

ESPEN - ESPGHAN Symposium Challenges in Infant Nutrition



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Breast feeding: impact on future health

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Impact of infant feeding quality



- Very rapid growth
 - Tissue and organ development
 - High nutrient requirement / kg body weight
 - Very limited body stores
 - Immature gastrointestinal, metabolic & renal functions
- ➔ High probability that quality of substrate supply has immediate and long-term effects

Infant feeding and infections during the first 3 months

	Breast (n=95)	Breast + Formula (n=126)	Formula (n=257)	p
Gastrointestinal Infections	2.9 %	5.1 %	15.7 %	<0.001
Respiratory Infections	25.6 %	24.2 %	37.0 %	<0.05

Prospective study, corrected for social class, maternal age and parental smoking.
Howie et al 1990

Antimicrobial factors in human milk

Humoral components

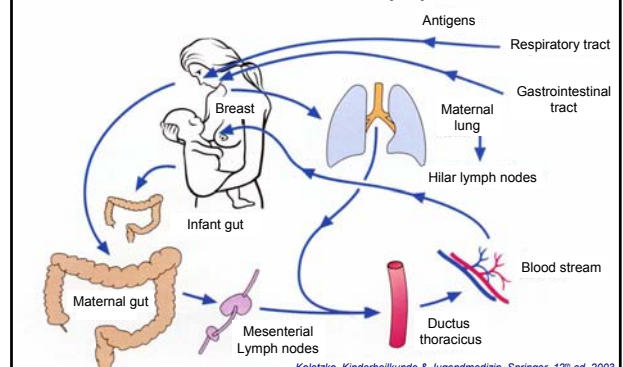
- sIgA, IgG, IgM, IgD
- Lysozyme
- Lactoferrin
- Fibronectin
- Lactoperoxidase
- Oligo- and Polysaccharides, Glycoconjugates
- Monoglycerides, non esterified fatty acids
- Nucleotides
- Mucines

Cellular components

- Neutrophil granulocytes, macrophages
- Lymphocytes
- Membranes of epithelial cells
- Membranes of milk fat globuli

Koletzko & Schroten 1999

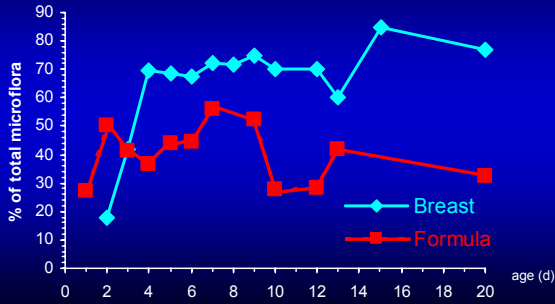
Entero Broncho Mammary System



Koletzko, Kinderheilkunde & Jugendmedizin, Springer, 12th ed. 2003

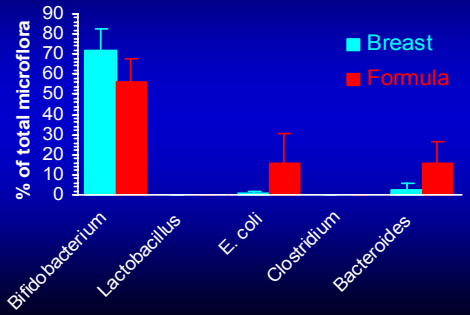
Bifidobacterium flora in breast- and formula-fed babies

Harmsen et al, JPGN 2000



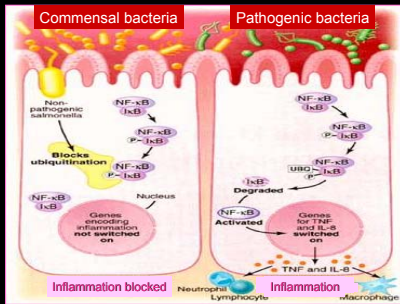
Microflora in breast- and formula fed babies (d 7)

Harmsen et al, JPGN 2000

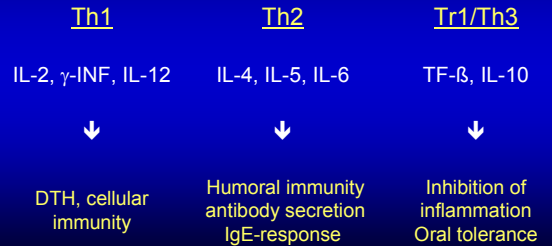


Prokaryotic regulation of epithelial responses

Neish et al, Science 2000



Modulation of T-cell subpopulations by commensal bacteria

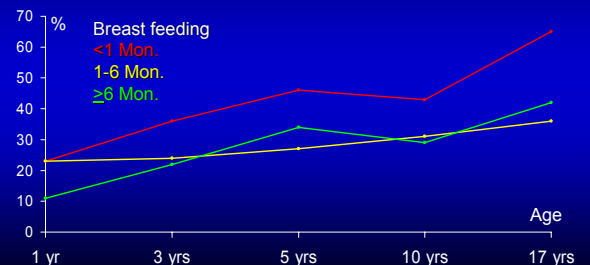


Breast feeding may reduce risk for later autoimmune disorders

Disease	Rel. Risk if not breast fed	p	Subjects	Author/yr.
Malignant lymphomas	150 %	<0.002	201 patients 181 controls	Davies et al 1988
Diabetes type I	230 %	<0.02	188 diabetes pats., 165 siblings	Borch-Johnson et al 1984
Crohn's disease	380 %	<0.005	114 Crohn's dis., 180 siblings	Koletzko et al 1988

Does long breast feeding protect against later atopic disease?

Prospective cohort study, 235 Finnish children, follow up at 17 yrs. 64 %
Saarinen & Kajosaari, Lancet 1995



Does breast feeding increase allergy risk?

Prospective Cohort Study, 1037 children born 1972/73, Newzealand
Sears et al, *Lancet* 2002;360:901

Multi variance analysis: Breast feeding ≥ 4 weeks increases risk for

Asthma at 9 yrs.	OR 2.40 (1.36-4.26; p=0.0027)
Pos. SPT (mites) at 13 yrs.	OR 1.70 (1.21-2.38; p=0.0020)
All pos. SPT at 13 yrs.	OR 1.94 (1.42-2.65; p<0.0001)
Asthma at 9-26 yrs.	OR 1.83 (1.35-2.47; p<0.0001)

Does breast feeding increase allergy risk?

Prospective Multicentric Allergy Study, 5 German centers
Bergmann et al, *Clin Exp Allergy* 2002;32:205

Breast Feeding Duration	OR	95% CI
Ever / Never	1.62	0.93-2.8
>2 mon / <2 mon	1.4	1.03-1.87

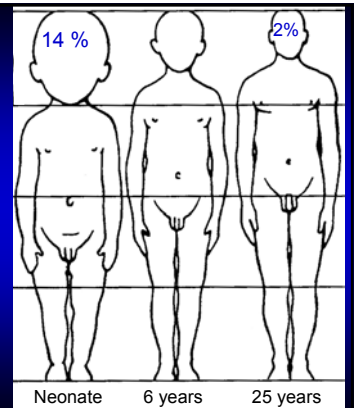
Does breast feeding by asthmatic mothers increase childhood asthma risk up to age 11 yrs?

	Total	Never BF	Exclusive BF <4mon.	≥ 4 mon.
Total group	20.8%(904)	17.6%(142)	20.4%(441)	22.7%(321)
Maternal asthma*	40.6%(101)	9.1% (11)	35.8% (53)	56.8% (37)
No maternal asthma	18.3%(792)	17.3%(127)	18.5%(384)	18.5% (281)

(*p<.01, trend chi square p<.005)

Wright et al, in: Koletzko B, Hernell O, Michaelsen KF (eds.): *Short and Long Term Effects of Breast Feeding on Child Health*. Advances in Experimental Medicine and Biology, Vol. 248. New York, Kluwer Academic / Plenum Publishers 2000

Varying body proportions with age:
brain size

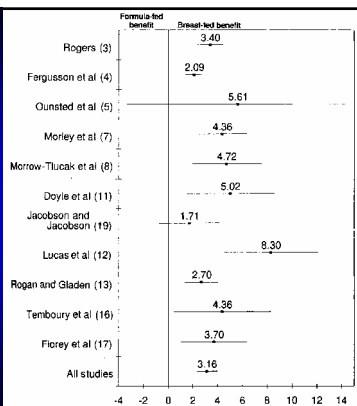


From: Koletzko (ed.) *Kinderheilkunde und Jugendmedizin*, 12th ed. Berlin, Springer Verlag 2003

Breast feeding and later cognitive development

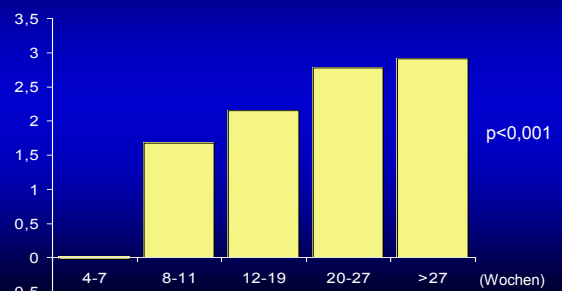
Anderson et al, *AJCN* 1999;70:525

Meta-Analysis of 20 published studies comparing predominately breast (>10.000) and formula (<32.500) fed infants, corrected for measured covariables



Duration of breast feeding and later cognitive development

>10,000 breast, >32,500 formula fed infants. Anderson et al 1999



Breast-feeding and cognitive development: a meta-analysis

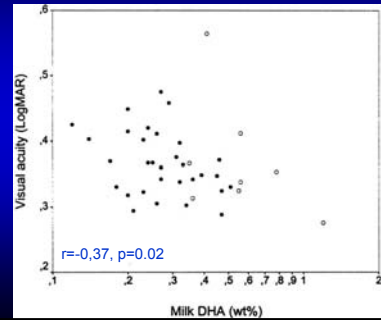
Anderson et al, AJCN 1999;70:525

Effect of birth-weight on weighted mean difference in cognitive development score between breast and formula fed infants

	Mean Δ	SE	95 % CI
Normal / mixed birth-weight	2.66	0.26	(2.15-3.17)
Low birth-weight	5.18	0.81	(3.59-6.77)

Visual acuity* in breast fed infants at 4 months correlates with breast milk DHA content

* Swept visual evoked potentials. Jorgensen et al, J Ped Gastro Nutr 2001;32:293-6



Stereo-acuity at age 3.5 y in 435 children born full-term: effect of pre- and postnatal n-3 LC-PUFA supply

ALSPAC study: Williams et al, Am J Clin Nutr 2001;73:316-322

Predictors of stereoacuity (adjusted logistic regression)

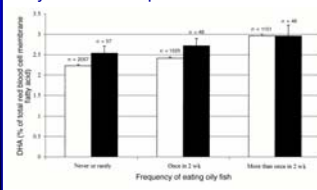
Breast feeding

Never	1.00
≥ 4 months	2.77 (1.54-4.97)

Maternal consumption of oily fish

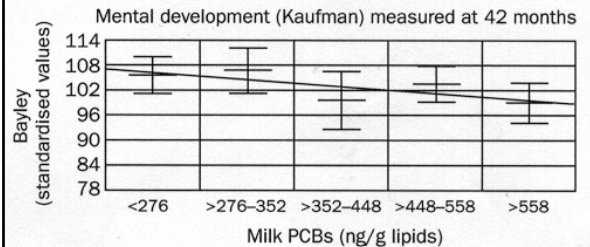
No	1.00
Yes	1.57 (1.00-2.45)

Oily fish consumption and DHA levels



Polychlorinated biphenyls (PCB) in breast milk and later mental development

Prospective study in 171 mother-child-pairs (Düsseldorf). Prenatal PCB exposure associated with lower mental development with 30 & 42 months. Inverse association also with milk PCB. Walkowiak et al, Lancet 2001;358



Childhood Obesity



- Global epidemic, alarming increase of prevalence & severity
- Severe psychosocial & health burdens, huge costs
- Difficult to treat
- ➔ Primary prevention greatly needed

Koletzko B, Chen W, Dietz W, et al. Obesity in children and adolescents world-wide: current views and future directions. JPGN 2002 (August)

Genetics

- ➔ energy expenditure
- ➔ food intake
- ➔ substrate metabolism
- ➔ endocrine regulation

Current lifestyle

- ➔ diet
- ➔ physical activity

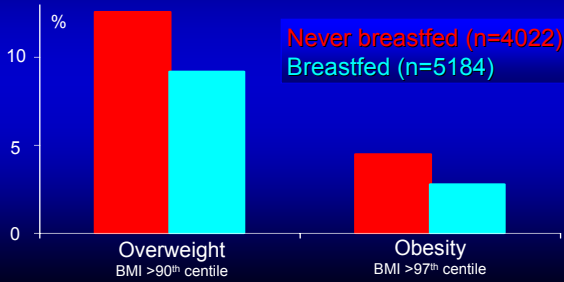
Obesity risk

Metabolic imprinting?

- ➔ intrauterine metabolism?
- ➔ postnatal diet/growth?
- ➔ endocrine regulation?

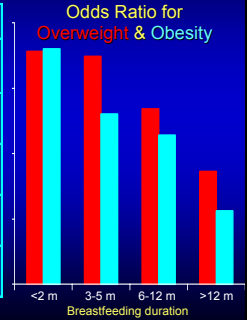
Breast feeding reduces obesity prevalence at school age

School entry examinations, Bavaria, complete data for 9206 children
 von Kries, Koletzko et al, Brit Med J 1999, 319:147-150



Adjusted OR (95 %CI) for overweight and obesity by duration of „exclusive“ breast feeding

Breast	Overwt	Obese
<i>Ever</i>	0.79 (0.68-0.93)	0.75 (0.57-0.98)
<2 mon. (n=2084)	0.89 (0.73-1.07)	0.90 (0.74-1.02)
3-5 mon. (n=2052)	0.87 (0.72-1.05)	0.65 (0.44-0.95)
6-12 mon. (n=863)	0.67 (0.49-0.91)	0.57 (0.33-0.99)
>12 mon. (n=121)	0.43 (0.17-1.07)	0.28 (0.04-2.04)



von Kries, Koletzko et al, Brit Med J 1999, 319:147-150

Overweight and obesity in Czech children (6-14 yrs)

J Pediatrics 2002;141:764-9

- Cross-sectional survey in 1991 on 33,768 school-children aged 6-14 years in the Czech Republic
- Multiple logistic regression analyses: Effect of breastfeeding did not diminish with age, not explained by confounders (parental education, parental obesity, maternal smoking, high birthweight, watching TV, number of siblings, physical activity)

Adjusted Odds Ratios

	Overweight	Obesity
Breastfeeding	0.80 (0.71-0.90)	0.80 (0.66-0.96)

→ ↓ overweight/obesity prevalence with breast feeding also in an Eastern European socialist country in 1991

Breast feeding and later overweight

7 cross-sectional studies, 2 prospective studies, total 97,769 subjects

Country	Number	Age (y)	↓ Overwt	↓ Obesity	Dose-Response	Author/Yr
Canada	517	12-18	0.85	0.57	Yes	Kramer 1981
Germany	9,206	5-6	0.79	0.75	Yes	von Kries 1999
Germany	2,126	9-10	0.66	-	Yes	Liese 2001
USA	2,656	3-5	0.63	(0.84)	-	Hediger 2001
USA	15,341	9-14	0.8	-	Yes	Gilman 2001
Scotland	32,200	3	0.7	-	-	Armstrong 2001
New Zealand	1,037	18	0.51 (6 m b.f.)	-	Yes	Poulton 2001
Czech Repub.	33,768	6-14	0.80	0.80	-	Toschke 2002
Germany	918	6	0.53	0.46	Yes	Bergmann 2003



Breastfeeding reduces later risk for overweight and obesity by ≈20-50 %

Why does breast feeding protect against later obesity? Mechanisms?

Behaviour




- Suckling behaviour
- Self regulation of meal size
- ↑ Variation of taste experience → food choice?

Growth / substrate supply / endocrine regulation


- Early weight / length gain
- Energy density
- Protein supply
- Insulin / IGF 1
- Leptin resistance

High early protein intake: a risk factor for later obesity?

EU Childhood Obesity Programme
Childhood Obesity: Programming by Infant Nutrition (CHOPIN)
www.childhood-obesity.org

Breast is best (but why?)



- Supports stable maternal-infant bonding, security
- Matches infant nutrient needs
- High nutrient bioavailability (e.g. iron)
- Changing milk composition with infant age/ during each meal
- Anti-infective and anti-inflammatory properties
- Bioactive factors
- Supports dominance of bifidobacteriae in gut flora
- ↓ Risk for some later diseases (Obesity, IDDM, Crohn's disease)
- ↑ Cognitive performance

→ Further research needed to clarify mechanisms and effects
 → Expected results have great potential for preventive application to improve health, performance and well-being

European Commission sponsored Scientific Conference

Early Nutrition and its Later Consequences: New Opportunities

2-3 July 2004

Satellite Meeting to World Congress on
 Pediatric Gastroenterology & Nutrition, Paris

www.metabolic-programming.org





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