

**Starting Obesity Prevention
in Infancy: The Role of
Breastfeeding and Baby
Behavior**

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Presenter Disclosures

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-The following personal financial relationships with
commercial interests relevant to this presentation
existed during the past 12 months:

I have nothing to disclose.



Part I

Does Breastfeeding
Influence Risk for
Childhood Obesity?

Infant Feeding and Obesity

- If there is a connection, why are there inconsistent results from studies examining the association between BF and subsequent overweight?



**Early weight gain (g/d) in breastfed and
formula-fed infants**

Nelson et al. *Early Hum Develop.* 1989;19:223-239.

Age Interval	Breastfed (n = 419)	Formula-fed (n = 720)
1-6 wk	36.4 (9.5)	36.6 (7.6)
6-16 wk	24.0 (6.3)	26.6 (5.8)*

*P <.001

**Growth patterns of breastfed and
formula-fed infants**

- After the first 6 weeks, breastfed infants gain weight more slowly than formula-fed infants
- By 12 months of age, breastfed infants are leaner than formula-fed infants
 - Difference in attained weight at 12 mo is approximately 600-650 g (from pooled dataset) but groups similar at 24-36 mo
- Intakes of breastfed infants are lower than those of formula-fed infants
 - The introduction of solid foods does not alter growth patterns

Infant Feeding and Risk for Subsequent Overweight

Methodological Issues

- Not ethical to randomize
- Criteria for feeding groups
 - Duration, exclusivity often not considered – while counterintuitive, few BF exclusively in earlier studies
 - Infant feeding not fixed
 - Data collection may rely on distant recall
- Age at follow-up varies enormously (3 to 70 y)

Methodological Issues

- Growth parameters measured: W/L, BMI, skinfold thickness, % body fat
- Degree and distribution of overweight
 - Breastfeeding tends to “reduce the tails” on both sides of the distribution
 - Best to examine proportions in overweight/obese categories rather than means/medians
- Variable sample sizes
- Multiple confounders

Association of Breastfeeding with Child Obesity (Review)

Study selection criteria:

- $N \geq 100$ per feeding group
- Age at follow-up > 3 y and < 20 y
- Outcome = % overweight or obese

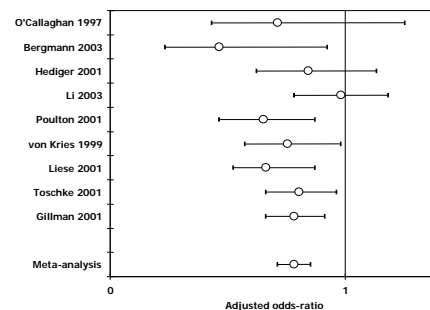
Dewey K. *Journal of Human Lactation*. 2003;19:9-18.

Association of Breastfeeding with Child Obesity (Review)

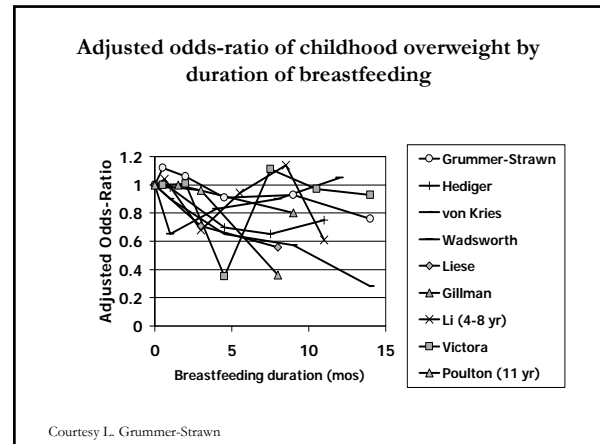
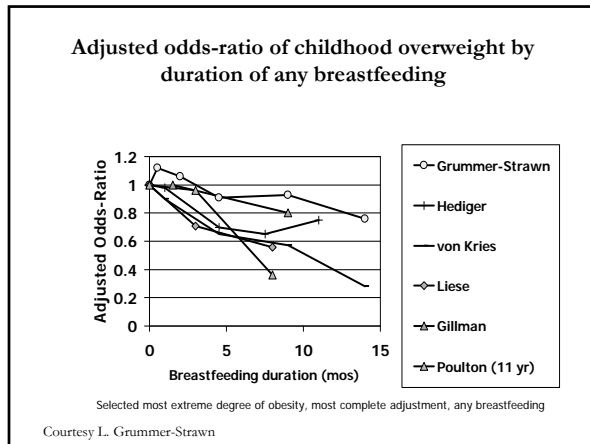
- 15 studies met the inclusion criteria: 12 showed an association between breastfeeding and a lower risk of obesity, at least in certain subgroups
- When BF defined as EBF, Full BF, or Predominant BF for 2-6 mo, 8 of 8 studies showed a significant association
- Ten studies controlled for maternal BMI; 7 of these showed a significant association
- Across studies, the association was more consistent for children 6-14 y of age than for preschool children or older adolescents

Dewey K. *Journal of Human Lactation*. 2003;19:9-18.

Effect of any breastfeeding vs. formula feeding on childhood obesity



Source: Arenz et al. *Intl J Obes*, 2004 (courtesy L. Grummer-Strawn)



Duration of Breastfeeding and Risk of Overweight: A Meta-Analysis

- Harder et al. – Am J Epidemiol (2005)
 - Included 17 studies in a meta-analysis to examine the association between duration of any BF and subsequent overweight (6 mo to 33 years later)
 - Compared anthropometric outcomes between BF infants and those excl FF from birth
 - Significant dose response effect found OR 0.96 per month of BF (CI 0.94 – 0.98) for the first 9 mo
 - Found similar results with meta-regression

17 studies from 1970s to recent

Pediatric Nutrition Surveillance System Study 2004 (PedNSS)

- BMI-for-age >95th percentile in CDC 2000 growth reference
- Assessed in 4-year-olds (4-4.9), n=177,304
- Logistic regression controlling for:
 - 1) Sex, race/ethnicity, birth weight
 - 2) + mother's age, education, pre-pregnancy BMI, pregnancy weight gain, pp smoking

Source: Grummer-Strawn L. & Mei Z, *Pediatrics* Feb. 2004

Key findings

- Longer breastfeeding associated with lower rates of overweight
 - esp. >6 mos
 - Minimal effect with breastfeeding <3 mos
 - No data on exclusivity
- Effects differ by race/ethnicity
 - No effect found in Blacks or Hispanics
 - Issue of limited sample size and exclusivity?

Source: Grummer-Strawn L. & Mei Z, *Pediatrics* Feb. 2004

Owen- Quantitative Reviews (2005)

- Examining evidence from observational studies of association between infant feeding and mean BMI throughout life
- Included 36 studies (28 published) with BF duration classified in 5+ ways (20 studies provided some information about exclusivity but not enough to use data)
- Outcomes assessed in many ways, ages 1-70 y

Owen Am J Clin Nutr 2005; 82: 1298-1307. *Pediatrics* 2005; 115: 1367-1377

Owen- Quantitative Reviews (2005)

- Outcomes
 - BF associated with slightly lower mean BMI
 - Mean BMI not best outcome
 - Mean difference was larger in smaller studies
 - Adjustment for SES, maternal smoking and BMI abolished the effect in 11 of 28 studies
 - Exclusivity and duration apparently associated with greater effect but few studies reported sufficient information

Owen Am J Clin Nutr 2005; 82: 1298-1307; Pediatrics 2005; 115: 1367-1377.

Infant Feeding and Obesity Throughout Life Course (2007)

- Data from 35, 256 participants in the Nurses Health Study II (followed 1989-2001)
- Mothers of participants provided detailed info on infant feeding (duration of BF and FF) and later growth
 - Recall issues?
 - Some 40 years later

Michels et al. Int J Obes, 2007 prepub.

Infant Feeding and Obesity Throughout Life Course (2007)

- Duration of BF, including exclusive BF not related to self-reported overweight (BMI)
- No association 25-42 years later – “Although BF promotes the health of mother and child, it is unlikely to play an important role in controlling the obesity epidemic.”
- Many concerns with approach and expectation for lifelong protection

Michels et al. Int J Obes, 2007.

PROBIT (Belarus) Follow-up (2007)

- “Effects of prolonged and exclusive breastfeeding on child height, weight, adiposity, and blood pressure at age 6.5 y: evidence from a large randomized trial”
 - Randomized trial of BFHI policies (n=17,046) – higher rates of exclusive breastfeeding at 3 mo (43.3% vs. 6.4%, intervention vs. control)
 - Follow-up (n=13,889) at 6.5 y to compare groups for height, weight, BMI, skinfolds, blood pressure
 - All analyses based on intention to treat

Kramer et al. Am J Clin Nutr 2007

PROBIT (Belarus) Follow-up (2007)

- Results
 - No significant difference between groups in height, BMI (mean and proportion over 85th percentile), circumferences, skinfolds or blood pressure
 - No difference when comparison was made between infants weaned in the first mo (n=1136) and those who BF exclusively for ≥6 mo and continued BF to 12 mo (n=215) – analysis based on compliance
 - Conclusion: “Previously reported beneficial effects on these outcomes may be the result of uncontrolled confounding and selection bias.”

PROBIT (Belarus) Follow-up (2007)

- Nearly all initiated BF, 73% in the intervention group, and 60% of the control group were still BF at 3 mo, 50% vs. 36% still BF at 6 mo, 20% vs. 11% at 12 mo
- Excl BF = 43% vs. 6% at 3 mo, 8% vs. 1% at 6 mo
- Childhood overweight relatively rare in Belarus (5% over the 95th percentile)
- Compared BF vs. BF, with very little excl BF after 3 mo
- 2 possibilities – no protection or excl BF must continue beyond 3 mo to have lasting effect

CDC Infant Feeding Practices II

- National mail survey of 1896 mothers
 - 2000 mothers of healthy newborns responded to questionnaires sent prenatally and through 1st year
 - Asked about intensity of breastfeeding and bottle-emptying behaviors
- Using weight-for-age z-score, identified factors associated with excess weight in late infancy
 - Infants with low BF intensity 2X (<20% of feeds) more likely to have excess weight in later infancy than those with high intensity (>80% of feeds)

Li et al. *Pediatrics* 2008; 122: S77-84.

Potential mechanisms for an effect

- Composition of infant formula relative to breast milk – leptin, ghrelin, adiponectin, lipid changes
- Learned self-regulation of intake – infants not coaxed to take more, breast empties
- Differences in feeding patterns and behavior
 - BF mothers less likely to be “controlling” feeders
- Residual confounding
- Reduction in risk for early growth acceleration

Early Growth Acceleration

- Rapid weight gain during infancy is correlated with childhood obesity
 - Stettler et al., 2002, 2005
 - Ong et al., 2000
 - Cameron et al., 2003
- Breastfed infants less like to have rapid gain in infancy

Stettler et al. (US)

Pediatrics. 2002;109:194-199.

- N = 19,397 children born 1959-1965
- Outcome: BMI > 95th percentile at age 7 y
- Rate of weight gain during the first 4 mo was associated with risk of child overweight, even after adjustment for weight at 1 y (linear relationship)
- Almost 20% of overweight attributable to having a rate of weight gain 0-4 mo in the top quintile (981 - 1860 g/mo; 2-4 lb/mo throughout 4 mo)

Stettler et al. (US)

Circulation. 2005;111:1897-1903.

- N = 653 children born 1965-1978 (participants in infant formula studies, solids as early as 28 d)
- Outcome: Self reported BMI \geq 25 in adulthood (age 20-32 yrs)
- Rate of weight gain during the first 8 days associated with risk of adult overweight, after adjustment for confounders
- 28% increase in risk for every 100g weight gain in first wk (CI 8% to 52%), avg gain 205 g, range = 0-430g
- Limitations: self report, 28% attrition, avg gain of FF infants 80g, interpretation?

Bottom Line

- **Exclusive BF** for at least 3-6 months is associated with a reduction in risk for overweight
- BF is not a panacea, it is the start of obesity prevention efforts
- BF promotion is likely to be an **important component** in larger efforts to reduce childhood obesity



Part II

Do Caregiver Perceptions of Infant Behavior Influence Risk for Childhood Obesity?

Infant Feeding at WIC

- 44% of participants BF exclusively for 1 mo
- 15% BF exclusively for 4 mo
- 5% BF exclusively for 6 mo
- WIC participants are more likely than non-WIC participants to exclusively formula feed their infants, start solids before 4 mo, and to use sugary drinks
 - These behaviors are associated with increased risk for childhood obesity

Jacknowitz et al. *Pediatrics* 2007; 119: 281-289.

Results from 3 UCD Studies

- Focus groups (2003-2008)
 - 87 English-speaking, 67 Spanish-speaking low-income mothers
- 4 WIC agencies
 - Community Resource Project WIC Sacramento, Solano County, Yolo County, Butte County
- Sessions recorded and transcribed (supplemented with field notes)
- Transcriptions reviewed and independently coded by 3 researchers
 - Coding differences resolved by consensus

Heinig et al. *J Hum Lact.* 2006;22:27-38. Heinig et al. *J Hum Lact* 2009 and unpublished data 2008.

Infant Feeding Intentions/Practices

- Majority planned to breastfeed (though most planned to mix feed)
- Many changed plans after the baby was born (gave formula in first mo)
- Most reported giving solids at 4 mo on pre-session survey, but earlier intro was mentioned frequently
 - Cereal not always considered a solid food
 - Few gave juice or sugary drinks

Heinig et al. *J Hum Lact.* 2006;22:27-38.

Results – Focus Groups (2003) “Breast is best.”

- Health messages regarding breastfeeding were loud and clear
 - “Helps them protect against viruses better, breastfeeding. It’s also very important for development of the brain and eyes.”
 - “My mom breastfed my brothers and so that was something I wanted to do with my son because, you know, that special bond, and I feel there’s a bond and it’s healthier.”

Heinig et al. *J Hum Lact.* 2006;22:27-38.

UCD Focus Groups (2003)

- Many mothers reported that their infants were not satisfied when they followed guidelines
 - We asked how could they tell?
 - Many of the mothers told us about their baby’s behavior



Heinig et al. *J Hum Lact.* 2006; 22: 27-38.

UC Davis Focus Groups (2003)

- Many mothers believe babies cry because of hunger (formula and cereal prevent hunger)
 - “When I gave formula, the baby no longer cried and that is when I decided not to give him breast milk.”



Heinig et al. J Hum Lact. 2006; 22: 27-38.

UC Davis Focus Groups (2003)

- They believe babies wake because of hunger
 - “The baby sleeps better with formula.”
 - “From the time she was maybe 3 or 4 months old, I started putting a little cereal in her bottle, and it was like at night. It would help her; she would be full and sleep through the night.”



Heinig et al. J Hum Lact. 2006; 22: 27-38.

UC Davis Focus Groups (2003)

- They think their babies will stay full longer if they are overfed
 - “My baby used to wake up, but now I am giving him formula if he is already full and he no longer wakes up.”



Heinig et al. J Hum Lact. 2006; 22: 27-38.

UC Davis Focus Groups (2003)

- Mothers are pressured by others to feed:
 - “His dad went and bought the formula and he still would wake up. Oh my God, I’m not going to get no sleep. His grandma, she went and bought the rice cereal and started mixing it up, and he’d eat it and he’d burp a little and then he started sleeping more and more because he was full, but before that he was not full, he was always hungry and crying. His dad would say, ‘Are you feeding him?’ ”

Heinig et al. J Hum Lact. 2006; 22: 27-38.

Results – Focus Groups (2003)

- Mothers understand what is best, but many believe that their circumstances *force* them to make other choices
 - Full, quiet, sleeping child is norm
- Mothers believe that health care providers/ support staff do not understand what they are experiencing
 - “They don’t see what you’re going through. They are not there to see that you can’t do it and you keep trying. It’s like, ‘You try it.’ ”

Heinig et al. J Hum Lact. 2006; 22: 27-38.

Feeding in Response to Baby Behavior

- We found that mothers feel overwhelmed by crying and waking
 - If breastfeeding, they start adding formula
 - Add more formula, and more formula
 - Start solid foods (cereal in the bottle)
 - Add other foods and fluids
 - Feed every time the baby makes noise



Coping with Stress

Solution is possible

- Problem Management
 - Seek information
 - Identify solutions
 - Attempt and evaluate solutions

Solution is not possible

- Emotional Regulation
 - Reinterpret goals
 - Disengage, detach
 - Denial of consequences
 - Anger, aggression

Glanz J Occup Med 1992; 34: 1071-8.

The Project

WIC
Baby Behavior Study



Helping you understand your baby
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Fit WIC Baby Behavior Project


- 3 year grant from USDA WIC Special Projects Funds
- Purpose: To investigate how education and support for positive caregiver-infant interactions would influence infant feeding among WIC participants

This project has been funded at least in part with Federal funds from the U.S. Department of Agriculture, Food and Nutrition Service. The contents of this publication do not necessarily reflect the view or policies of the U.S. Department of Agriculture, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

Study Design


- 3-year quasi-randomized educational intervention project (8 sites, 4 each in No. and So. Cal.)
 - Year 1: Material development, staff training, and baseline data collection
 - Year 2: Intervention period
 - Year 3: Post-intervention data collection, write-up, and dissemination
- Concept: Create a *clinic environment* supporting positive caregiver-infant interactions
 - Social marketing materials, staff training, handouts, classes, activities, incentives


Our Study Approach





- Train staff to understand why babies behave the way they do
- Provide staff with tools (messages, methods, and materials) to help them feel safe and comfortable sharing baby behavior information with parents
- Use social marketing materials to tell parents that WIC is a place to learn about baby behavior

Handouts









Social Marketing Materials

- Posters were created to advertise that new information was available
- Activities and games were available in the waiting areas to promote messages

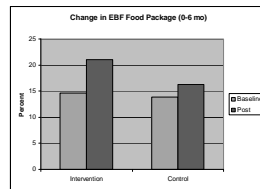


Infant Behavior Research

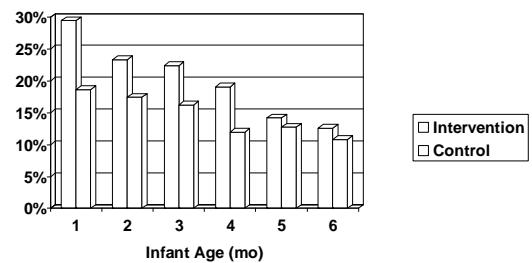
- Infant behavior has been explored and documented for more than 30 years
 - Brazelton, 1973
 - Barnard 1978, 1987, 1993
- Teaching parents about infant behavior is not new (Leitch, Nur Res, 1999)
 - Interventions have been shown to improve mother-infant attachment and promote infant development
- Current education is complex and time consuming, WIC has infrequent brief contacts with participants

All Sites Combined: WIC Food Package Selection

- Increase in Excl BF Food Package
 - Intervention = 6.3% (43% higher than baseline)
 - Control = 2.3%
- Decreased formula use
 - Reduction in cans of formula used while caseload increased



Exclusive BF Food Package by Age



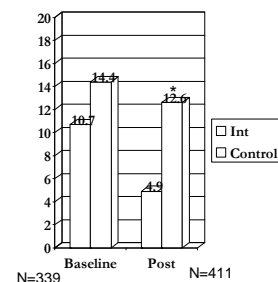
Infant Weights

- Weights of 5-7 month-old infants obtained in clinics using scales provided
 - Challenging to obtain
 - Missing data made many weights unusable
 - Made assumptions about weight of infant clothing



Infants >95th percentile wt/age

- Attained weight for age > 95th percentile 5-7 mo



According to WHO growth standards

NS *P<.01

Baby Behavior at WIC and Beyond

- California State WIC will use messages statewide
- Oregon State WIC staff has received training – looking to expand effort
- Efforts ongoing to integrate baby behavior messages in other programs



Materials on FitWIC website

- All of the WIC Baby Behavior materials (handouts, posters, etc) will be posted on the Fit WIC website, upon approval by USDA Food and Nutrition Service
- Class outlines and training materials will also be shared, upon approval by USDA FNS



http://www.nal.usda.gov/wicworks/Sharing_Center/statedev_FIT.html

Secrets of Baby Behavior

- More information on our website
<http://lactation.ucdavis.edu>
- Read our blog at:
www.secretsofbabybehavior.com
- We're on **Facebook** too!



Questions?

