, & Ickovics, 2011



Strategies to Assist
Women to Achieve Recommended Gain



1. Behavioral interventions
2. Counseling/education
3. Weight monitoring
4. Provider advice

Behavioral Interventions:
Dietary and Physical Activity

- **Can PWG be modified by an intervention combining dietary counseling and physical activity?**
 - **9 studies:** 4 RCTs and 5 nonrandomized trials (n=1549)
 - 3 trials included only OW or obese women
 - All studies used diet and physical activity(PA) interventions and weight monitoring
 - **Result:** Meta-analysis of all 9 trials indicated lower GWG in intervention groups ($P = 0.01$)

Strelung, Beyerlein, & von Kries, 2010

Behavioral Interventions

Physical Activity

- Exercise recommended via written and verbal
- Group exercise/walking as part of PNC
- Aqua aerobics
- Pedometer to monitor

Diet

- Nutrition counseling by a dietician
- Dietary information provided (groups or individual)
- Self-monitoring materials e.g. food diary, GWG chart

Streuling, Beyerlein, and von Kries, 2010.

Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: A randomized controlled trial (Asbee, 2009)

Sample ethnicity (n) Beginning of Intervention	Physical Activity	Dietary	Additional Rx	Control vs. Intervention	Reported P
U.S. multiethnic; Mostly Hisp and AA (n=100); BMI < 40 6-16 wk GA	Moderate exercising for 3-5 times/wk	Nutrition counseling by dietitian at 1 st visit, diet to contain 40% CHO, 30% prot, 30% fat	Information re: IOM GWG guidelines given; weight measured at each visit, body weight compared with guidelines and intervention adapted	16.2 lb Vs. 13.0 lb	0.01

Weight gain restriction for obese pregnant women: a case-control intervention study (Claesson, 2008)

Sample ethnicity (n) Beginning of Intervention	Physical Activity	Dietary	Additional Rx	Control vs. Intervention	Reported P
Swedish speaking with BMI ≥30 (n=348) Early pregnancy (week 10-12 GA)	Aqua aerobics designed for obese women, once or twice a week	Information about nutrition during pregnancy	Motivational talk/interview; weekly weight control and supportive talk; women who lacked sufficient knowledge, were offered information about diet, PA, and GWG	11.3 lb Vs. 8.7 lb	<0.001

Preventing Excessive Weight Gain in Pregnancy: How Do Prenatal Care Providers Approach Counseling?

- Focus groups of OB/GYNs, NPs, and CNMs
- Discussed barriers to weight gain counseling
 - Providers, especially the physicians, reported that they lacked knowledge and training about nutrition and weight management issues
 - Uncertainty, doubt about counseling effectiveness
 - Sensitivity of topic; fear of shaming or causing anxiety
 - Reactive approach (e.g. wait for the patient to bring up topic); identified lack of baseline assessment tools

Stotland, Gilbert, Bogatz, Harper, Abrams, & Gerbert, 2010

Provider Advice

- White, middle class women (n=2237) surveyed re: provider advice in pregnancy (Cogswell, Scanlon, Fein, & Schieve, 1999)
 - 27% received no advice about weight gain
 - Of those receiving advice, 22% were told to gain more than the guidelines recommended
- Multi-center study in SF Bay area (Stotland, et al, 2005)
 - 1/3 of women reported receiving no advice on GWG and overweight women were told to gain more than IOM guidelines
- National survey of OB- GYNs
 - Only 36% of respondents modified GWG counseling based on pre-pregnancy BMI (Power, Cogswell, & Schulkin, 2006)

Provider Advice

- In Hispanic women in Los Angeles, 18.8% of the women did not recall any discussions about PWG with health-care providers during pregnancy
- Among those who had such discussions,
 - only 42% reported receiving weight gain advice within the IOM Guidelines
 - 16.5% below guidelines, and 10% above
- The other women (13.5%) who reported having the discussion did not recall the recommended weight gain amount
- Compared with women who received accurate advice on PWG, women who reported advice
 - below IOM guidelines 1.7 times more likely to gain less than the recommended amount
 - above IOM guidelines were 2.0 times more likely to gain excessive PWG

Liu, et. al., 2016

Weight Monitoring

- **Does regular self- weighing decrease excessive PWG?**
- **Intervention:** RCT in which participants (n=236) recorded own weight at 16, 20, 24, 28, 30, 32 and 34 weeks' GA, using either a tabular or graphical format provided on personalized weight- measurement cards
- **Results:**
- Intervention group - 0.96 lb per-week weight gain vs. Control group -1.01 lb /week (NS)
- **However-** Intervention significantly reduced pregnancy weight gain in the group of women who were **overweight** but not obese at recruitment
 - Intervention group (20 OW women) gained 0.92 lb/week and the control group (18 women) gained 1.2 lb /week ($P=0.01$)

Jeffries, Shub, Walker, Hiscock & Permezel, 2009

Strategies for Optimizing PWG

- Document weight, height, and BMI at the first prenatal visit
- Educate patients about their BMI and set goals for weight gain during the pregnancy
- Provide nutritional counseling tailored for pregnancy, level of BMI, weight gain goals, and ethnic preferences
- Educate and set goals for activity during pregnancy
- Individualize prenatal visits pending adherence to weight gain goals.
- Discuss weight at each prenatal visit. Increase frequency of visits for women exceeding their goals and repeat nutritional counseling as needed.

Olson & Blackwell, 2011
