

Maternal Obesity and Pregnancy Outcomes

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Workshop C1
1:15pm-2:15pm
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Obesity Defined

- BMI ≥ 30 kg/m³
- BMI correlates best with body fat mass
- Increasing severity of class of obesity correlates with greater risks for adverse pregnancy outcomes
- Waist circumference >88 cm or 35 inches
 - Indicator of central obesity
 - Identifies women with higher risk for cardiovascular disease and metabolic disorders

World Health Organization

- Obesity is “one of the most blatantly visible, yet neglected, public-health problems that threatens to overwhelm both more and less developed countries”

World Health Organization

- Predictions for 2015:
 - 2.3 billion adults will be overweight
 - 700 million will be obese

International Obesity Taskforce

- At least 1.1 billion overweight adults worldwide
 - 312 million are obese
 - At all ages and throughout the world, women have higher mean BMI and higher rates of obesity than men for biological reasons

United States

- Recent 40% increase in prevalence of women who are in the overweight and obese categories prior to pregnancy
- Over 10 years, there has been a 36% increase in obesity at the time of delivery
- One in seven cesarean deliveries in 2001 were secondary to obesity complications (LaCoursiere et al.)

United States

- U.S. National 2007-2008 survey
 - Evaluated the obesity prevalence in all women >20 years old
 - Class I, 36%
 - Class II, 18%
 - Class III, 7%
- Public health concern, as 63% of the above women are in reproductive years

Obesity Trends Among U.S. Adults Between 1985 and 2010

- The data shown in the following maps are from the CDC website
- Behavioral Risk Factor Surveillance System (BRFSS)
- Each year, state health departments use standard procedures to collect data through a series of telephone interviews with U.S. adults. Height and weight data are self-reported.

Obesity Trends Among U.S. Adults BRFSS, 1990, 2000, 2010

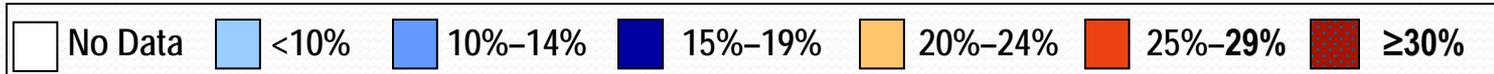
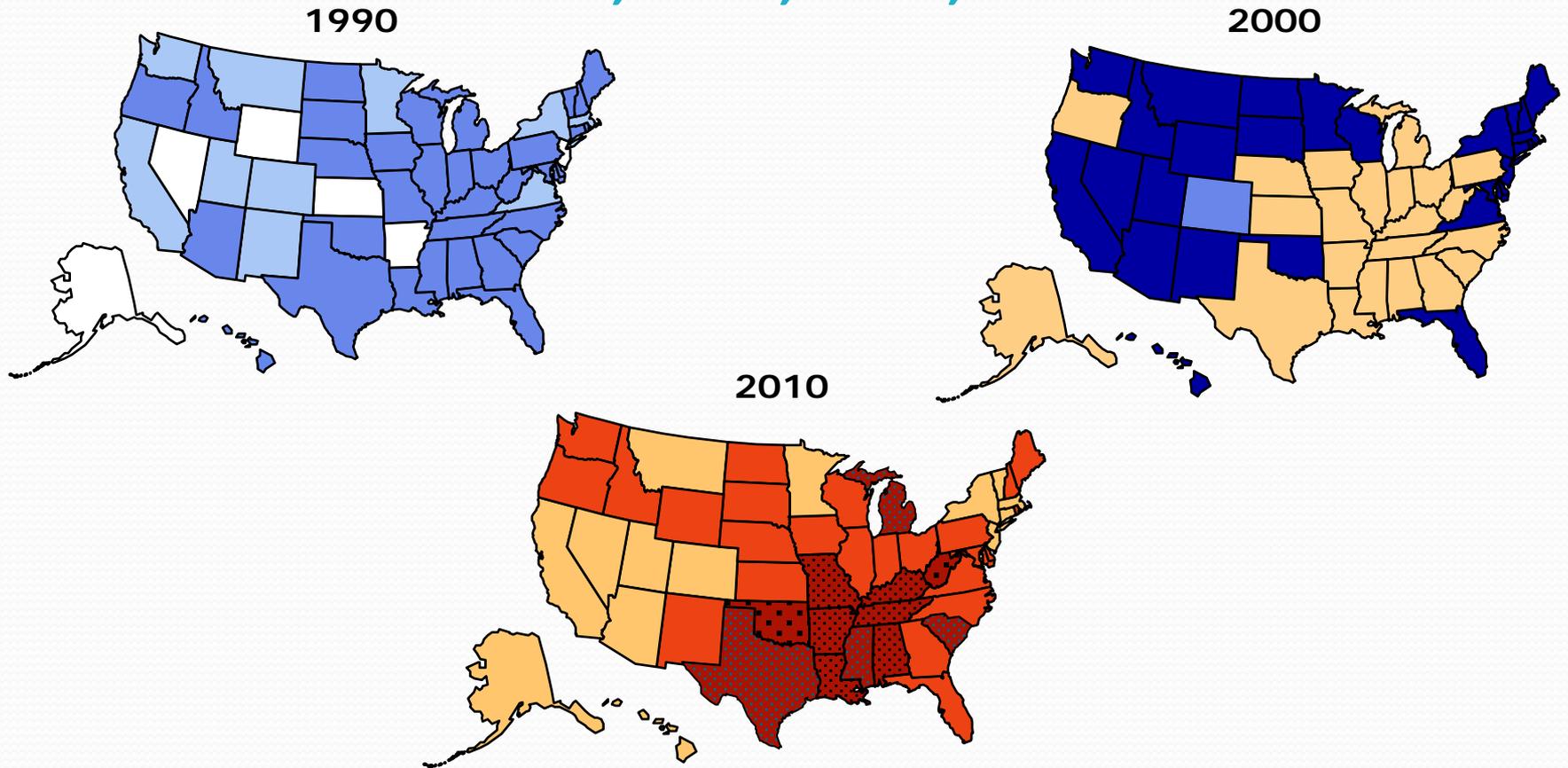


TABLE 2-1 Distribution of BMI (World Health Organization categories) from 1976 to 2004 Among U.S. Nonpregnant Women 12 to 44 Years of Age by Race or Ethnicity and Age (percentage)

	1976-1980	1988-1994	1999-2004
<i>Total (%)</i>			
Underweight	6.0	4.4	3.5
Normal weight	62.1	53.4	41.1
Overweight	18.8	20.8	25.3
Class I obese	7.9	12.2	15.8
Class II obese	3.5	6.0	7.7
Class III obese	1.7	3.4	6.5
<i>By Race or Ethnicity</i>			
<i>Non-Hispanic white (%)</i>			
Underweight	6.3	4.7	4.3
Normal weight	64.2	58.3	46.4
Overweight	17.9	18.4	23.3
Class I obese	7.2	10.5	13.8
Class II obese	2.9	5.3	6.9
Class III obese	1.5	2.8	5.3
<i>Non-Hispanic black (%)</i>			
Underweight	3.9	2.7	— ^a
Normal weight	47.8	37.3	23.4
Overweight	24.4	27.7	25.7
Class I obese	13.3	15.8	23.7
Class II obese	7.3	9.7	12.2
Class III obese	— ^a	6.8	13.3

Secular trends of mean BMI in pregnant nulliparous women

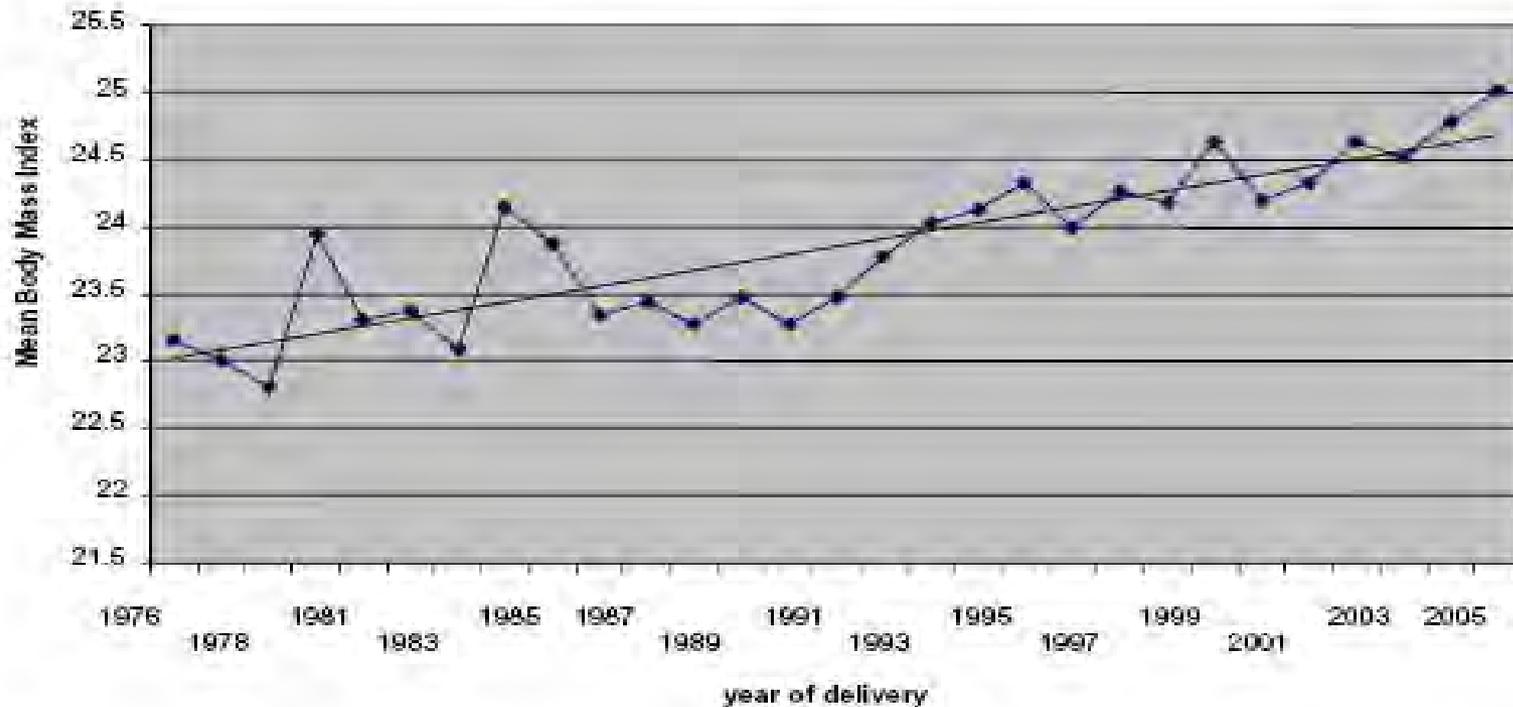


Figure 1
Trends in mean BMI, Aberdeen city & district 1976–2005.

Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies *BMC Public Health* 2007, 7:168

Shows the increasing trends in the prevalence of obesity in the study population over time.

WHO Classification of Weight According to BMI

Classification	BMI (kg/m ²)
Underweight	<18.5
Normal range	18.5–24.9
Overweight	25.0–30.0
Obese	≥30.0
Obese class I	30.0–34.9
Obese class II	35.0–39.9
Obese class III	≥40.0

Table 3.3 Health Risks Associated with Obesity

- Premature death
 - Type 2 diabetes
 - Metabolic syndrome
 - Heart disease
 - Stroke
 - Hypertension
 - Gallbladder disease
 - Sleep apnea
 - Depression
 - Cancer
 - High cholesterol
 - Hirsutism
 - Stress incontinence
 - Surgical risk
 - Osteoarthritis
 - Asthma
 - Social stigma
-

Institute of Medicine (IOM) Guidelines for Weight Gain in Pregnancy

- Updated in May, 2009
- Considered the welfare of both the fetus and mother
- Recommended weight gain categories based on pre-pregnancy BMI

IOM Guidelines

TABLE 1 NEW RECOMMENDATIONS FOR TOTAL AND RATE OF WEIGHT GAIN DURING PREGNANCY, BY PREPREGNANCY BMI

Prepregnancy BMI	BMI ⁺ (kg/m ²) (WHO)	Total Weight Gain Range (lbs)	Rates of Weight Gain* 2nd and 3rd Trimester (Mean Range in lbs/wk)
Underweight	<18.5	28–40	1 (1–1.3)
Normal weight	18.5–24.9	25–35	1 (0.8–1)
Overweight	25.0–29.9	15–25	0.6 (0.5–0.7)
Obese (includes all classes)	≥30.0	11–20	0.5 (0.4–0.6)

+ To calculate BMI go to www.nhlbisupport.com/bmi/

* Calculations assume a 0.5–2 kg (1.1–4.4 lbs) weight gain in the first trimester (based on Siega-Riz et al., 1994; Abrams et al., 1995; Carmichael et al., 1997)

IOM Guidelines: Twins and Weight Gain

- Normal BMI: 37-54 pounds
- Overweight: 31-50 pounds
- Obese: 25-42

Pregnancy Complications

- The higher the pre-pregnancy BMI, the higher the chance of complications
- Increased risk for congenital birth defects
 - Heart defects
 - Conotruncal defects, total anomalous pulmonary venous return, hypoplastic left heart syndrome, right ventricular outflow tract defects, and septal defects
 - Preconception or antenatal vitamin use did not reduce risk for CHD in the overweight and obese populations (Watkins et al.)

Pregnancy Complications

- Pre-pregnancy BMI ≥ 30 increased risk for other defects
 - Hypospadias
 - Cystic kidney
 - Pes equinovarus
 - Omphalocele
 - Diaphragmatic hernia
- Higher rate of anomalies persists in obese women even after controlling for diabetes (Bloomberg et al).

Pregnancy Complications

- Increased risk for stillbirth is 2.1 – 4.3-fold greater in obese compared with normal weight women (ACOG practice bulletin #105)
- Increased risk for large for gestational age and macrosomic infants (Larsen CE et al, and Bianco AT et al.)
- Each 1-unit increase in pregravid BMI (5 lb) increases the risk of cesarean delivery by about 7% (Brost et al.)

FASTER Trial

- First and Second Trimester Evaluation of Risk (FASTER)
- National Institute of Child Health and Human Development (NICHD) sponsored study
- A total of 16,102 records with complete antenatal, birth, and pediatric outcomes were available for review at the time this analysis was performed.
 - Control group = 13,752 (85%) patients
 - Obese group = 1,473 (9%) patients
 - Morbidly obese group = 877 (6%) patients

Weiss and Colleagues

Table III Obstetric complications by maternal BMI

Outcome	Obese vs control		Morbidly obese vs control	
	Adjusted OR (95% CI)	<i>P</i> -value	Adjusted OR (95% CI)	<i>P</i> -value
Gestational diabetes	2.6 (2.1-3.4)	<.0001	4.0 (3.1-5.2)	<.01
Gestational hypertension	2.5 (2.1-3.0)	<.0001	3.2 (2.6-4.0)	<.01
Preeclampsia	1.6 (1.1-2.25)	.007	3.3 (2.4-4.5)	<.01
Birth weight >4500 g	2.0 (1.4-3.0)	.0006	2.4 (1.5-3.8)	<.01
Birth weight >4000 g	1.7 (1.4-2.0)	<.0001	1.9 (1.5-2.3)	<.01
Preterm delivery	1.1 (0.9-1.5)	.4	1.5 (1.1-2.1)	.01
Operative vaginal delivery	1.0 (0.8-1.3)	.9	1.7 (1.2-2.2)	<.01
PPROM	1.3 (0.9-2.0)	.14	1.3 (0.8-2.2)	.2
IUGR	0.9 (0.5-1.6)	.82	0.8 (0.4-1.8)	.6
Placenta previa	1.3 (0.7-2.5)	.4	0.7 (0.3-2.0)	.6
Placental abruption	1.0 (0.6-1.9)	.9	1.0 (0.5-2.2)	.9

Weiss and Colleagues

Table V Cesarean delivery rate among nulliparous patients

	Cesarean delivery	OR (95% CI)	<i>P</i> -value
Overall	22.7%	—	—
Control	20.7%	—	—
Obese	33.8%	1.7 (1.4-2.2)	<.01
Morbidly obese	47.4%	3.0 (2.2-4.0)	<.01

Gastric Bypass

- Candidates
 - Women with BMI >40 or BMI >35 with comorbid conditions
 - Failure of previous interventions such as diet, physical activity, possible drug therapy and and behavior modification
- Prenatal concern due to more patients with history of gastric bypass becoming pregnant
- In 2008, more than 200,000 patients had bariatric surgery
 - At least $\frac{1}{2}$ of them were women of reproductive age (Stellato, TA)

Gastric Bypass

- Post-operative benefits
 - Sleep apnea may resolve
 - Cancer death rate may be reduced
 - Improvement in fertility and pregnancy outcomes
- Recommend delaying pregnancy until weight loss has stabilized
- Some experts recommend 12-18 months

Gastric Bypass

- Bariatric-related operative complications may be delayed during pregnancy
 - Anasotmotic leaks, bowel obstructions, internal hernias, ventral hernias, band erosion and band migration
 - Dumping syndrome
- Pregnant patients with signs and symptoms of intestinal obstruction, perforation, or hemorrhage
- May be difficult to determine if symptoms are pregnancy related
 - CT scan recommended to establish diagnosis since this can be associated with 20% maternal mortality

Diabetes: Gestational and Pre-existing

- Recommendations for increased frequency of antenatal testing
- Monthly HbA_{1c} levels
- Fasting and 2-hour post-prandial blood glucose monitoring
- Risk increases for large fetuses
 - Labor dystocia and cesarean delivery increased in these populations
- A scheduled cesarean at 39 weeks should be planned if the estimated fetal weight is >4500 in a diabetic patient and >5000 in a nondiabetic obese patient

Fetal Macrosomia

- Prepregnancy obesity is an independent risk factor for large for gestational age (LGA) fetuses and macrosomia
- Prepregnancy BMI correlated with increasing categories of obesity and gestational weight gain
- Macrosomic fetuses
 - Increased for childhood obesity and adult metabolic syndrome
- Excessive weight gain during pregnancy can increase the risk of macrosomia by 30%.
- Incidence of shoulder dystocia cannot be clearly defined, as some reports indicate higher incidence and some report no difference in obese versus non-obese populations.

Sleep Apnea

- Prevalence of obstructive sleep apnea among women is estimated to be 2-5%
- Remains underdiagnosed
- Major risk factor for development of OSA is obesity
 - Higher incidence with neck circumference >38 cm
- Some case reports have identified a link between OSA and preeclampsia, IUGR, and stillbirth.

Sleep Apnea

- OSA (n=57) patients compared with normal weight non-OSA controls (n = 114) by Louis et al:
 - OSA group confirmed with polysomnogram
 - More preeclampsia (19.3% vs 7.0%; P = 0.02)
 - More preterm birth (29.8% vs 12.3%; P=0.007)
 - Increasing indicated PTB due to preeclampsia in OSA group

Difficulty with Prenatal Diagnosis

- Ultrasonography for detection of anomalies can be limited with increasing severity of obesity
- Detection rate with standard ultrasonography
 - Normal BMI = 66%
 - Overweight = 49%
 - Class I = 48%
 - Class II = 42%
 - Class III = 25%
- Detection rate with targeted ultrasonography
 - Normal BMI = 97%
 - Overweight = 91%
 - Class I = 75%
 - Class II = 88%
 - Class III = 75%

Obesity Associated Costs

- Chu and colleagues evaluated costs associated with Obesity
- Electronic data systems of a large U.S. group-practice health maintenance organization to identify 13,442 pregnancies among women 18 years of age or older at the time of conception that resulted in live births or stillbirths.
- The primary outcome was the mean length of hospital stay for delivery.

Obesity Associated Costs

- **Results**
- Patient population was adjusted for age, race or ethnic group, level of education, and parity
- Mean length of hospital stay for delivery was significantly ($P < 0.05$) greater among women who were overweight (3.7 ± 0.1 days), obese (4.0 ± 0.1 days), very obese (4.1 ± 0.1 days), and extremely obese (4.4 ± 0.1 days) than among women with normal BMI (3.6 ± 0.1 days).

Obesity Associated Costs

- A higher-than-normal BMI was associated with significantly more prenatal fetal tests
 - Obstetrical ultrasonographic examinations
 - Medications dispensed from the outpatient pharmacy
 - Telephone calls to the department of obstetrics and gynecology
 - Prenatal visits with physicians.
 - Fewer prenatal visits with nurse practitioners and physician assistants
 - Most of the increase in length of stay associated with higher BMI was related to increased rates of cesarean delivery and obesity-related high-risk conditions.

Table 4. Number of Prenatal Tests, Medications, and Visits with Health Care Providers According to Maternal Body-Mass Index and Presence or Absence of a High-Risk Condition.*

Variable	Underweight, BMI <18.5 (N= 259)	Normal, BMI 18.5–24.9 (N= 6091)	Overweight, BMI 25.0–29.9 (N= 3634)	Obese, BMI 30.0–34.9 (N= 1848)	Very Obese, BMI 35.0–39.9 (N= 918)	Extremely Obese, BMI ≥40.0 (N= 692)
	<i>number</i>					
Fetal tests						
All pregnancies	1.3±0.3	1.6±0.1	1.8±0.1	2.1±0.1†	2.8±0.2†	3.8±0.2†
With high-risk condition	2.6±1.2	3.5±0.3	3.9±0.3	3.9±0.4	5.4±0.4†	6.4±0.4†
Without high-risk condition	1.3±0.2	1.3±0.1	1.3±0.1	1.4±0.1	1.4±0.1	1.7±0.2
Obstetrical ultrasonographic examinations						
All pregnancies	3.5±0.4	3.7±0.1	3.9±0.2	4.4±0.2†	5.4±0.2†	7.5±0.2†
With high-risk condition	6.2±1.7	6.6±0.5	7.0±0.5	7.1±0.5	9.2±0.6†	11.0±0.6†
Without high-risk condition	3.3±0.3	3.3±0.1	3.3±0.1	3.3±0.2	3.4±0.2	4.7±0.3†
Physician visits						
All pregnancies	4.3±0.3	4.4±0.1	4.6±0.1	4.8±0.1†	5.4±0.2†	6.0±0.2†
With high-risk condition	5.1±1.1	5.6±0.3	5.9±0.3	5.9±0.3	6.6±0.4†	7.6±0.4†
Without high-risk condition	4.3±0.3	4.2±0.1	4.4±0.1	4.4±0.2	4.8±0.2†	4.9±0.2†
Visits with nurse practitioner or physician assistant						
All pregnancies	5.0±0.3	4.9±0.1	4.8±0.1	4.6±0.1	4.5±0.2†	3.9±0.2†
With high-risk condition	3.9±0.9	4.1±0.2	4.1±0.2	3.6±0.2	3.6±0.3	3.2±0.3†
Without high-risk condition	5.1±0.3	5.0±0.1	4.9±0.1	4.9±0.2	4.9±0.2	4.3±0.2†
Medications dispensed from outpatient pharmacy‡						
All pregnancies	3.6±0.4	3.6±0.1	4.1±0.2†	4.9±0.2†	6.3±0.2†	7.7±0.3†
With high-risk condition	4.7±2.0	5.6±0.5	6.4±0.5	7.0±0.6†	9.9±0.6†	10.8±0.6†
Without high-risk condition	3.5±0.3	3.4±0.1	3.6±0.2	4.1±0.2†	4.5±0.2†	5.1±0.3†
Telephone calls to obstetrician-gynecologist						
All pregnancies	5.0±0.3	4.8±0.1	5.2±0.1†	5.4±0.1†	6.5±0.2†	7.0±0.2†
With high-risk condition	8.5±1.3	7.0±0.4	7.6±0.4	7.4±0.4	9.5±0.4†	9.5±0.4†
Without high-risk condition	4.7±0.3	4.5±0.1	4.6±0.1	4.7±0.1	5.1±0.2†	5.3±0.2†

* Plus–minus values are means ±SE. Means were adjusted for maternal age, race or ethnic group, education, and parity. Prenatal refers to the interval between the start of pregnancy and admission to the hospital for delivery. High-risk conditions during pregnancy were preexisting diabetes mellitus, gestational diabetes mellitus, and hypertensive disorders, as reported on the electronic medical record or the birth certificate.

† P<0.05 for the comparison with women of normal weight.

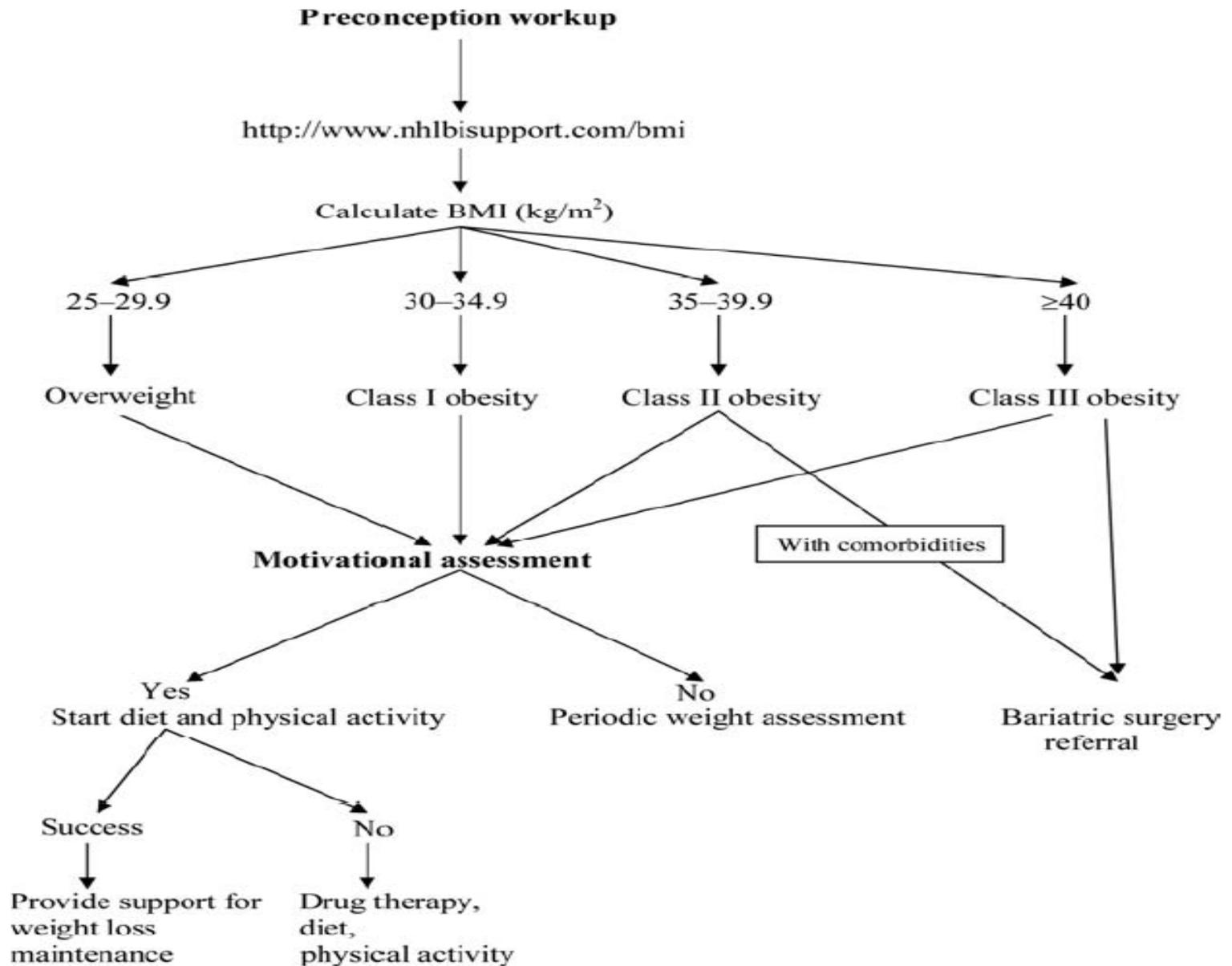
‡ For women in all categories of body-mass index, the most commonly dispensed medications were antibiotics, narcotics, antiemetics, antidepressants, antiasthmatics, and cough-and-cold preparations. The single exception was insulin, which was the second most frequently used medication among very obese and extremely obese women but was not commonly used by women in other categories.

Preconceptual Counseling

- Identification and awareness by both patient and health care worker of obesity is the first step in prevention of complications and appropriate management.
- BMI category should be reviewed with patient
- Discussion about obesity related comorbid conditions and outcomes with patient

Preconceptual Counseling

- Women with BMI 40 or 35 with comorbidities are candidates for bariatric surgery in the preconception period
- Incidences of gestational diabetes and hypertension are reduced after gastric bypass surgery, especially if BMI is back to less than obese levels.
- Pregnant patients with bariatric surgery can be started on vitamin B₁₂, folate, iron, and calcium if deficient.



Interventions During Pregnancy

- Encouraging nutrition consultation during pregnancy
- Enforcing new Institute of Medicine guidelines for weight gain in pregnancy
- BMI at first visit with documentation of pre-pregnancy BMI to assess risk
- Discuss known risks of obesity with patient
- Recommend exercise if no pregnancy contraindications

Post-Partum

- Postpartum, women should be strongly encouraged and helped to return to a normal BMI
 - Counseling, diet, exercise, and breast-feeding.
- Breast feeding benefits mother and infant
 - Return faster to pre-pregnancy weight
 - Helps avoid weight retention
 - Decreases chronic disease
 - Type 2 DM, breast cancer, ovarian cancer
 - Infants who breastfeed have lower incidence of obesity

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