

## **Breastfeeding & Obesity**

**Breastfeeding Grand Rounds  
August 4, 2005  
University at Albany School of  
Public Health**

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## **Speakers**

**Ruth Lawrence, MD  
Kathleen M. Rasmussen, ScD, RD**

**Moderator:  
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## ***Breastfeeding Medicine***

- New journal from the Academy of Breastfeeding Medicine
- Dr. Ruth Lawrence, editor

## **Breastfeeding & Obesity**

## **The Gold Standard**

- Uniquely adapted to human infants' nutritional needs for growth & development
- Protects against infections – from mild to life-threatening
- Helps prevent growing list of chronic diseases
- Reduces risk of childhood obesity

## **The Mud Standard?**

- Stated another way . . .
- Formula feeding increases infants' risk of:
  - Growth & development problems
  - Infections
  - Chronic diseases
  - Obesity in childhood and later life

## **Maternal Health Benefits**

- Lower risk of chronic illnesses, e.g. breast cancer, diabetes
- More rapid recovery from childbirth
- Help returning to pre-pregnant weight

## **Role in Obesity Prevention**

- Recognized by CDC in their national obesity prevention program
  - Increase breastfeeding rates
  - Increase fruit & vegetable consumption
  - Increase physical activity
  - Decrease TV viewing

## Breastfeeding & Obesity – Today's Topics

- Protection against childhood obesity
- Postpartum maternal weight loss
- Breastfeeding difficulties for overweight & obese mothers

## Does Breastfeeding Protect Against Childhood Obesity?



Dr. Ruth A. Lawrence, M.D.  
Professor of Pediatrics  
University of Rochester School of Medicine  
Golisano Children's Hospital  
Rochester, New York

**Some studies have resulted in  
the impression that fat babies  
do not lead to fat children.**

## Shapiro et al

- An obese infant does not predict an obese child nor an obese 9 year old. Obesity begins at 6-9 years old. No breastfeeding data.

Shapiro LR et al. *AJPH* 74(9):968, 1984

## Calipers and Scale



## Body Mass Index

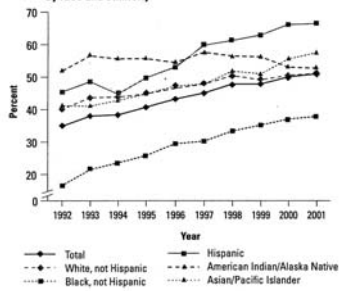
$$\frac{\text{Weight}}{\text{Height}^2}$$

> 85% overweight

> 95% obese

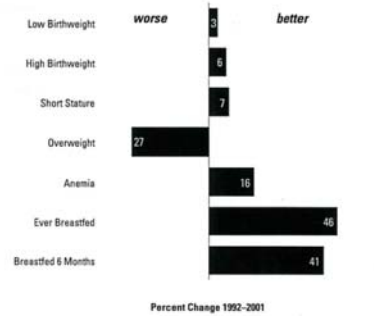
“relatively fat”

**Figure 7. Trends in the percentage of infants ever breastfed,\* by race and ethnicity**



\* Among infants born during the reporting period. Year 2010 target: increase the proportion of mothers who breastfed their babies in the early postpartum period to 75%.  
2001 National Pediatric Table 19D

**Figure 8. Infant and child health advances and concerns: percent change 1992 to 2001**



2001 National Pediatric Table 2D

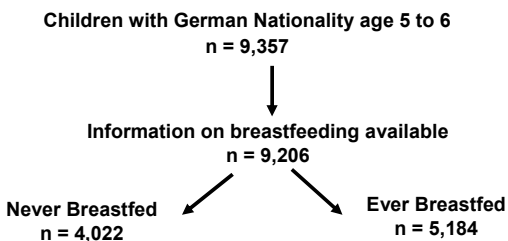
## AAP Guidelines 2005

- Breastfeed exclusively for the first six months
- Continued breastfeeding while adding weaning foods for the next six months
- Continue for as long as mother and child wish

## BMI Predictors

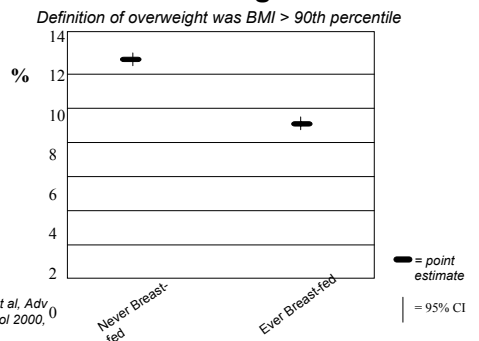
- The strongest predictor of child BMI status was mothers concurrent BMI
- Children were at a moderately increased risk with an overweight mother
- Three times more likely to be at risk with maternal obesity

## Overweight and Obesity in Bavarian Children at School Entry in 1997

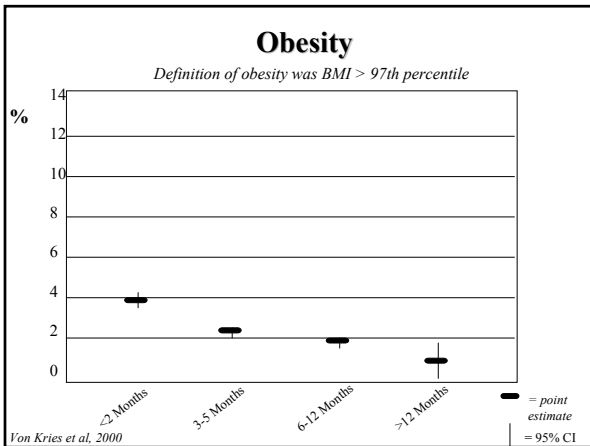
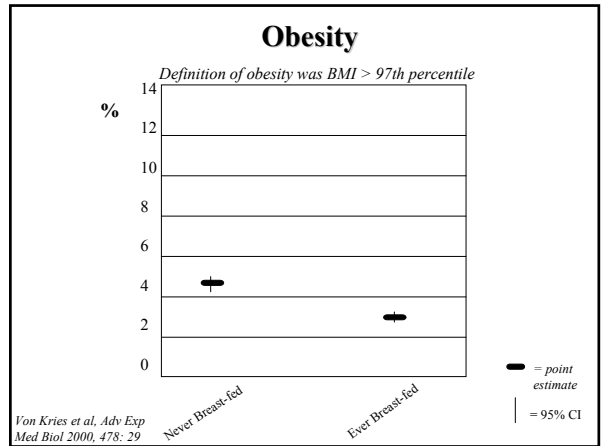
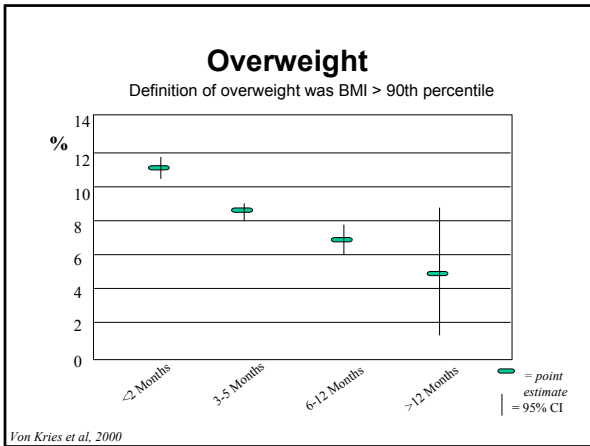


Von Kries et al, *BMJ* 1999 319: 147

## Overweight



Von Kries et al, *Adv Exp Med Biol* 2000, 478: 29



### Breastfeeding and Obesity: Cross Sectional Study

Dose response	Risk
Never breastfed	4.5%
Average breastfed	2.8%
2 months breastfed	3.8%
3-5 months breastfed	2.3%
6-12 months breastfed	1.7%
>12 months breastfed	0.8%

Overweight BMI >90%  
Obesity BMI >97%

Von Kries R et al. *BMJ* 319:147, 1999

### Mean Age-Adjusted BMI and Proportion of subjects Classified as overweight at Age 9 to 14 years, by category of Infant Feeding in the First 6 Months of Life\*

■ = BOYS (n=7155)   ■ = GIRLS (n=8186)

Category	No.	Mean BMI, kg/m <sup>2</sup>	Overweight, No. (%)	No.	Mean BMI, kg/m <sup>2</sup>	Overweight, No. (%)
Breast Milk Only	2188	18.8	100(7.1)	2899	18.8	198(4.1)
More breast milk than infant formula	3311	19.1	162(7.9)	2517	18.9	110(4.4)
Both equally	472	19.3	21(19.8)	559	19.0	25(4.5)
More infant formula than breast milk	1379	19.5	164(12.0)	1487	19.1	92(6.2)
Infant formula only	876	19.3	88(10.0)	1009	19.3	69(6.8)

\* Definition of overweight was BMI > 95th percentile for age and sex from US data  
MW Gillman et al JAMA 2001

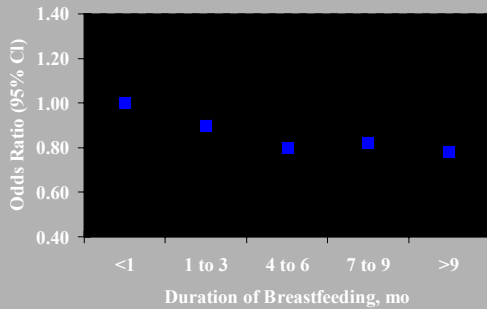
### Mean Age-Adjusted Body Mass Index and Proportions of Subjects Classified as Overweight at Age 9 to 14 years, by Duration of Breastfeeding in Infancy\*

■ = BOYS (n=7155)   ■ = GIRLS (n=8186)

Duration, mo	No.	Mean BMI, kg/m <sup>2</sup>	Overweight, No. (%)	No.	Mean BMI, kg/m <sup>2</sup>	Overweight, No. (%)
0	695	19.4	68(3.9)	824	19.3	53(6.4)
<1	393	19.4	41(10.0)	427	19.1	20(6.6)
1-3	1075	19.4	123(11.0)	1192	19.1	62(5.2)
4-6	1813	19.1	130(8.8)	1858	19.0	83(5.0)
7-9	1109	19.1	88(7.9)	1232	19.0	65(5.3)
>9	2191	18.9	140(6.8)	2654	18.7	100(3.8)

\* Definition of overweight was BMI > 95th percentile for age and sex from US data  
MW Gillman et al JAMA 2001

## Risk of Overweight in Adolescence by Duration of Breastfeeding in Infancy



MW Gillman et al JAMA, 2001

## Infants Who Were Breastfed

- Were less likely than infants who were formula fed to manifest overweight as adolescents.
- Adjustments made for confounding variables
- A dose response relationship noted

Gillman, Rifas-Shiman, Carmargo, et al. JAMA (285): 2461, 2001.

## Methods

- A study of 177,304 children up to 60 months of age with duration of breastfeeding measured up to 2 years and weight status analyzed at 4 years.



Grummer-Strawn LM, Mei Z. Pediatrics 113: e81, 2004

## Dose Relationship

Ratio	Odds
6 to 12 months of breastfeeding vs. never	.70
More than 12 months breastfeeding vs. never	.49



Grummer-Strawn LM, Mei Z. Pediatrics 113: e81, 2004

## Crude and Adjusted Odds Ratios of Association Between Breastfeeding Duration and Overweight in Children Aged 4 years

Breastfeeding Duration	Crude Association		Adjusted for Child's Gender, Race/Ethnicity, and Birth Weight	
	Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval
Never breastfed	1.00	—	1.00	—
<1 mo	1.01	0.97-1.06	0.98	0.94-1.03
1-2.9 mo	0.94	0.89-0.99	0.88	0.83-0.93
3-5.9 mo	0.90	0.84-0.96	0.81	0.76-0.87
6-11.9 mo	0.82	0.76-0.88	0.73	0.68-0.79
≥12 mo	0.79	0.71-0.88	0.72	0.65-0.80

Grummer-Strawn LM, Mei Z. Pediatrics 113: e81, 2004

## Study Conclusion

“Prolonged breastfeeding is associated with a reduced risk of overweight among non-Hispanic white children.”



Grummer-Strawn LM, Mei Z. Pediatrics 113: e81, 2004

## Problems

- “Ever Breastfed” is used for many studies to define breastfeeding which mutes the real impact of breastfeeding
- Style of breastfeeding for months is not defined. The strongest effect is with exclusive breastfeeding the first six months
- Race, ethnicity, poverty have little effect when exclusivity is documented

## Population Impact

- Based on the unadjusted risks of overweight for infants fed only or mostly formula for infants never fed breast milk
- The population attributable risk of overweight due to formula feeding is 15% to 20%

## Longitudinal Study of Adolescent Health

11, 998 children

Breastfeeding > 9 months odds ratio 0.90

Breastfeeding < 3 months odds ratio 0.78

Risk of overweight ↓ as breastfeeding ↑

850 sibling pairs – genetic and environmental  
No evidence of breastfeeding effect

Nelson et al. *Epidemiology* 16:247, 2005

## Adding Solid Foods

- The timing of introduction of solid foods was associated with a 0.1 % reduction in risk of overweight for each month that the introduction of solids was delayed

## Plausible Explanations

- Self-regulation of energy intake
- Metabolic programming due to composition protein intake, rate of weight gain in early life
- Confounding by feeding practices and activity



Dewey. *J Hum Lact* 19(1), 2003

## Prevalence of Obesity Significantly Lower in Breastfed Children

- Association persists after adjustment for SES, sex and birthlot.
- Results suggest breastfeeding is associated with a reduction in childhood obesity risk



Armstrong, *Lancet* 2002, 359: 2003.

Both feeding behaviors in nursing infant and metabolic effects may contribute to the reported inverse association of breastfeeding and overweight



Liese, *International J of Obesity* 2001, 25; 1644

### Stettler et al 2002: Infant Weight and Later Overweight

- 27,899 eligible participants born at term 1959-1965 at 12 United States sites
- Measure overweight status at age 7
- Overweight – BMI > 95 percentile

### Stettler Results

- Overweight at age 7 – 5.4%
- Rate of weight gain in first 4 months of life (100g per month) was associated with overweight at 7 years

### Stettler Conclusions

- A pattern of rapid weight gain in the first 4 months of life is associated with increased risk of overweight at age 7 but independent of birth weight and weight at one year.

### A Systematic Review of Published Studies

- Initial breastfeeding protects against obesity in later life
- 61 studies
- 28 studies (298,000 subjects) provides odds ratios
- Confounding factors of parental obesity, maternal smoking and social class reduced but did not obliterate the association

Owen et al. *Pediatrics*, 2005; 115; 1367-1377

Breastfeeding, especially exclusive breastfeeding for six months, does decrease the risk of childhood obesity.



## Breastfeeding & Maternal Weight

- Effect of breastfeeding on maternal weight loss postpartum
- Effect of maternal obesity on successful initiation and continuation of breastfeeding

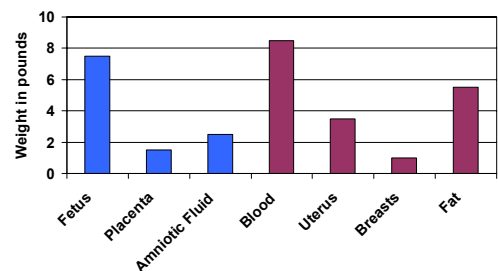
## Postpartum Weight Loss

- Few studies about effect of breastfeeding on maternal weight
- Biological basis
- Epidemiological observations

## Prenatal Weight Gain

<u>BMI Category</u>	<u>IOM Weight Gain Recommendations</u>	
	(kg)	(lb)
Low (<19.8)	12.5 – 18	28 – 40
Normal (19.8 – 26.0)	11.5 – 16	25 – 35
High (26.1 – 29.0)	7 – 11.5	15 – 25
Obese (>29.0)	at least 7	at least 15

## Prenatal Weight Gain Where Does 30 lbs Go?



## Prenatal Weight Gain Components

- 1/3 = fetus, placenta, amniotic fluid
- 2/3 = maternal fluids and tissues
  - uterus
  - breasts
  - blood & body fluid volume
  - fat ← THIS IS THE MOST VARIABLE

## Maternal Energy Stores

- 5.5 pounds of fat = 23,000 calories of stored energy
- Converted to breastmilk = enough to feed infant for ~6 weeks

## Fourth Trimester of Pregnancy

- Breastfeeding completes cycle
- Energy storage → Energy transfer
- Survival advantage in case of famine
- Risk for obesity for mothers who don't breastfeed

## Caloric Expenditure

- Early days and weeks: small intake, small energy expenditure
- By 3 months: baby may consume 600 calories/day
- Equal to running 1.25 hours/day

## Epidemiologic Observations

- Literature review by Dr. Renee Samelson
- Few studies
- Wide variation in results
  - Different definitions of breastfeeding
  - Different durations of breastfeeding
  - Different lengths of follow up

## Potential Confounders

- Pre-pregnancy weight
- Pregnancy weight gain
- Duration & exclusivity of breastfeeding
- Concurrent dieting
- Other differences between breastfeeding and formula feeding mothers
- Rate of breastfeeding in the population

## DARLING Study

- Kathryn Dewey, et al. – Davis, CA
- Analyzed cohort of 61 non-breastfeeding and 77 long-breastfeeding mothers
- Observed changes in weight postpartum
- All had normal pre-pregnancy weight
- Matched for SES, pregnancy weight gain, infant birthweight
- Excluded dieters

## DARLING Study – Findings

- Weight status similar at 1 mo. postpartum
- Gradually diverged after ~ 3 months
- Greater weight loss among nursing mothers
- Difference = 3.2 kg (7 pounds)

## Reasons for Delayed Weight Loss

- **Early weeks:**
  - Little milk production
  - High prolactin levels → increased appetite
  - EXPENDITURE ≈ INTAKE
- **After 3 months:**
  - Much greater milk production
  - Prolactin levels and appetite subside
  - EXPENDITURE > INTAKE

## Pregnancy-Associated Obesity Among African Americans

- Sally Lederman, et al. – New York City
- Studied influence of pregnancy weight gain & breastfeeding on mothers' obesity risk

## Pregnancy-Associated Obesity Among African Americans

- High rates of pre-pregnancy overweight and excess pregnancy weight gain
- Almost NO long-term breastfeeding
  - Almost no exclusive breastfeeding by 2 weeks
  - Only 15% breastfeeding at all by 2 months
- No opportunity to see benefit

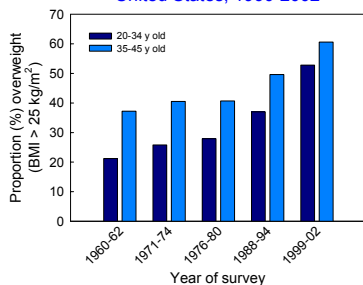


## Overweight and Obesity Before Pregnancy and Lactational Performance

Kathleen M. Rasmussen  
Division of Nutritional Sciences  
Cornell University  
Ithaca, NY 14850

Pablo Picasso, 1963.

Overweight among women of reproductive age:  
United States, 1960-2002

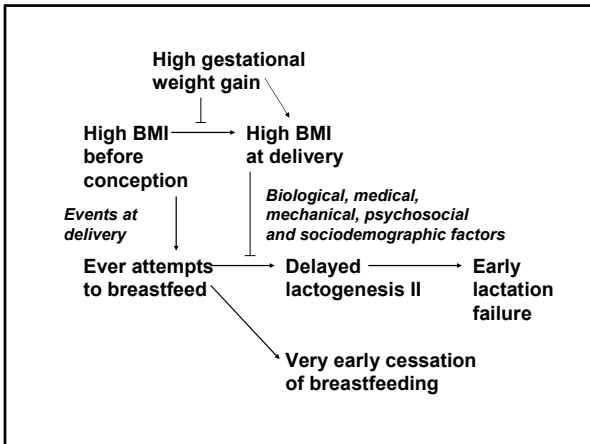


From: Health, United States, 2004 (<http://www.cdc.gov/nchs/data/hus/04trend.pdf#069>)

## Effect of High-Fat Feeding Before & During Pregnancy on Transition to Lactation in Rats

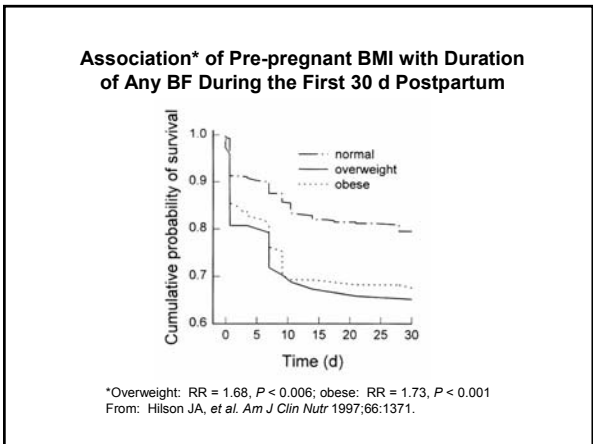
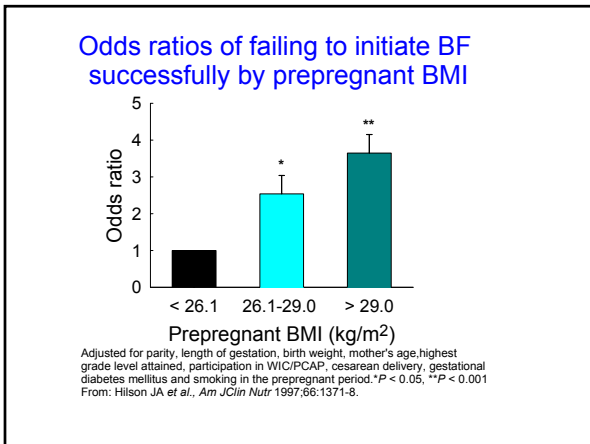
- Rats fed the high-fat diet had:
  - Early lactation failure (pups died without any milk in their stomachs)
  - Lower reduction in plasma insulin values from day 20 of pregnancy to day 3 of lactation
  - Lower increment in plasma prolactin values in this same interval

From: Shaw MA, et al. *J Nutr* 1997;67:64.



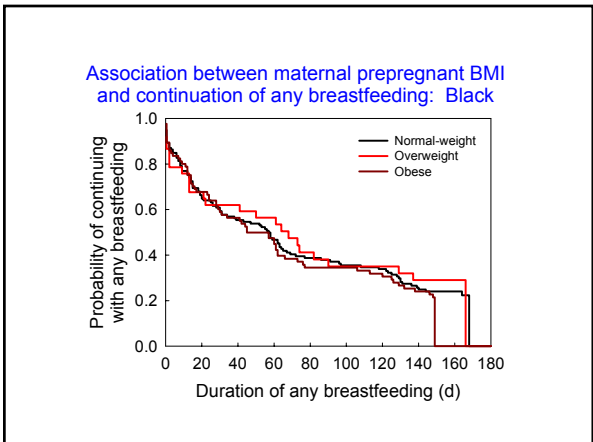
### Pre-pregnant BMI and duration of BF among white women

- Subjects: 19-40 y old women who delivered singleton, term infants from 1/92-3/94 ( $n = 810$ ) and attempted to breastfeed their newborns
- Outcomes: still BF at hospital discharge (usually 2 d postpartum), duration of exclusive and any BF

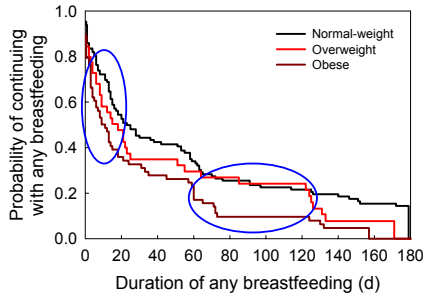


### Pre-pregnant BMI and the Duration of BF among Black and Hispanic Women

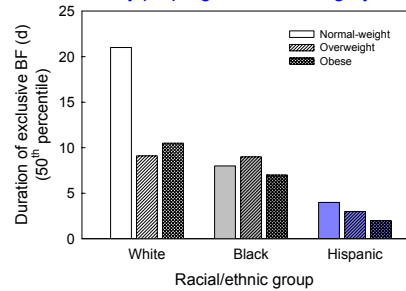
- Subjects: 19-40 y old women who delivered healthy, singleton term infants over a 2- or 3-yr period ( $n = 587$  Hispanic women and 640 Black) and attempted to breastfeed their newborns
- Outcomes: infant feeding method in the last 5 feeds before discharge; duration of exclusive and any BF



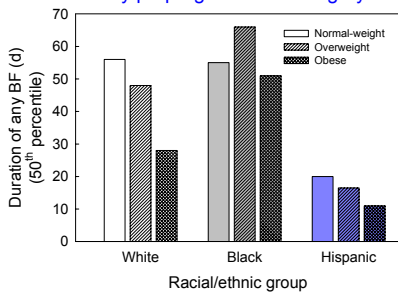
Association between maternal prepregnant BMI and continuation of any breastfeeding: Hispanic



Association between racial/ethnic group and duration of exclusive breastfeeding by prepregnant BMI category



Association between racial/ethnic group and duration of any breastfeeding by prepregnant BMI category



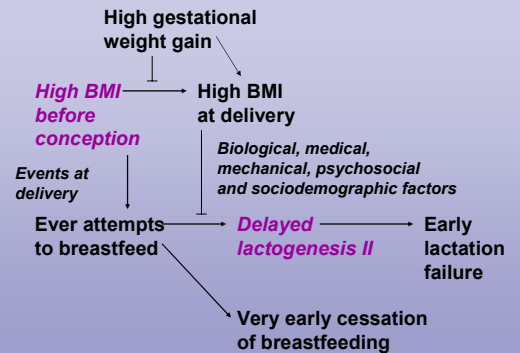
Pre-pregnant BMI and the Duration of BF Among Danish Women

- Compared to normal-weight women,
  - Overweight and obese women were both about 1.5 times more likely to be unsuccessful in initiating BF
  - Obese women in particular were likely to discontinue exclusive BF early
- These findings are very similar to those among White women in New York

From: Baker JL, et al. Manuscript in preparation

Pre-pregnant BMI and the Initiation and the Duration of BF

- There is a highly reproducible association between high prepregnant BMI and failure to initiate and sustain BF
  - Among white and Hispanic, but not Black, women
  - Independent of social support for BF, which is high among both Hispanic and, particularly, Danish women



## Pre-pregnant BMI and Lactogenesis

- **Subjects:** 19-45 y old women with singleton fetus; stated intention to breastfeed ( $n = 117$ )
- Questionnaires about demographic and psychosocial characteristics
- Telephone interview (days 1-5 or until milk “came in”)
- **Mother-Baby Assessment score**

## Association Between the Timing of Lactogenesis II and Maternal and Infant Characteristics

Characteristic	Earlier onset ( $n = 87$ )	Later onset ( $n = 29$ )
Prepregnant BMI <sup>a</sup>	24.5 ± 5.9 <sup>b</sup>	28.3 ± 6.3 <sup>1</sup>
Primiparity (%)	32.2	71.4 <sup>2</sup>
Infant MBA score	4.2 ± 0.5	4.0 ± 0.4 <sup>1</sup>
Duration of any BF (wk)	6.7 ± 8.7	5.5 ± 3.9
Planned duration of BF (mo)	8.8 ± 5.9	7.7 ± 3.4

<sup>a</sup>Abbreviations used: BMI, body mass index; MBA, Mother Baby Assessment score

<sup>b</sup>Mean ± SD

Significantly different from earlier onset, <sup>1</sup> $P < 0.05$ , <sup>2</sup> $P < 0.01$   
From: Hilson JA, Rasmussen KM, Kjolhede CL. *J Hum Lact* 2004;20:18.

## Pre-pregnant BMI and Psychosocial Characteristics

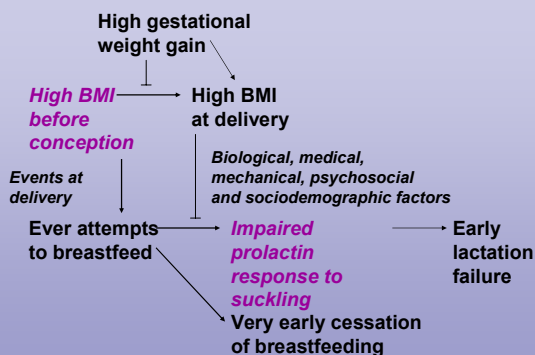
- Psychosocial constructs that are known to predict the duration of BF in general did not modify the association between prepregnant BMI and the onset of lactogenesis II
- These included: behavioral beliefs about breast- or bottle-feeding, knowledge of BF, social learning, maternal self-confidence about BF, social support

## Pre-pregnant BMI and Lactogenesis

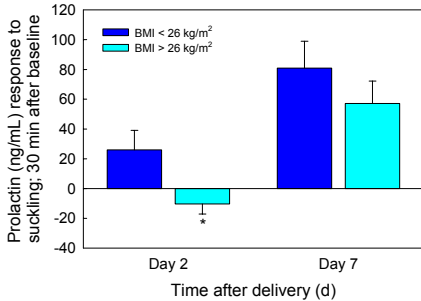
- Higher prepregnant BMI was indeed significantly associated with a clinically important delay in lactogenesis II
- Other factors were also significantly associated with this delay: in particular primiparity, and a lower infant score from the Mother Baby Assessment tool
- Our sample size was possibly too small to rule out a role for psychosocial factors

## Pre-pregnant BMI and the Prolactin Response to Suckling

- **Subjects:** 19-40 y old women with singleton infants and no contraindications for BF ( $n = 40$ )
- **Outcome:** prolactin response to suckling at d 2 and d 7 postpartum
  - Measured as the difference between the pre-suckling value and that 30 min later



### Association between prepregant BMI category and the prolactin response to suckling



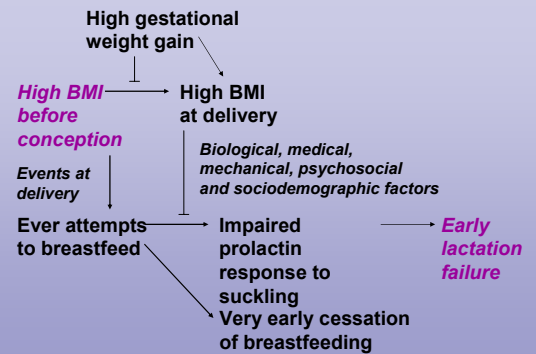
\*Significantly ( $P < 0.05$ ) different from the normal-weight group  
From: Rasmussen KM, Kjolhede CL. *Pediatrics* 2004;113:e465.

### Pre-pregnant BMI and the Prolactin Response to Suckling

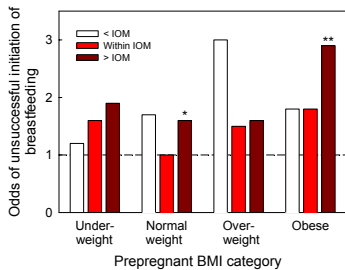
- Reduced prolactin response to suckling in the first week postpartum represents one *biological* mechanism by which maternal overweight before conception negatively affects the success of BF

### Pre-pregnant BMI and BF

- High pre-pregnant BMI is reproducibly associated with the initiation and duration of BF
  - This association may have some socio-cultural and/or psychosocial components that merit additional study
  - It also has a plausible, but as yet incompletely studied, biological basis

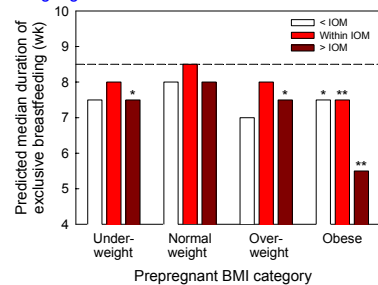


### Association of prepregant weight and gestational weight gain with the initiation of breastfeeding



\* $P < 0.05$ , \*\* $P < 0.01$   
From: Hilson JA, et al. Unpublished data.

### Association of prepregant BMI category and gestational weight gain with the duration of exclusive breastfeeding



\* $P < 0.05$ , \*\* $P < 0.01$   
From: Hilson JA, et al. Unpublished data.

## Pre-pregnant BMI and BF: Does it Matter for Children?

- **Subjects:** Mothers and their term infants from the DNBC (*n* = 3786)
- **Outcomes:** Infant weight gain between birth and age 1 y
- **Results:** High prepregnant BMI was associated with high infant weight gain during the first year of life through a direct association, shorter BF and, thus, earlier introduction of solid foods as well as an interaction between these factors

Baker JL, et al. *Am J Clin Nutr* 2004;80:1579.

## Implications for Clinical Practice

- **Black women should be given additional support so that they will at least attempt to breastfeed**
  - This is a much a matter of socio-cultural condition as it is of hospital practice
- **White and Hispanic women with high pre-pregnant BMI values need additional support to succeed at BF**

## Implications for Clinical Practice

- **Beyond a “baby-friendly” environment, they may need:**
  - Anticipatory guidance about the possibility of delayed lactogenesis (particularly for primiparous women)
  - Additional support from suitably trained personnel in the immediate postpartum period
  - Support (by telephone) after discharge to identify and treat those who need additional attention

## Implications for Public Health

- **Women should be advised to begin pregnancy at a healthy weight and to gain weight appropriately during gestation**
- **Women should be able to deliver in a “baby-friendly” environment**
- **Women should be encouraged to breastfeed and supported in doing so both before and after hospital discharge**
- **Women should have adequate maternity leave**

With thanks to . . .

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**Janet G. Kugyelka, MD**

**Jennifer L. Baker, PhD**

**Maureen Shaw, BA**

## Evaluations

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*Thank You!*