Breastfeeding: Long and short term effects on infant and mother

Complementary feeding

Winterschool 2010-2011. Individual Health and Nutrition

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Problems with observational studies of breastfeeding

- Confounding
  - Parental education
  - Socioeconomic group
  - Parental BMI
  - Birthweight
  - Caring ability
  - Stimulation of child
- Residual confounding
- Reverse causation

Randomised studies

- Preterm infants randomised to breast milk or infant formula
  - Allan Lucas, Atul Singhal, Mary Fewtrell
- Belarus PROBIT study
  - Michael Kramer

Systematic reviews and meta-analysis

Evidence on the long-term effects of breastfeeding

World Health Organization 2007
Main conclusions from WHO systematic review and meta-analysis

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Effect</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>-1.21 (-1.7 to -0.7)</td>
<td>Smaller effect than other intervention</td>
</tr>
<tr>
<td>Systolic - mmHg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total s-cholesterol</td>
<td>-0.18 (-0.3 to -0.06)</td>
<td>Larger than other interventions</td>
</tr>
<tr>
<td>mmol/l</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight or obesity</td>
<td>0.78 (0.72 to 0.84)</td>
<td>Other interventions no significant effect</td>
</tr>
<tr>
<td>Odds ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type II diabetes</td>
<td>0.63 (0.45 to 0.89)</td>
<td>Similar to other interventions</td>
</tr>
<tr>
<td>Odds ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligence IQ points</td>
<td>4.9 (3.0-6.9)</td>
<td>Other interventions?</td>
</tr>
</tbody>
</table>

U.S. Department of Health and Human Services
Agency of Health and Human Services, 2007
Evidence Report: Technology Assessment
Number 153

Breastfeeding and Maternal and Infant Health Outcomes in Developed Countries

US Department of Health Evidence report - 2007

• BF associated with reduced risk of
  – Acute otitis media
  – Non-specific gastroenteritis
  – Severe lower respiratory tract infections
  – Atopy dermatitis
  – Asthma (young children)
  – Obesity
  – Type 1 and 2 diabetes
  – Childhood leukemia
  – SIDS
  – NEC

US Department of Health Evidence report - 2007

• No relationship between BF in term infants and cognitive performance
• Relationship between BF and cardiovascular disease unclear
• Unclear relationship between BF and infant mortality in developed countries

US Department of Health Evidence report – 2007 Maternal outcomes

• BF associated with reduced risk of type II diabetes and breast and ovarian cancer
• Early cessation or no BF associated with increased risk of postpartum depression
• No effect on osteoporosis
• Effect of BF on postpartum weight loss unclear

Infections and immune effects
Relative Risk of Death from ARI and Diarrhea Among Non-Breastfed Children in Two Studies, Compared to Breastfed Infants (set at ARO of 1)


Adjusted Relative Odds of Mortality

Risk of infectious diseases 0-6 mo

Duijts et al. Pediatrics 2010

Imune systems in Human Milk

- Leucocytes
  - B lymphocytes
  - Macrophages
  - Neutrophiles
  - T lymphocytes*
- Secretory immunoglobulin A (SIgA)
- Oligosacharides
- Bifidus factor
- Lysozyme
- Lactoferrin
- Gamma-interferon*
- Nucleotides*
- Cytokines*

Protective effect towards immune related diseases later in life

- Type I diabetes
  - OR 0.75 (0.58-0.96).
  - European Multicenter study, Diabetes care 2002
- Crohn's disease
  - RR 2.3 if not breastfed
  - Koletzko S 1988
- Childhood cancer
  - 3 out of 9 studies found significant protection, mainly against Hodgkins disease.
  - Davies Int J Cancer 1998

Breastfeeding and allergic disease

  - Odijk et al. Allergy 2003;58:833
- Breastfeeding *seems* to protect from the development of atopic disease; the effect appears even stronger in families with atopic disease.
Growth

Mean Z-scores of healthy breastfed infants relative to the NCHS/WHO reference

Source: An Evaluation of Infant Growth, WHO, 1994

Eligibility criteria of individuals

- No health, environmental or economic constraints on growth
- Mother willing to follow feeding recommendations – Full BF 4-6 mo and continued breastfeeding for at least 9-12 mo
- Term birth
- Single birth
- Lack of significant perinatal morbidity
- No smoking mothers (before and after delivery)

SKOT Cohort
312 healthy term infants from Copenhagen
54 % breastfed at 9 months

<table>
<thead>
<tr>
<th>z-scores</th>
<th>HAZ</th>
<th>BAZ</th>
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<tr>
<td></td>
<td>BF9</td>
<td>BF&lt;9</td>
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<tr>
<td>9 mo</td>
<td>0.2</td>
<td>0.5**</td>
</tr>
<tr>
<td>18 mo</td>
<td>0.0</td>
<td>0.3**</td>
</tr>
<tr>
<td>36 mo</td>
<td>-0.1</td>
<td>0.2*</td>
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</table>

Implementation WHO Child Growth Standards
November 2009

USA – CDC 0-2 y
Denmark 0-5 y
French speaking Belgium 0-5 y?
Breastfeeding and IGFs

- IGF-I lower in BF infants at 6 mo (n=321)
  - Socha et al. JPGN 2004; 39, 5547 (abstract)
- IGF-I lower in BF infants before 4 mo (n=142)
- IGF-I lower in breastfed infants; age 3 mo (n=185)
  - Chellakooty et al. J Clin Endocrinol Metab 2006, 91, 820-6

Breastfeeding and IGF-I later in life
ALSPAC Cohort

IGF-I measured at 7-8 year, n=488
- Never breastfed reference ~142 ng/ml
- Partial breastfed + 6.1 ng/ml
- Excl. breastfed (≥ 2 mo) +13.8 ng/ml
  
p=0.04

Breastfeeding and adult stature
The Boyd-Orr cohort study (UK, born 1920-30, n=2995)

- Breastfed boys were 2.5 cm taller (p=0.002)
- Breastfed girls were 1.0 cm taller (p=0.12)
- The effect was mainly in leg length and not trunk length

IGF-I concentration at 17y as a function of IGF-I concentration at 9 mo (n=40)

p=0.014

Larnkjær et al
Growth Horm IGF Res
2009
Leunissen JAMA 2009
Chomtho AJCN 2008
Ekelund AJCN 2006

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<th>18-24 y</th>
<th>11 y</th>
<th>17 y</th>
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<td>0-3 mo weight gain</td>
<td>Positive assoc</td>
<td>Positive assoc</td>
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<tr>
<td>3-6 mo weight gain</td>
<td>No assoc</td>
<td>Positive assoc</td>
</tr>
<tr>
<td>6-9 mo weight gain</td>
<td>No assoc</td>
<td>No assoc</td>
</tr>
<tr>
<td>9-12 mo weight gain</td>
<td>No assoc</td>
<td>No assoc</td>
</tr>
<tr>
<td>3-6 y weight gain</td>
<td>NE</td>
<td>NE</td>
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Cardiovascular and metabolic risk factors
Fat mass
Waist circ.
Trunk fat
Fat mass
Waist circ.

Significant associations between weight gain in 5 periods and outcomes at 9 years

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<tr>
<td>3-6 mo weight gain</td>
<td>No assoc</td>
<td>Positive assoc</td>
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<td>3-6 y weight gain</td>
<td>NE</td>
<td>NE</td>
<td>Positive assoc</td>
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Wells et al. Int J Obesity 2005

Breast feeding and risk of obesity
Quantitative Review

OR=0.87 (0.85-0.89)

Possible mechanisms for protective effect of BF on childhood obesity

- Low protein intake in BF infants
- Bioactive factors in human milk
- Better sateity regulation in BF infants
- Parental interest/care/neglect
- Residual confounding
Breastmilk composition and taste changes during a feeding

This provides satiety signals for the infant to stop suckling

The BF infant plays a more active role in the feeding process

Negative effects on long term health

- HIV
- Pollutants

Cognitive development

IQ

AJCN 1999; 70:525

Breast-feeding and cognitive development: a meta-analysis

Anderson JW et al. AJCN 1999; 70:525

Contrast in DHA exposure between BF and non-BF group

Potential mechanism?
Factors associated with the feeding situation?

Physical and psychological contact during breastfeeding?
- also a cause effect

Temporal peri-partal impairment in memory and attention and its possible relation to oxytocin concentration
Silber at al. Life Sci 1990;47:57-65

- 20 pregnant women and controls
- Cognitive tests of memory and attention
- Cases improved their performance significantly 6-12 months after delivery compared to late pregnancy and lactation (at 3 months)

Selective effects of oxytocin on human memory
Heinrichs et al 2004, Physiology and behaviour 2004

- 38 healthy men
- Intranasal oxytocin or placebo 50 min before tests
- Oxytocin significantly impaired recall performance

From the discussion
- Other studies show impaired cognitive performance in the presence of improved social memory or social behaviour
- Isolate the mother from distracting stimuli during lactation
- Focus maternal attention on the interaction between mother and infant

Oxytoxin
  - Administration of oxytocin to male humans enhances the encoding of positive social information to make it more memorable. Results suggest that oxytocin could enhance social approach, intimacy, and bonding in male humans
  - Oxytocin increases trust in humans. These results concur with animal research suggesting an essential role for oxytocin as a biological basis of prosocial approach behaviour.

”Breastfeeding Brain” (maternal)
The Association Between Duration of Breastfeeding and Adult Intelligence

JAMA 2002;287:2365-71

OBJECTIVE: To determine the association between duration of effort breastfeeding and intelligence in young adult breastfed persons.

Methods: A longitudinal study of breastfed and non-breastfed women and their offspring, started in 1931 and ended in 1970. The sample was divided into 5 categories based on duration of breastfeeding, as measured by physician interview with mothers at 1 year examination.

Result: A number of studies suggest a positive association between breastfeeding and higher development in early and middle childhood; however, the only prior study that examined the association between breastfeeding, and intelligence in adults had been methodologically weak.

Conclusion: In our study, the association between duration of effort breastfeeding and intelligence in young adult breastfed persons was significant.

Breast cancer and BF

Collaborative group on Hormonal Factors in Breast Cancer

Lancet 2002

- Reanalysis of individual data from 47 studies in 30 countries with 50,302 women
- RR risk of breast cancer decreases by
  - 4.3% for every 12 mo of breastfeeding (p<0.0001)
  - 7% for each birth
- Can explain most of the difference between breast cancer in developed and developing countries

Lactation and Maternal Measures of Subclinical Cardiovascular Disease

Elsasser Bandschneider, MD, MA, Caroline K. McCarty, MD, Ping G. Tupper, MD, Rebecca Thorsten, RN, Jodie Janson, RN, Kevin D. Mcdonald, MD, and Kim Natren-Teusell, MD

297 women examined 45-58 y old

Electron beam tomography for aortic calcification

 Mothers who had not breastfed remained more likely to have aortic calcification than mothers who had consistently breastfed (OR 5.26, 95% CI 1.47–20.00).
Conclusions

• Exclusive breast-feeding for around 6 months is a desirable goal, but partial breast-feeding as well as breast-feeding for shorter periods of time are also valuable.
• Continuation of breastfeeding after the introduction of complementary feeding is encouraged as long as mutually desired by mother and child.
• The role of health care workers, including paediatricians, is to protect, promote, and support breast-feeding.
• Health care workers should be trained in breast-feeding issues and counselling, and they should encourage practices that do not undermine breast-feeding.
• Societal standards and legal regulations that facilitate breast-feeding should be promoted, such as providing maternity leave for at least 6 months and protecting working mothers.

Complementary feeding

4-6 mdr

≈ 6 mdr (4 mdr)
Important issues in complementary feeding

- Protein content
- Fat content and quality
- Energy density
- Iron content
- Sugar content

Dramatic change in fat and protein content

- Fat energy percentage
  - Breastmilk - 52%
  - Family food – 25-30%
- Protein energy percentage
  - Breastmilk – 5%
  - Family Food 15-20%

ESPGHAN paper – conclusions I

- Exclusive or full breast-feeding for about 6 mo is a desirable goal
- Complementary feeding should not be introduced in any infant before 17 weeks and all infants should start complementary feeding by 26 weeks
- Although there are theoretical reasons why different complementary foods may have particular benefits for breast-fed or formula-fed infants, the Committee considers that attempts to devise and implement separate recommendations for breast-fed and formula-fed infants may present considerable practical difficulties and are therefore undesirable

ESPGHAN paper – conclusions II

- Avoidance or delayed introduction of potentially allergenic foods, such as fish and eggs, has not been convincingly shown to reduce allergies, either in infants considered at risk for the development of allergy or in those not considered to be at risk
- During the complementary feeding period, >90% of the iron requirements of a breast-fed infant must be met by complementary foods. These should provide sufficient bioavailable iron.
- Cow’s milk is a poor iron source. It should not be used as the main drink before 12 months, although small volumes may be added to complementary foods.

“Historically focus on prevention of malnutrition. Focus has shifted to a balanced protein and energy intake and preventing risk of long-term disease. Most current guidelines not evidence based”

BOMAT?
**ESPGHAN paper – conclusions III**

- It is prudent to avoid both early (<4 mo) and late (7 mo) introduction of gluten and to introduce gluten gradually while the infant is still breast-fed because this may reduce the risk of CD, type 1 diabetes mellitus, and wheat allergy.
- Infants and young children receiving a vegetarian diet should receive a sufficient amount (500 mL) of milk (breast milk or formula) and dairy products.
- Infants and young children should not receive a vegan diet.

**Fat intake and adiposity**

- No association in cross-sectional studies of 2-5 y old children between FE% and BMI (Davies 1997, Shea at al 1993) or body fat% (Atkin and Davies 2000)
- No association between fat intake and body fat in longitudinal study 0-8y (Boulton and Margarey 1995)
- No difference in body composition at 2 y between children consuming milk with 2.0 or 3.5% fat (Wosje et al 2001)

**Conclusions from working group of the Danish Nutrition Council 2004: Children, Fat and Cardiovascular disease**

- Limited scientific basis
- Prudent to give recommendations
- Avoid very low fat content
  - No fat reduced milk before 12 mo
  - No skimmed milk before 3 y
  - Add a teaspoon of vegetable fat or oil for each serving of homemade porridge or vegetable mash up to 12 mo
- Prudent to reduce saturated fat to 10 E% at 12 months
- Use semi-skimmed milk (1.5%) from 12 months

**Fat**
Dramatic change in dietary protein content during weaning

- Protein energy percentage
  - Breastmilk: 5%
  - Infant formula: 9%
  - Whole cow’s milk: 20%
  - Family Food: 15-20%
  - Skimmed milk: 45%

High protein intake in late infancy

- Safe protein intake 9-12 mo: 1g/kg
- Mean protein intake 3-5 g/kg
- 90-95 percentile in Danish and Italian studies: 6-7 g/kg
- 1 liter cow’s milk at 12 months equal to 3.5 g protein/kg

All infants in industrialized countries have a sufficient protein intake during the complementary feeding period

Cow’s milk

Cow’s milk and linear growth in industrialized and developing countries

Camilla Hoppe, Christian Molgaard, and Kim F. Michaelsen

Department of Human Nutrition and Center for Advancement of Food Studies, The Royal Veterinary and Agricultural University, DK-1833 Frederiksberg C, Denmark; email: hoppe@vet.dk

Key Words: growth factors, IGF-I, insulin, noncommunicable diseases, bioactive peptides

Abstract: The strongest evidence that cow’s milk stimulates linear growth comes from observational and intervention studies in developing countries that show considerable effects. Additionally, many observational studies from well-nourished populations

Milk stimulate IGF-I and linear growth

We speculate that it is components in the protein fraction that stimulate IGF-I

Milk has evolved as a diet to support the newborn during a period of high growth velocity
High postnatal growth velocity has been associated with

- Obesity
- Cardiovascular disease
- Type 2 diabetes
- Metabolic syndrome
- Endocrine cancers

Protein intake at 9 mo compared with anthropometry at 10 y

(Partial correlation coefficients controlled for sex, n=105)

<table>
<thead>
<tr>
<th>Weight</th>
<th>Height</th>
<th>BMI</th>
<th>Body fat% (DEXA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE%</td>
<td>0.29**</td>
<td>0.28**</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Hoppe et al. AJCN

What is optimal growth?

Fatness/leanness at 12 months?

Negative effects of catch-up growth?

Linear growth: Is more always better?

Mælk giver øget slim i svaelige og luftveje – positivt fordi det renser ud

Mine bedste råd

Mælkprodukter bør være økologiske og uhydroponiserede. Server de sundt mælkeprodukter som fløde, klædet smør, og kogt varm mælk.

Undgå kold mælk og server i stedet varm mælk宕t med fordeler fremmende krydderier.

Mælk bør indtastes separat fra andre fødevare.

Undgå alle fejldækkende mælkeprodukter og bland i stedet sodmælk eller fløde med vand.

Brug fløde i stedet for mælk til madlavning eller bageri. Vælg komfort for fælomælk eller godsmælk og undgå sojamed.

Mælk giver øget slim i svaelig og luftveje – positivt fordi det renser ud
Dyr fyldes med fortvivlelse og desperation og danner stress hormoner
når det skal slægtes. Når man spiser dyr spiser man samtidig disse negative
kemiske stoffer.

Det samme gælder fisk. Man har vist at de udsætter adrenalin og noradrenalin
i blodet straks de bliver fangt.