

# Maternal Obesity and Its Effect on Pregnancy Outcomes and Implications for the Postpartum Period

Anna Maria Siega-Riz

Associate Professor

Departments of Maternal and Child Health  
and Nutrition

School of Public Health

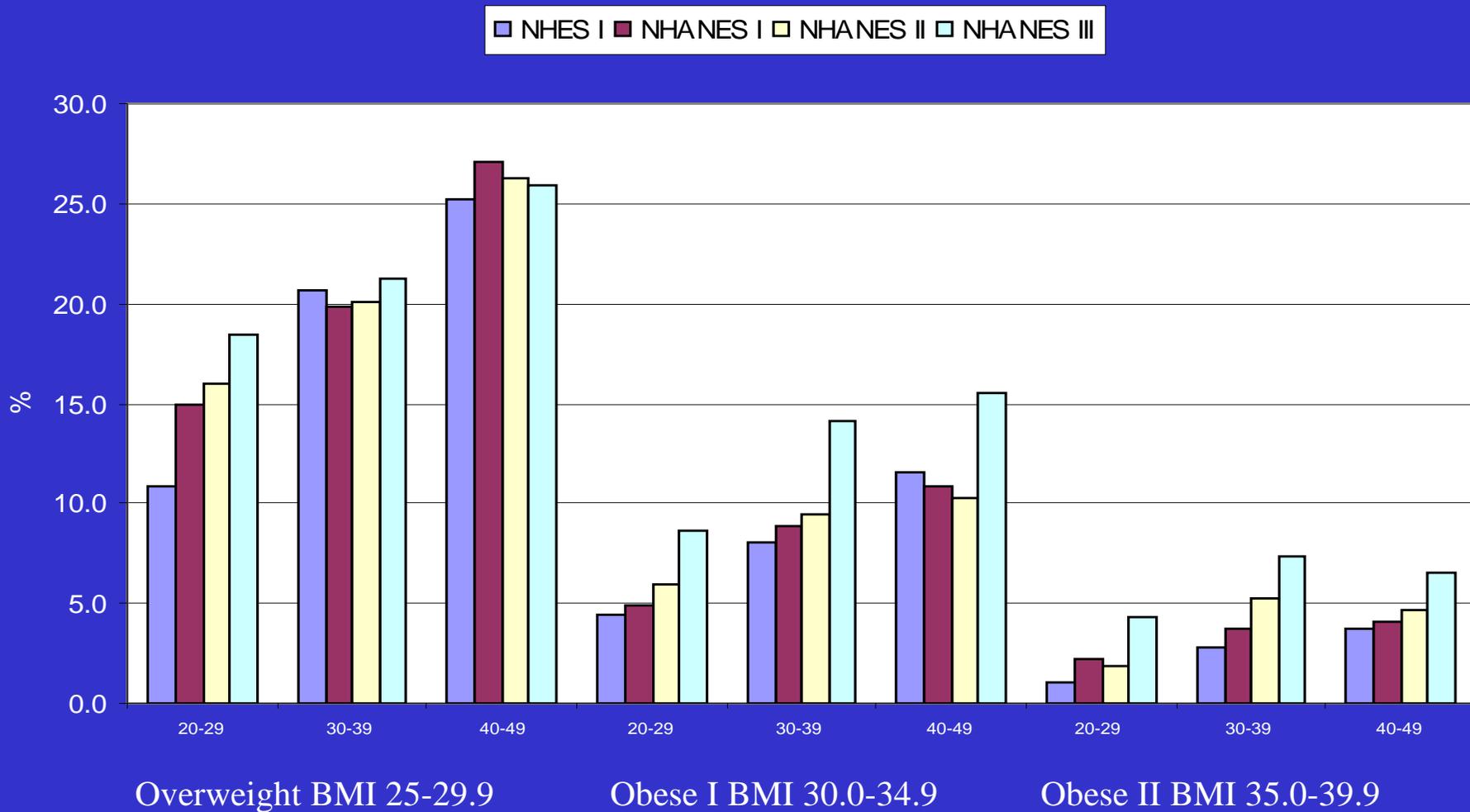


THE UNIVERSITY  
*of* NORTH CAROLINA  
*at* CHAPEL HILL

# Prevalence of Obesity in Women of Childbearing Age

- Obesity is a growing public health problem among women of childbearing age in the U.S.

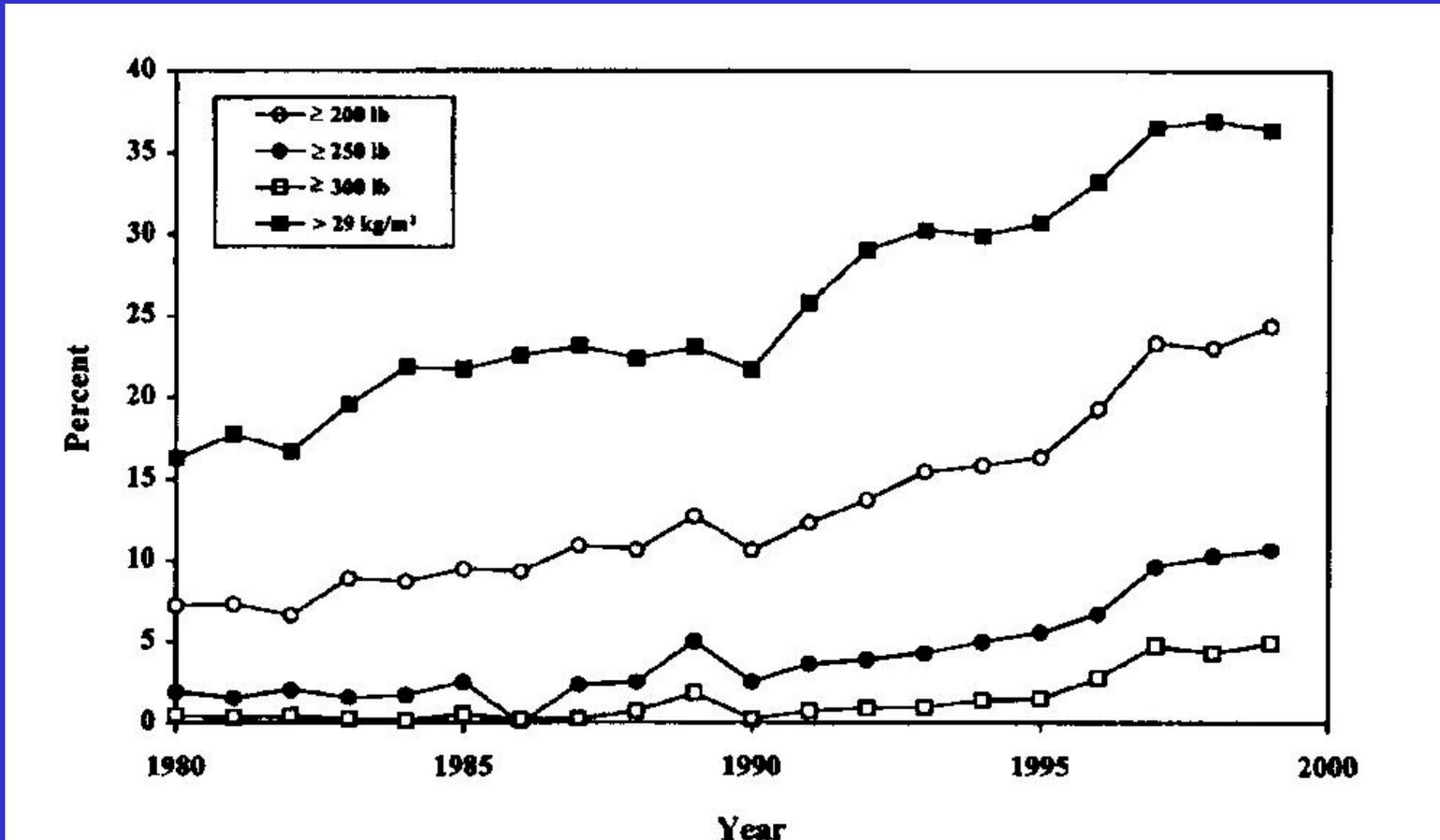
# Prevalence of overweight and obesity among women by age group and survey



# Prevalence of Obesity in Women of Childbearing Age

- Obesity is a growing public health problem among women of childbearing age in the U.S.
- Obesity rates by ethnic groups-African-American 38.9%, Hispanics 36.3%, compared to 23.7% for white women

# Prevalence of obesity at first prenatal visit: 1980-1999



Lu et al., Am J Ob GYN 2001

# Implications of Obesity on Maternal and Infant Health Status

## Independent of Pregnancy:

- Cardiovascular disease
- Type II diabetes
- Gallbladder disease
- Osteoarthritis
- Reduced fecundity and fertility

# Implications of Obesity on Maternal and Infant Health Status

## During Pregnancy:

- Gestational diabetes
- Gestational hypertension
- Preeclampsia
- Cesarean Delivery
- Fetal macrosomia
- Late fetal death
- Early neonatal death
- Thromboembolic Diseases
- Birth Defects

## Postpartum:

- Postpartum weight retention
- Anemia

# The Pregnancy, Infection, and Nutrition Study



©Pecoraro, EthnoGraphics®



# Data Collection

- Specimen collection-genital tract swabs, blood, and urine
- Ultrasound 24-29 wks
- Questionnaires (socio-demographic, food frequency, health habits, medical history, psychosocial, etc.)
- Birth outcome from delivery logs
- Medical Abstraction of pregnancy and intra-partum complications

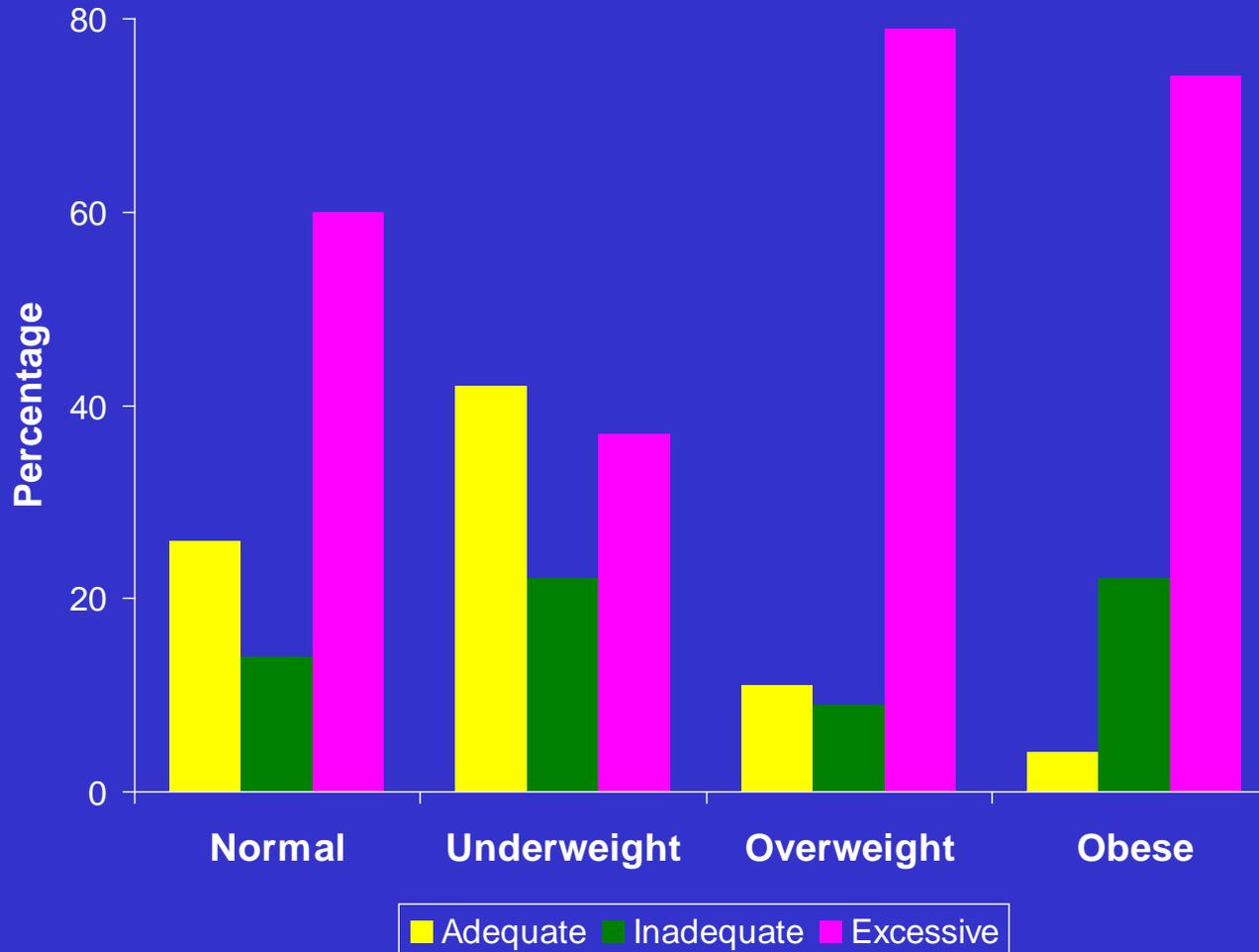


# Weight Gain



There needs to be a delicate balance between the benefits of weight gain for the infant versus the consequences of weight retention for the mother.

# Adequacy of Total Weight Gain Differs by Pre-pregnancy Weight Status



# Dietary Intake of Pregnant Women and Its Relation to Gestational Weight Gain

- Women who diet habitually prior to becoming pregnant gain more weight during pregnancy (Abrams 2001) and retain more weight postpartum (Baker 1999)
- Fewer restrained eaters experienced weight gains within the recommended range for their prepregnancy BMI compared to unrestrained eaters (Conway et al 1999)

# Differences by Pregravid BMI

- Fat gain during pregnancy
  - Underweight women who gained within the IOM recommendations put on 6.0 kg of fat while normal and overweight women put on 3.5 kg and obese women actually had a net loss of  $-0.6$  kg.

Lederman et al. *Obstet Gynecol* 1997;90:483-88

- Overweight women retain more weight than normal weight women (Ohlin & Rossner 1990)

# Physical Activity During the Postpartum Period

- Women who retained at least 5 kg at 1 yr postpartum were less active during their leisure time as compared to women who gained less than this amount.
- Among women who gained 10 kg postpartum, 23% were not active during leisure their time compared to 4% of the women who retained less weight.

# Birth Defects

- 17 studies reported in the literature since 1969
- 2 fold increased risk in NTD's for obese compared to normal weight women
- 2 to 6 fold increased risk for congenital heart defects



# Gestational Diabetes

- Gestational Diabetes (GDM): Carbohydrate intolerance that is first recognized in pregnancy, an established risk factor for poor pregnancy outcome.
  - 3-5% of women develop GDM in the US
- The prevalence of GDM may be rising in the US due to the increased number of obese women in their childbearing years.
- Women with GDM have a 30% chance of developing type 2 diabetes later in life.



# Glucose Screening Protocol

Universal Screen  
50 gram glucose Load

Negative

<140mg/dl at UNC clinics  
<130 mg/dl at Wake clinics

Positive

$\geq 140$ mg/dl at UNC clinics  
 $\geq 130$ mg/dl at Wake clinics

Oral Glucose Tolerance Test (OGTT)  
100 grams glucose

NGT

Normal Glucose  
Tolerant

IGT

1 high value

GDM

2 high value

*Carpenter & Coustan  
Criteria*

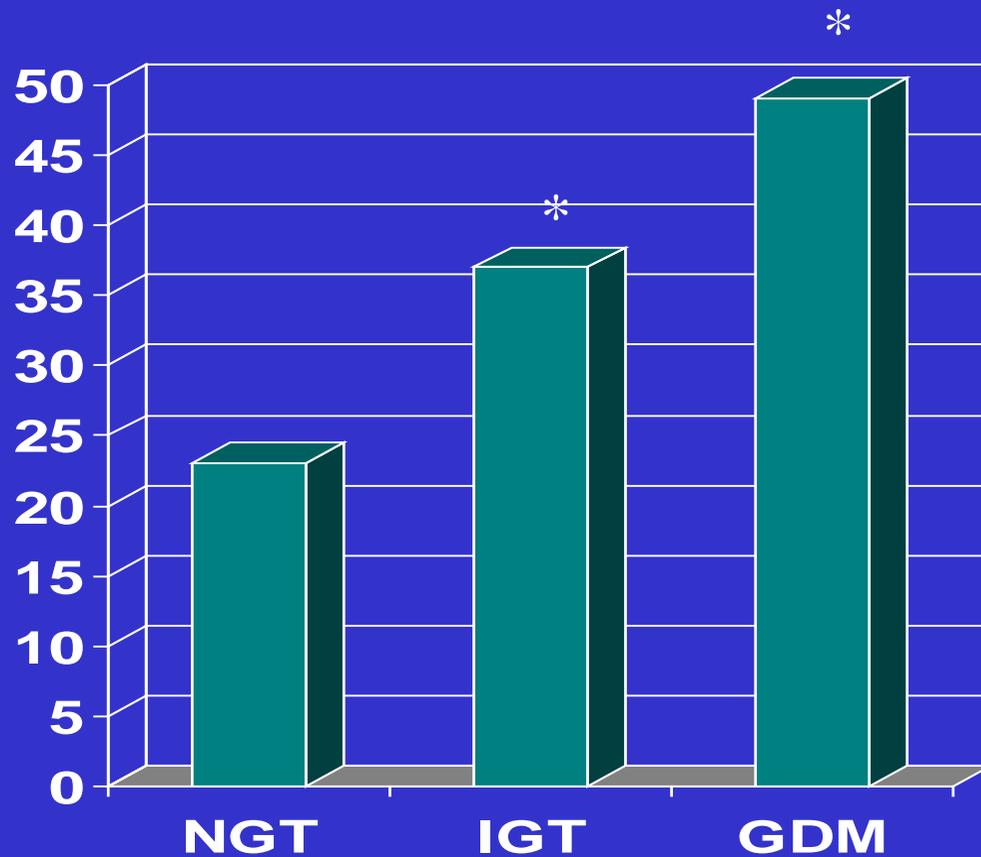
*fasting* 95 mg/dl

*1 hour* 180mg/dl

*2 hour* 155mg/dl

*3 hour* 135mg/dl

# Percentage of obesity by glucose status



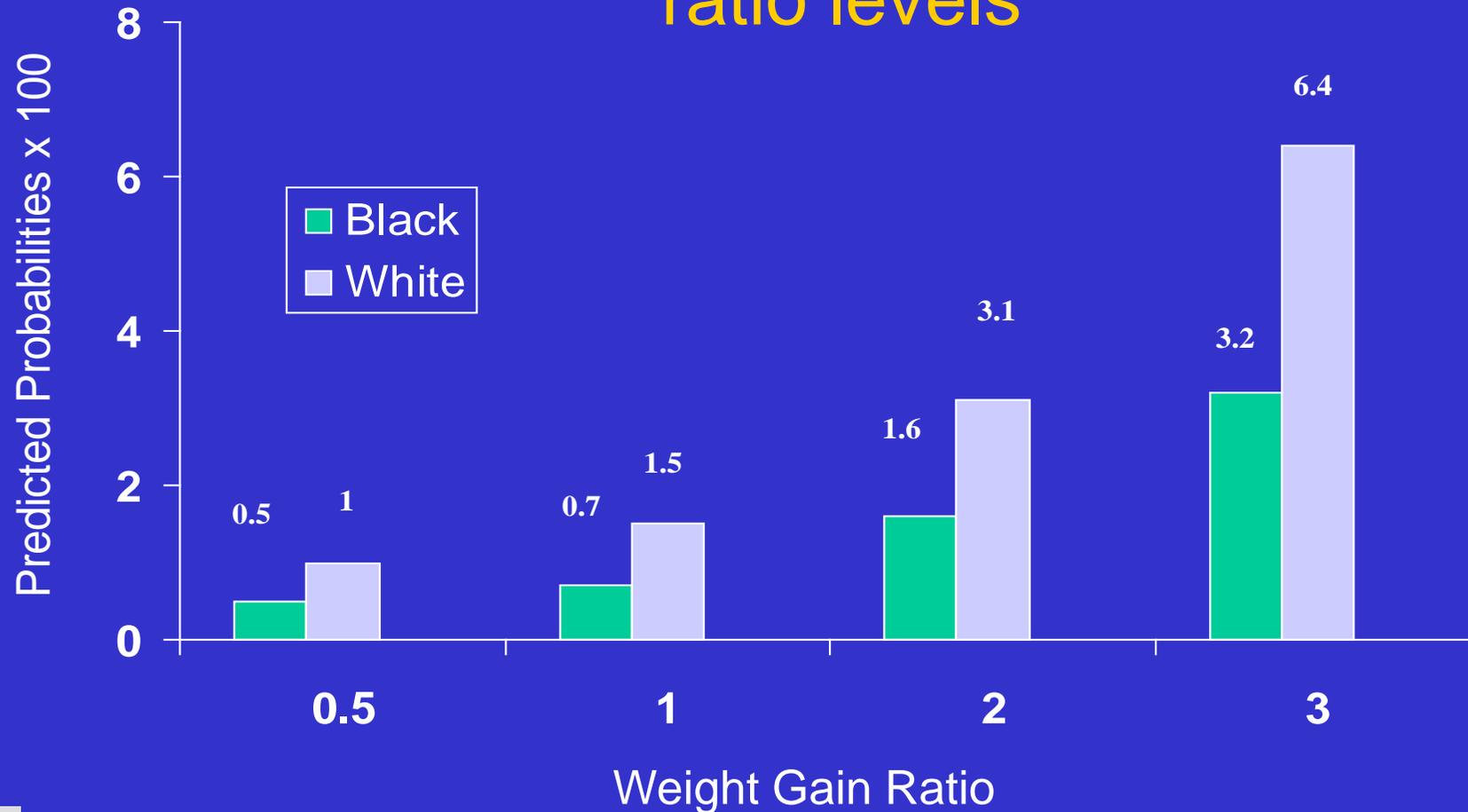
\* p-value < 0.001 compared to NGT

# Results from Logistic Regression Weight Gain Ratio Models

- Model 1: Outcome= GDM
  - Prepregnancy overweight women OR= 2.2(1.1-4.3)\*
  - Prepregnancy obese women OR= 3.7 (2.2-6.3)\*\*
  
- Model 2: Outcome= IGT
  - Interaction:
  - (Weight Gain ratio)(Pregregravant Overweight Status)\*

Models adjusted for race, mother's age, gestational week of measurement  
\*p<0.05, \*\*p<0.01

# Risk of IGT in prepregnant overweight black and white women by increasing weight gain ratio levels



# Gestational Hypertension

- Risk ratios of 1.7 and 2.2 for overweight and obese women respectively compared to BMI  $<21$  kg/m<sup>2</sup> (Thadhani et al., 1999)
- Risk of pre-eclampsia is 2 fold for overweight and obese women compared to underweight women (Sibai et al 1997)

# Pre-pregnancy Obesity & Cesarean Delivery

## Overview of the Literature

- Seven observational studies published
- AOR range: 1.7 to 4.0 for pre-pregnancy obesity



# Pre-pregnancy Obesity & Labor Overview of the Literature – Jensen et al, 1999

- Sample restricted to low-risk, term pregnancies with a spontaneous onset of labor
- Oxytocin to augment labor (in primiparous women):
  - Normal weight women: 40%
  - Overweight women: 52%
  - Obese women: 57%
- Cesarean delivery rates (in primiparous women):
  - Normal weight women: 6%
  - Overweight women: 10%
  - Obese women: 11%

# Rationale

## What do we know?

- Increasing prevalence of overweight and obesity among women of childbearing age
- Generally, women gain weight outside of their pre-pregnancy specific IOM recommended range
- Higher cesarean delivery rate reported
- Increased risk of perinatal mortality
- Concerns of pregnancy contributing to postpartum weight retention and childhood obesity

# Rationale

## What do we need to know?

- Is the association between maternal pre-pregnancy weight status and cesarean delivery accurate?
- If so, why are overweight and obese women more likely to have a cesarean delivery?
- Is the intrapartum experience of overweight and obese women different from normal-weight women?

# Body Mass & Cesarean Delivery Methods

- Restricted multivariable analyses to women who underwent a trial of labor. (excluded 29 women with an elective cesarean delivery).
- Computed unadjusted and adjusted risk ratios and 95% confidence intervals for the risk of an emergent cesarean delivery.
- Final sample for multivariable analysis: 612 women (297 normal weight, 115 overweight, and 200 obese).

# Body Mass & Cesarean Delivery Risk Ratios & 95% Confidence Intervals

	Normal	Overweight	Obese
RR (overall)	1.0	1.4 (0.97, 2.1)	1.4 (1.0, 2.0)
ARR (overall) *	1.0	1.2 (0.8, 1.8)	<b>1.5 (1.1, 2.1)</b>
ARR (first stage) *	1.0	1.4 (0.9, 2.2)	1.4 (0.95, 2.2)
ARR (dystocia) *	1.0	1.1 (0.6, 2.1)	1.7 (0.98, 2.9)
ARR (fetal distress) *	1.0	1.3 (0.7, 2.7)	1.3 (0.7, 2.5)

\*Adjusted for maternal height, education, gestational weight gain, labor induction, and oxytocin use.

# Body Mass & Cesarean Delivery

## Comments

- Overweight and obese women may have an increased risk for an emergent cesarean delivery, compared to normal weight women.
- The risk is not as high as those reported in previous studies.
- The risk is highest in obese women when the cesarean is performed based on an indication of dystocia.
- Providers waited longer than the 2-hour minimum for arrest of dilation for first stage cesareans due to dystocia.

# Background

## Labor progression: Then and Now

- Current definitions of labor protraction and arrest are based on Friedman's work.
- However, the management of labor and delivery and the patient population have changed dramatically over the past 50 years.
- Nevertheless, clinicians continue to refer to Friedman's work, despite these changes in management and practice.

# Background

## Changes in obstetric practice

### Obstetric Interventions

- Induction of labor: 1989: 9.0% 2002: 20.6%
- Augmentation of labor 1989: 10.9% 2002: 17.3%

### Obstetric Procedures

- EFM: 1989: 68.4% 2002: 85.2%
- Ultrasound: 1989: 47.7% 2002: 68.0%

### Birth Outcomes

- Cesarean delivery 1996: 20.7% 2002: 26.1%

# Background

## Changes in the patient population

- Increases in both maternal pre-pregnancy weight and gestational weight gain.
- Correspond to increases in fetal size and infant birth weight.
- Zhang et al (1999): Labor appears to proceed more slowly than originally suspected, especially during the active phase.

Adjusted \* median duration of time elapsed (in hours) in labor for each centimeter of cervical dilation for term, nulliparous women, according to their pre-pregnancy body mass index, Pregnancy, Infection, and Nutrition Study, 1995-2002.

Cervical dilation	Normal (BMI 19.8-26.0 kg/m <sup>2</sup> ) (N=297)	Overweight (BMI 26.1-29.0 kg/m <sup>2</sup> ) (N=115)	p <sup>†</sup>	Obese (BMI > 29.0 kg/m <sup>2</sup> ) (N=200)	p <sup>‡</sup>
From 4 to 10 cm	6.20	7.52	< 0.01	7.94	<0.001
From 3 to 4 cm	1.58	1.43	0.03	1.74	0.17
From 4 to 5 cm	1.41	1.63	0.06	1.69	< 0.01
From 5 to 6 cm	0.80	0.98	< 0.001	1.27	<0.001
From 6 to 7 cm	0.64	0.61	0.33	0.80	< 0.001
From 7 to 8 cm	0.58	0.60	0.47	0.47	< 0.001
From 8 to 9 cm	0.49	0.51	0.46	0.46	0.02
From 9 to 10 cm	0.45	0.44	0.65	0.49	0.02
Second stage of labor (geometric mean, minutes)	62.7	60.2	0.73	47.4	0.01

\* An interval-censored regression model with a log normal distribution was fitted to adjust for maternal height, membrane rupture, epidural analgesia, timing of epidural analgesia placement, labor induction, oxytocin use, net maternal weight gain, and fetal size

† Comparison between normal weight and overweight women

‡ Comparison between normal weight and obese women



# Body Mass & Labor Progression Results

- Overweight and obese women have a significantly **longer** median duration of labor from 4-10 cm, compared to normal weight women.
  - Overweight women: their prolonged labor was concentrated around 4 to 6 cm.
  - Obese women: their prolonged labor was due to a slower labor progression prior to 7 cm.

# Summary

Compared to normal-weight women:

- Obese women have a moderately increased risk for an emergent cesarean delivery.
- Overweight women have a weak increased risk for an emergent cesarean delivery.
- Both overweight and obese women have a slower labor progression prior to 6 cm.
- Maternal weight gain and fetal size do not appear to explain this association.

# Possible Explanations

- Dystocia due to an increased deposition of soft tissues in the maternal pelvis
- Fetal macrosomia
- Inadequate uterine contractions
- Non-clinical factors



# Body Mass & Labor Progression Results

- Patient dropout due to a first stage cesarean delivery may have influenced some of our results.
- To assess whether these trends persisted among vaginal deliveries, we fitted the same models but excluded women who delivered by cesarean section.
- Normal weight and overweight women had a similar median duration of labor from 4-10 cm, but all other trends persisted.

# Percentage of selected perinatal outcomes attributable to obesity

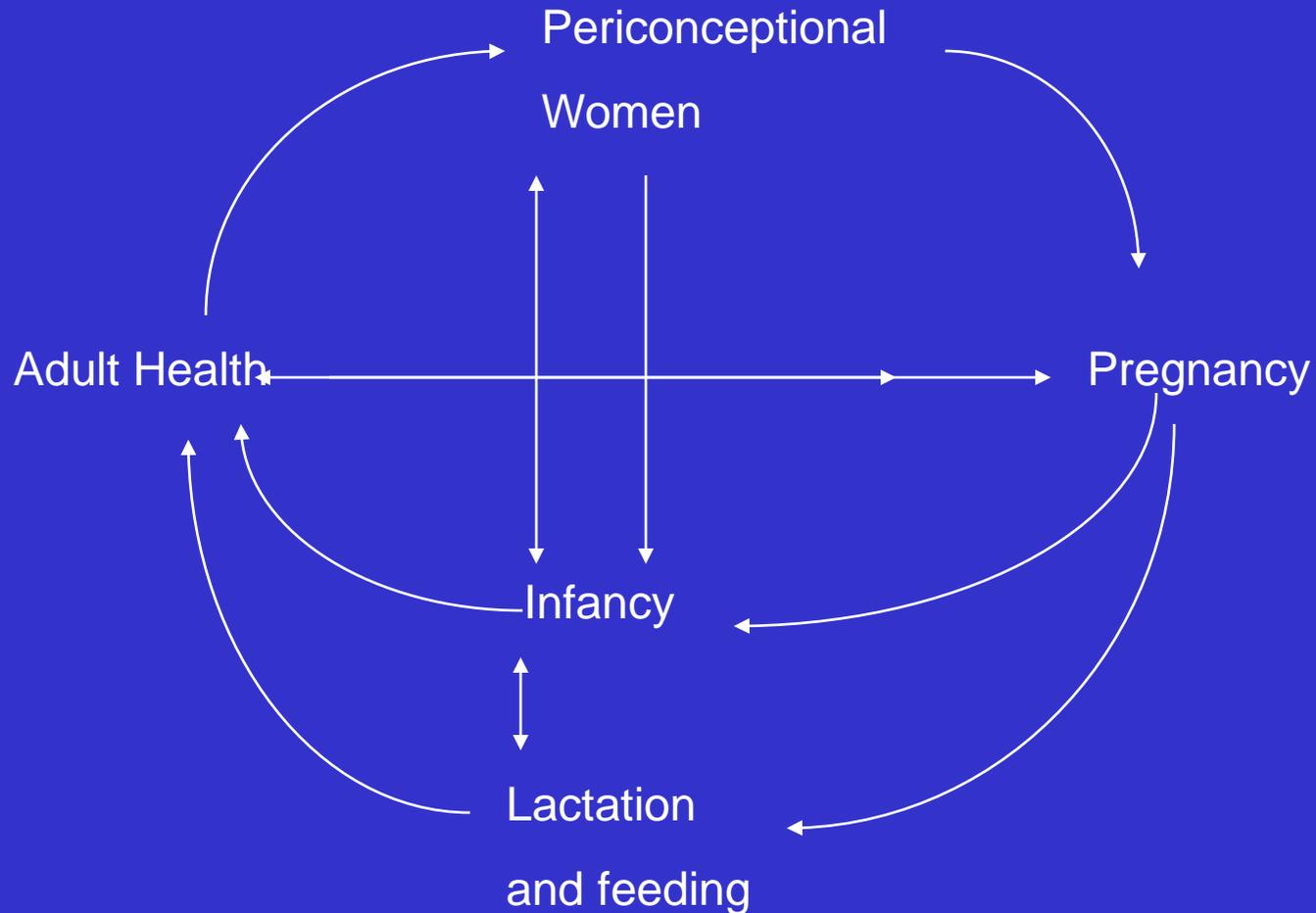
	1980-84	1985-89	1990-94	1995-99
C-section	3.9 (2.4,5.0)	6.4 (4.8,7.7)	10.6 (8.4,11.1)	11.6 (9.5, 13.4)
GDM	12.8 (9.8,15.1)	9.6 (4.6,13.1)	22.7 (20, 25)	29.6 (25, 33)
LGA	6.5 (5.2,7.8)	8.0 (6.1,9.6)	11.8 (10.7,13)	19.1 (17, 20.8)
>4000 g	16.2 (12.2,18.7)	39.1 (28,42)	25.2 (20.8,28)	25.7 (17.4,31)

# Postpartum Health

- Adjusted relative risk of postpartum anemia increased as BMI increased from 24 to 38.
- Women with a BMI of 28 had about 1.8 (95% CI 1.3,2.5) times the postpartum risk of anemia compared to a women with a BMI of 20.
- Women with a BMI 36 had approximately 2.8 (95% CI 1.7,4.7) times the risk

Bodnar et al. 2004 Obesity Research in press.

# Schematic diagram of the life cycle showing the relationships among the life stages



# In Conclusion



**Given the lack of success in the treatment of obesity among adults, it is important to learn about ways to prevent obesity as early in life as possible. Women, infants and young children are most vulnerable to nutritional influences, and thus the most important targets for preventive efforts.**