Breastfeeding: Long and short term effects on infant and mother

Complementary feeding

Winterschool 2010-2011. Individual Health and Nutrition

Kim Fleischer Michaelsen
Department of Human Nutrition
University of Copenhagen
Pediatric Nutrition Unit, Juliane Marie Centre, Rigshospitalet

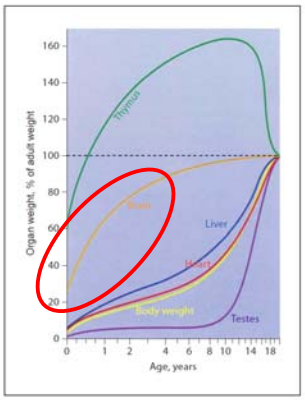


Fig. 3. Relative growth of different organs as percentage of adult body weight. Modified from Koletzko [8].

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

Main conclusions from WHO systematic review and meta-analysis

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

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

Prepared by:
Tufts-New England Medical Center Evidence-Based Practice Center
Boston, Massachusetts

Investigators
Stanley Ip, M.D., Project Leader
Mei Chung, M.P.H.
Gowri Raman, M.D.
Priscilla Chew, M.P.H.
Nombulelo Magula, M.D.
Deirdre DeVine, M.Litt., Project Manager
Thomas Trikalinos, M.D., Ph.D.
Joseph Lau, M.D., Principal Investigator

http://www.ahrq.gov/clinic/tp/brfouttp.htm Warning: 415 pages

US Department of Health Evidence report - 2007

- BF associated with reduced risk of
  - Acute otitis media
  - Non-specific gastroenteritis
  - Severe lower respiratory tract infections
  - Atopic dermatitis
  - Astma (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

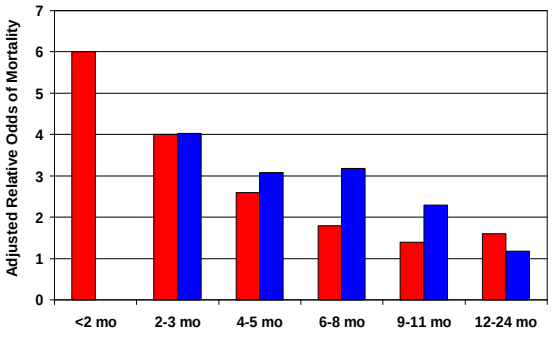
- BF associated with reduced risk of type II diabetes and breast and ovarian cancer
- Early cessation or no BF associated with increased risk of postpartum depression
- No effect on osteoporosis
- Effect of BF on postpartum weight loss unclear

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)

WHO Collaborative Team on the Role of Breastfeeding in the Prevention of Infant Mortality, Lancet 2000;55:451-5

Rutstein,S. International Journal of Gyn/Obstet. 2005; 89:S7-S24..



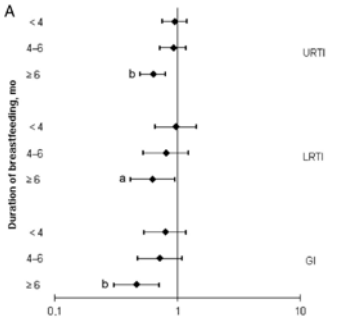
Prolonged and Exclusive Breastfeeding Reduces the Risk of Infectious Diseases in Infancy

AUTHORS: Liesbeth Duijts, MD, PhD,[a,b] Vincent W. V. Jaddoe, MD, PhD,[a,b,c] Albert Hofman, MD, PhD,[c] and Henriëtte A. Moll, MD, PhD[b]

[a]Generation R Study Group, Rotterdam, Netherlands; and Departments of [b]Pediatrics and [c]Epidemiology, Erasmus Medical Center, Rotterdam, Netherlands

PEDIATRICS 2010

Risk of infectious diseases 0-6 mo



Duijts et al. Pediatrics 2010

Immune systems in Human Milk

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

Protective effect towards immune related diseases later in life

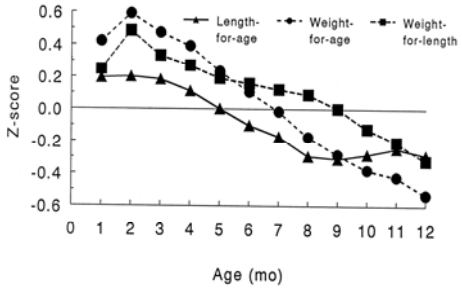
- Type I diabetes
  - OR 0.75 (0.58-0.96).
    - European Multicenter study, Diabetes care 2002
- Crohn's disease
  - RR 2.3 if not breastfed
    - Koletzko S 1988
- Childhood cancer
  - 3 out of 9 studies found significant protection, mainly against Hodgkins disease.
    - Davies Int J Cancer 1998

Breastfeeding and allergic disease

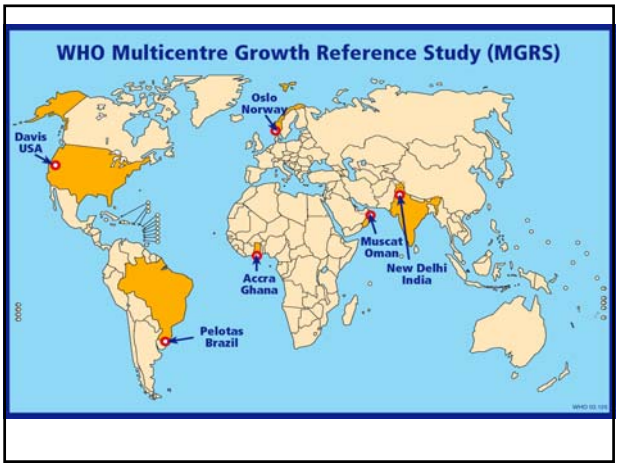
- Multidisciplinary review of the litterature (1966-2001) on the mode of early feeding in infancy and its impact on later atopic manifestations.
  - Odijk et al. Allergy 2003;58:833
- Breastfeeding *seems* to protect from the development of atopic disease; the effect appears even stronger in families 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

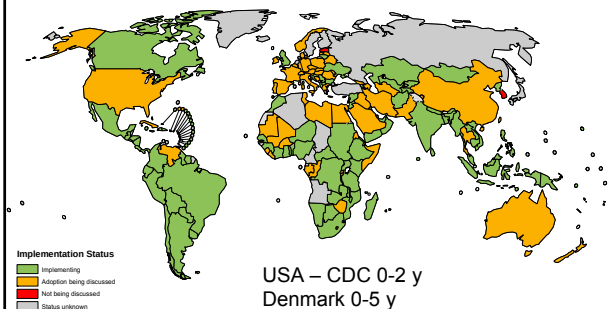
- No health, environmental or economic constraints on growth
- Mother willing to follow feeding recommendations – Full BF 4-6 mo and continued breastfeeding for at least 9-12 mo
- Term birth
- Single birth
- Lack of significant perinatal morbidity
- No smoking mothers (before and after delivery)

SKOT Cohort

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

z-scores	HAZ		BAZ	
	BF9	BF<9	BF9	BF<9
9 mo	0.2	0.5**	0.2	0.5**
18 mo	0.0	0.3**	0.4	0.7**
36 mo	-0.1	0.2*	0.3	0.3

Implementation WHO Child Growth Standards November 2009



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

Comment in press for the December issue of JPGN

SUPPLEMENT

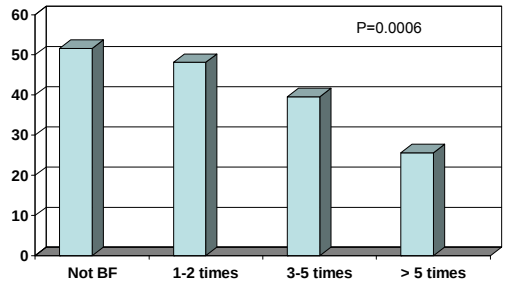
WHO Growth Standards—Should They be Implemented as National Standards?

Kim Fleischer Michaelsen

Breastfeeding and IGFs

- IGF-I - **lower** in BF infants at 6 mo (n=321)
  - Socha et al. JPGN 2004; 39, S547 (abstract)
- IGF-I - **lower** in BF infants before 4 mo (n=142)
  - Savino et al. Acta Pæd 2005; 94: 531-537
- IGF-I - **lower** in breastfed infants; age 3 mo (n=185)
  - Chellakooty et al. J Clin Endocrinol Metab 2006, 91, 820-6

IGF-I at 9 mo and number of breastfeedings



Madsen A et al. unpublished

Breastfeeding and IGF-I later in life

ALSPAC Cohort

Martin et al. Clin Endocrinol 2005, 62, 728-37

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

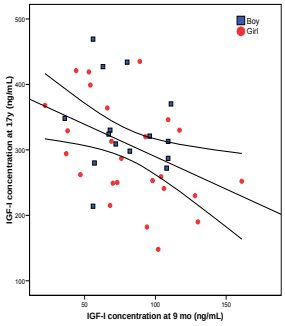
p=0.04

Breastfeeding and adult stature

The Boyd-Orr cohort study (UK, born 1920-30, n=2995)
Martin et al. Arch Dis Child 2002, 87, F193-201

- 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)

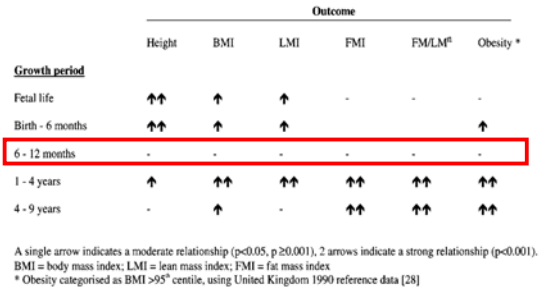


p=0.014

Larnkjær et al
Growth Horm IGF Res
2009

	Leunissen JAMA 2009	Chomtho AJCN 2008	Ekelund AJCN 2006
	18-24 y	11 y	17 y
	Cardiovascular and metabolic risk factors	Fat mass Waist circ. Trunk fat	Fat mass Waist circ.
0-3 mo weight gain	Positive assoc.	Positive assoc	Positive assoc
3-6 mo weight gain	No assoc	Positive assoc	
6-9 mo weight gain	No assoc	No assoc	NE
9-12 mo weight gain	No assoc		NE
3-6 y weight gain	NE	NE	Positive assoc

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



A single arrow indicates a moderate relationship ($p<0.05$, $p \geq 0.001$), 2 arrows indicate a strong relationship ($p<0.001$).
BMI = body mass index; LMI = lean mass index; FMI = fat mass index
* Obesity categorised as BMI >95th centile, using United Kingdom 1990 reference data [28]

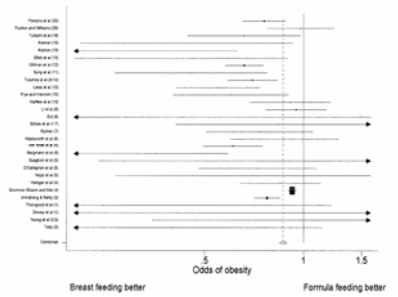
Wells et al. Int J Obesity 2005

Obesity

Breast feeding and risk of obesity

Quantitative Review

Owen CG et al. Pediatrics 2005;115:1367-77



OR=0.87 (0.85-0.89)

AJCN 2008

Late introduction of complementary feeding, rather than duration of breastfeeding, may protect against adult overweight[1–3]

Lene Schack-Nielsen, Thorkild IA Sørensen, Erik Lykke Mortensen, and Kim Fleischer Michaelsen

Conclusion: The findings of this study suggest that introduction of CF at a later age (within the range of 2 to 6 mo) is protective against overweight in adulthood but do not support a protective effect of a longer duration of BF.

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

Better sateity regulation

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[1–3]

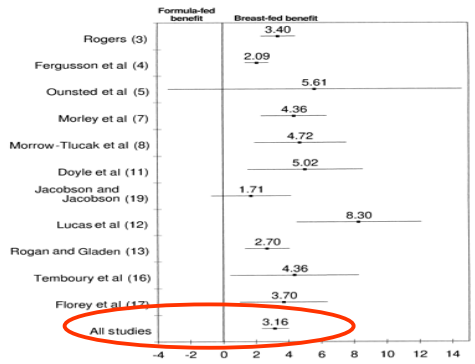
James W Anderson, Bryan M Johnstone, and Daniel T Remley

See corresponding editorial on page 433.

ABSTRACT

Background: Although the results of many clinical studies suggest that breast-fed children score higher on tests of cognitive function than do formula-fed children, some investigators have

fed (2–19). Although many investigators report that differences in cognitive development persist after adjustment for important covariates (3–8, 11–13, 16, 17), other investigators (9, 18, 19) suggest that these differences are not significant after appropriate



Anderson JW et al. AJCN 1999; 70:525

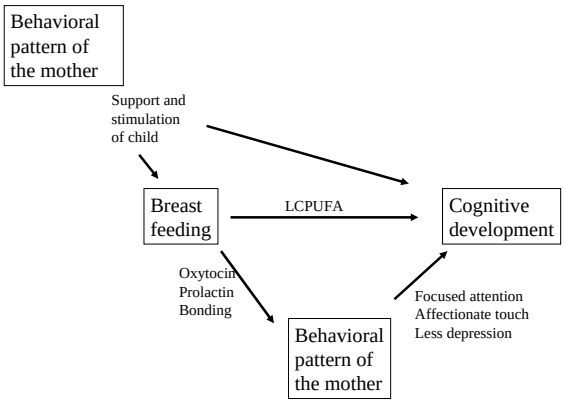
Potential mechanism?

Contrast in DHA exposure between BF and non-BF group

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 lactatioon (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

- Guastella AJ et al. Biol Psychiatry. 2008;64:256-8.
  - 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
- Kosfeld M et al, Nature 2005 435:673-6.
  - 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)

JAMA 2002;287:2365-71

ORIGINAL CONTRIBUTION

The Association Between Duration of Breastfeeding and Adult Intelligence

Erik Lykke Mortensen, PhD
Kim Fleischer Michaelsen, MD, ScD
Stephanie A. Sanders, PhD
June Machover Reinisch, PhD

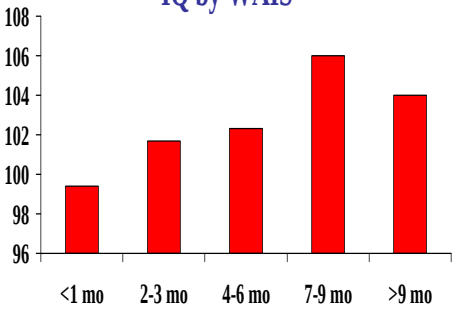
Context A number of studies suggest a positive association between breastfeeding and cognitive development in early and middle childhood. However, the only previous study that investigated the relationship between breastfeeding and intelligence in adults had several methodological shortcomings.

Objective To determine the association between duration of infant breastfeeding and intelligence in young adulthood.

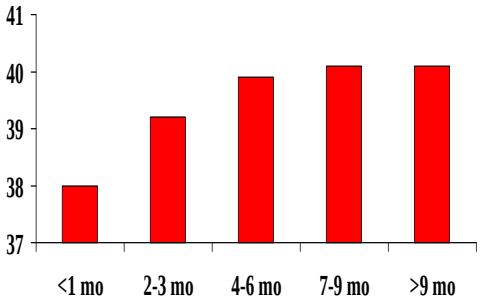
Design, Setting, and Participants Prospective longitudinal birth cohort study conducted in a sample of 973 men and women and a sample of 2280 men, all of whom were born in Copenhagen, Denmark, between October 1959 and December 1961. The samples were divided into 5 categories based on duration of breastfeeding, as assessed by physician interview with mothers at a 1-year examination.

A NUMBER OF STUDIES HAVE SUGgested a positive association between breastfeeding and cognitive and intellectual development in early and middle childhood.[1,2] However, studies of correla-

973 males and females (27.7 y)
IQ by WAIS



2280 males (18.7 y)
IQ by BPP



Maternal effects

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

Eleanor Bimla Schwarz, MD, MS, Candace K. McClure, PhD, Ping G. Tepper, PhD, Rebecca Thurston, PhD, Imke Janssen, PhD, Karen A. Matthews, PhD, and Kim Sutton-Tyrrell, DrPH

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).

Breast-feeding: A Commentary by the ESPGHAN Committee on Nutrition

ESPGHAN Committee on Nutrition: *[1]Carlo Agostoni, †Christian Braegger, ‡Tamas Decsi, §Sanja Kolacek, ||[1]Berthold Koletzko, ¶[1]Kim Fleischer Michaelsen, #Walter Mihatsch, **Luis A. Moreno, ††John Puntis, ‡‡[2]Raanan Shamir, §§Hania Szajewska, ||||[3]Dominique Turck, and ¶¶Johannes van Goudoever

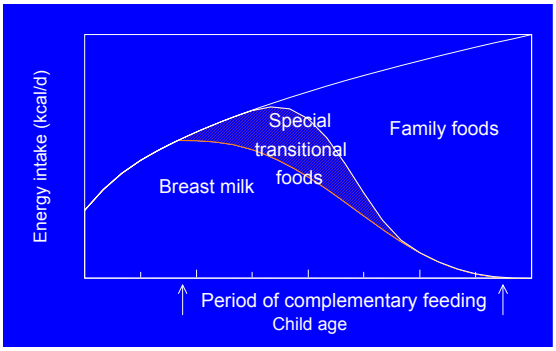
JPGN 2009

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

Complementary feeding



4-6 mdr

≈ 6 mdr (4 mdr)

efsa
European Food Safety Authority

EFSA Journal (2009) 7(12): 1423

SCIENTIFIC OPINION

Scientific Opinion on the appropriate age for introduction of complementary feeding of infants[1]

EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

Following a request from the Commission, the Panel on Dietetic Products, Nutrition and Allergies was asked to deliver a scientific opinion on the appropriate age for the introduction of complementary food for infants in the EU. Many European countries have adopted the WHO recommendation for the duration of exclusive breast-

Late introduction of complementary feeding, rather than duration of breastfeeding, may protect against adult overweight[1–3]

Lene Schack-Nielsen, Thorkild IA Sørensen, Erik Lykke Mortensen, and Kim Fleischer Michaelsen

Conclusion: The findings of this study suggest that introduction of CF at a later age (within the range of 2 to 6 mo) is protective against overweight in adulthood but do not support a protective effect of a longer duration of BF.

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%

Journal of Pediatric Gastroenterology and Nutrition
46:99–110 © 2008 by European Society for Pediatric Gastroenterology, Hepatology, and Nutrition and North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition

Medical Position Paper

Complementary Feeding: A Commentary by the ESPGHAN Committee on Nutrition

ESPGHAN Committee on Nutrition: *Carlo Agostoni, †Tamas Decsi, ‡‡Mary Fewtrell, §Olivier Goulet, ¶Sanja Kolacek, ||¹Berthold Koletzko, **³Kim Fleischer Michaelsen, ††Luis Moreno, ‡‡John Puntis, §§Jacques Rigo, ¶¶Raanan Shamir, ||||²Hania Szajewska, ***Dominique Turck, and †††Johannes van Goudoever

*San Paolo Hospital, University of Milano, Milano, Italy, †Department of Paediatrics, University of Pecs, Hungary, ‡Institute of Child Health, London, UK, §Hôpital Necker Enfants-Malades, University of Paris Descartes, Paris, France, ¶Children's Hospital, Zagreb Medical University, Croatia, ||Dr von Hauner Children's Hospital, University of Munich, Germany, **Department of Human Nutrition, University of Copenhagen, Denmark, ††Escuela Universitaria de Ciencias de la Salud, Universidad de Zaragoza, Zaragoza, Spain, ‡‡Leeds General Infirmary, Leeds, UK, §§CHR Citadelle, University of Liege, Liege, Belgium, ¶¶Meyer Children's Hospital of Haifa, Ruth and Bruce Rappaport School of Medicine, Technion, Haifa, Israel, ||||Medical University of Warsaw, Poland, ***University of Lille, Lille, France, and †††Erasmus MC/Sophia Children's Hospital, Rotterdam, The Netherlands

"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 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

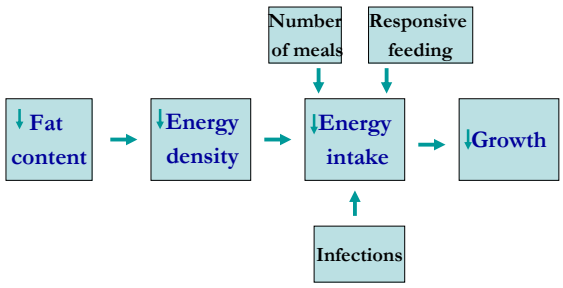
ESPGHAN paper – conclusions II

- 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.

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



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

Protein

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

Annu. Rev. Nutr. 2006. 26:131–73
doi: 10.1146/annurev.nutr.26.010506.103757

First published online as a Review in Advance on April 21, 2006

COW'S MILK AND LINEAR GROWTH IN INDUSTRIALIZED AND DEVELOPING COUNTRIES

Camilla Hoppe, Christian Mølgaard, and Kim F. Michaelsen
Department of Human Nutrition and Center for Advanced Food Studies, The Royal Veterinary and Agricultural University, DK-1958 Frederiksberg C, Denmark; email: kfm@kvl.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)

	Weight	Height	BMI	Body fat% (DEXA)
PE%	0.29**	0.28**	0.17	0.13

Hoppe et al. AJCN

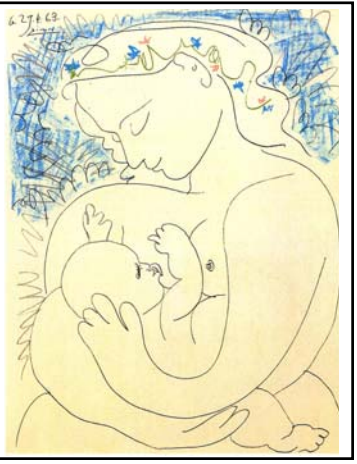
What is optimal growth?

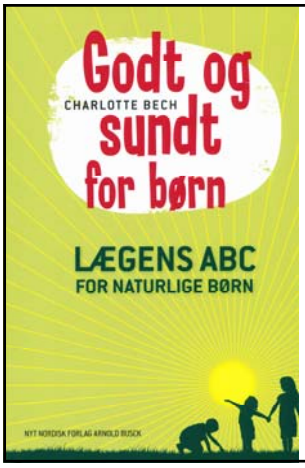
Fatness/leanness at 12 months?

Negative effects of catch-up growth?

Linear growth: Is more always better?

kfm@life.ku.dk





- Holistisk
- Ayurveda
- Psykoneuro-immunologi

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

Fedtstoffer

Mine bedste råd

Sørg for at give dit barn tilstrækkeligt med sunde fedtstoffer hver dag især om morgenen, fx i form af nødder, mandler, avocado, kværnede/knuste hørfrø, kæmpenatlysolie, smør eller klaret smør.
Undgå margarine og blandingsprodukter.
Undgå kød, fjerkræ og fisk.

Dyr fyldes med fortvivlelse og desperation og danner stress hormoner
når det skal slagtes. Når man spiser kød spiser man samtidig disse negative
Kemiske stoffer

Det samme gælder fisk. Man har vist at de udskiller adrenalin og noradrenalin
I blodet straks de bliver fanget

Hold fingrene fra de små børns mad

Politiken
31.Maj 2008