

This important study from Ghana was designed to evaluate whether the timing of breastfeeding initiation and the type of breastfeeding practised are associated with risk of neonatal mortality. The study included 10,947 infants who survived day 2 and whose mothers were visited during the neonatal period.

Breastfeeding was initiated during the first day in 71% of infants and in 98.7% by day 3. Breastfeeding was exclusive for 70% during the neonatal period. The risk of neonatal death was fourfold higher in infants given milk-based fluids or solids in addition to breastmilk. There was a marked dose-response of increasing risk of neonatal mortality with delayed breastfeeding initiation from hour 1 to day 7. Initiation after day 1 was associated with a 2.4 fold increase in mortality risk. The authors conclude that 16% of neonatal deaths can be prevented if all infants are breastfed from day 1 and 22% can be prevented if breastfeeding is initiated during the first hour.

Edmond KM, Zandoh C, Quigley MA, Amenga-Etego S, Owusu-Agyei S, Kirkwood BR. Delayed breastfeeding initiation increases risk of neonatal mortality. *Pediatrics* 117: 380-386, 2006

More than 10 million children die every year in low- and middle-income countries before they reach the age of five. It is estimated that 2/3 of these deaths are related to inadequate nutrition and are preventable. Each of these numbers represents an infant or a child, with a mother and father full of hope and expectation, yet ending in tragedy. This is a global crisis of obscene proportions in a world where trillions of dollars are spent on war and destruction, while the causes of poverty and disparity are not addressed.

The 5-part Lancet Child Survival Series: The Lancet 361: 2003 documents the need to make child health an international health priority and to fight for the resources needed to give all children the right to food, health and life itself.

In the context of extreme poverty for so many, the promotion and support of breastfeeding not only prevents illness, but also is vital to the protection of life itself.

Preventive intervention	Estimated deaths prevented (thousands)	(per cent of all deaths)
Breastfeeding	1,301	13
Insecticide-treated materials	691	7
Complementary feeding	587	6
Clean delivery (efforts to ensure that childbirth is free of unnecessary contamination)	411	4
H. influenzae type b vaccination	403	4
Zinc supplementation	351	4
Clean water, sanitation, hygiene	326	3
Vitamin A supplementation	176	2
Tetanus toxoid vaccination	161	2

The Lancet Child Survival Series: The Lancet 361: 2003

## 1 INCREASED RISK OF OTITIS MEDIA AND EAR INFECTIONS

The number of episodes of acute otitis media increased significantly with decreased duration and exclusivity of breastfeeding. US infants who were exclusively breastfed for four months or more had a 50 per cent reduction of episodes compared to infants who were not breastfed. A 40 per cent reduction of episodes was reported for breastfeeding infants who were supplemented before four months of age.

Duncan B, Ey J, Holberg CJ, Wright AL, Martinez F, Taussig LM. Exclusive breastfeeding for at least 4 months protects against otitis media. *Pediatrics* 91: 867-872, 1993

Between six and 12 months of age the incidence of first episodes of otitis media increased from 25 per cent to 51 per cent in infants exclusively breastfed. In infants that were exclusively formula fed the incidence rose from 54 per cent to 76 per cent during the second half of the first year. The authors

concluded that breastfeeding even for a short period (three months) would significantly reduce the episodes of otitis media during infancy.

Duffy LC, Faden H, Wasielewski R, Wolf J, Krystofik D. Exclusive breastfeeding protects against bacterial colonization and day care exposure to otitis media. *Pediatrics* 100: E7, 1997

## 16 INCREASED RISK OF SIDE EFFECTS OF ENVIRONMENTAL CONTAMINANTS

A Dutch study showed that at six years of age, cognitive development is affected by prenatal exposure to polychlorinated biphenyls (PCBs) and dioxins. An adverse effect of prenatal exposure on neurological outcome was also demonstrated in the formula-fed group but not in the breastfed group. Despite higher PCB exposures from breast milk, the study found at 18 months, 42 months of age, and at six years of age a beneficial effect of breastfeeding on the quality of movements, in terms of fluency, and in cognitive development tests.

The data gives evidence that prenatal exposure to PCBs does have subtle negative effects on neurological and cognitive development of the child up to school age. The study also gives evidence that breastfeeding counteracts the adverse developmental effects of PCBs and dioxins.

Boersma ER, Lanting CI. Environmental exposure to polychlorinated biphenyls (PCBs) and dioxins. Consequences for longterm neurological and cognitive development of the child. *Adv Exp Med Biol* 478:271-87, 2000

Another Dutch study to determine the perinatal effects of exposure to polychlorinated biphenyls (PCBs), assessed breastfed and formula-fed infants at nine years of age. By measuring auditory P300 latencies (the reaction time to incoming stimuli, which are known to be negatively impacted by PCBs) they found that those who were formula-fed or breastfed for less than 6 to 16 weeks, experienced greater latency and delayed mechanisms in the central nervous system that evaluate and process relevant stimuli. On the other hand breastfeeding accelerates these mechanisms.

Vreugedenhill HJ, Van Zanten GA, Brocaar MP, Mulder PGH, Weisglas-Kuperus, N. Prenatal exposure to polychlorinated biphenols and breastfeeding: opposing effects on auditory P300 latencies in 9-year old Dutch children. *Develop Med & Child Neurol* 46: 398-405, 2004

## Risks of Formula Feeding FOR MOTHERS

### 1 INCREASED RISK OF BREAST CANCER

Researchers from England evaluated a possible association between cancer incidence and breastfeeding during infancy. This study included nearly 4,000 adults who were originally surveyed from 1937-1939. The data included on meta-analysis showed that rates of breast cancer diagnosed in premenopausal women were approximately 12% lower among women who had been breast-fed as infants.

Martin R, Middleton N, Gunnell D, Owen C, Smith G. Breast-Feeding and Cancer: The Boyd Orr Cohort and a Systematic Review With Meta-Analysis. *Journal of the National Cancer Institute*. 97: 1446-1457, 2005

Breast-feeding decreases the risk of breast cancer in mothers and infection, allergy, and autoimmunity in infants. The presence of mediators of the innate immune system in human milk, including defensins, cathelicidins, and toll-like receptors (TLRs), were extracted and analysed from the whey fractions of colostrum and transitional and mature milk (n = 40) from normal mothers (n = 18) and from mothers with autoimmune or allergic diseases.

The authors suggest that the innate immune system in breastmilk is complex and likely provides protection for

maternal breast tissue and the developing digestive tract of newborns.

Armogida, Sheila A.; Yannaras, Niki M.; Melton, Alton L.; Srivastava, Maya D. Identification and quantification of innate immune system mediators in human breast milk. *Allergy and Asthma Proc* 25: 297-304, 2004

### 2 INCREASED RISK OF OVERWEIGHT

A Brazilian cohort of 405 women were followed at 6 and 9 months postpartum to determine the association between weight retention and breastfeeding practices. When women who had 22% body fat and breastfed for 180 days were compared with those who had breastfed for only 30 days, each month of breastfeeding brought an average reduction of 0.44 kg in weight. In conclusion the authors confirm the association between breastfeeding and postpartum weight and that the promotion of longer duration can contribute to decreases in postpartum weight retention.

Kac G, Benicio MHA, Velásquez-Meléndez G, Valente JG, Struchiner CJ. Breastfeeding and postpartum weight retention in a cohort of Brazilian women. *Am J Clin Nutr* 79: 487-493, 2004

### 3 INCREASED RISK OF OVARIAN CANCER AND ENDOMETRIAL CANCER

Not breastfeeding has been associated with increased risk of ovarian cancer. A large case-control Italian study of 1031 women with epithelial ovarian cancer were compared to 2411 women admitted to the same network of hospitals for a wide spectrum of acute non-neoplastic conditions, unrelated to known risk factors for ovarian cancer. Results showed inverse trends in risk with increasing duration of breastfeeding and number of children breastfed. Additional analyses by histologic subtypes suggested that the protective role of breastfeeding would be larger for serious neoplasms.

Chiaffarino F, Pelucchi C, Negri E, Parazzini F, Franceschi S, Talamini R, Montella M, Ramazzotti V, La Vecchia C. Breastfeeding and the risk of epithelial ovarian cancer in an Italian population. *Gynecol Oncol*. 98: 304-308, 2005

To determine the link between breastfeeding and endometrial cancer, this Japanese hospital-based case-control study compared cases of women with endometrial cancer (155) with controls (96) selected from women attending the outpatient clinic for cervical cancer screening. The women were interviewed to determine breastfeeding practices, contraceptive usage, as well as potential risk factors for endometrial cancer. The authors observed a greater risk of endometrial cancer for parous women who had never breastfed, and concluded that breastfeeding reduces the risk of endometrial cancer in Japanese women.

Okamura C, Tsubono Y, Ito K, Niikura H, Takano T, Nagase S, Yoshinaga K, Terada Y, Murakami T, Sato S, Aoki D, Jobo T, Okamura K, Yaegashi N. Tohoku J Exp Med. Lactation and risk of endometrial cancer in Japan: a case-control study. 208: 109-115, 2006

### 4 INCREASED RISK OF OSTEOPOROSIS

Longitudinal studies have suggested that both pregnancy and lactation are associated with a bone mineral density loss of up to 5%, and that the loss recovers after weaning. Cross-sectional studies have indicated that women with many children and a long total period of lactation have similar or higher bone mineral density and similar or lower fracture risk than their

peers who have not given birth and breastfed. This trend has been observational and found in cross-sectional case-control studies. The causal relationships have yet to be determined.

Karlsson MK, Ahlborg HG, Karlsson C, Maternity and mineral density. *Acta Orthopaedica* 76: 2-13, 2005

### 5 REDUCED NATURAL CHILD SPACING

A questionnaire was used to obtain data from Nigerian breastfeeding mothers to determine the impact of breastfeeding practices on lactational amenorrhoea. Exclusive breastfeeding was practised by 100% of the mothers on discharge. This went down to 3.9% at six months. Feeding on cue was practised by 98.9% of the mothers. By 6 weeks 33.8% of mothers resumed mensus and this rose to 70.2% at six months. The duration of lactational amenorrhoea was longer in exclusively breast-feeding mothers than in those who were not. None of the 178 mothers who participated in the survey became pregnant.

Egbunu I, Ezechukwu CC, Chukwuika JO, Ikechebu JI. Breast-feeding, return of menses, sexual activity and contraceptive practices among mothers in the first six months of lactation in Onitsha, South Eastern Nigeria. *J Obstet Gynaecol*. 25: 500-503, 2005

### 6 INCREASED RISK OF RHEUMATOID ARTHRITIS

Female reproductive and hormonal risks factors were studied in a cohort of 121,700 women enrolled in the Nurses' Health Study. Breastfeeding for more than 12 months was inversely related to the development of rheumatoid arthritis. The effect was found to be dose related. Those who breastfed shorter had a higher risk.

Karlson E W et al. Do breast-feeding and other reproductive factors influence future risk of rheumatoid arthritis?: Results from the Nurses Health Study. *Arthritis & Rheumatism* 50: 3458-3467, 2004

### 7 INCREASED STRESS AND ANXIETY

To find out if there is a relationship between feeding practices, stress, and mood and levels of serum cortisol, prolactin and ACTH (adrenocorticotrophic hormone) in mothers, the author compared the emotional responses of 84 exclusively breastfeeding, 99 exclusively formula-feeding and 33 non post-partum healthy control women. The mothers' responses were studied at 4 to 6 weeks post-partum.

Overall the breastfeeding mothers had more positive moods, reported more positive events, and perceived less stress than formula-feeders. Breastfeeders had less depression and anger than formula feeders and serum prolactin levels were inversely related to stress and mood in formula-feeders.

Groer M W. Differences between exclusive breastfeeders, formula-feeders, and controls: a study of stress, mood and endocrine variables. *Biol. Res Nurs*. 7: 106-117, 2005

### 8 INCREASED RISK OF MATERNAL DIABETES

Breastfeeding also reduces the mother's risk of type II diabetes later in life. The longer the duration of breastfeeding, the lower the incidence of diabetes, according to this Harvard based study. The researchers studied 83,585 mothers in the Nurses' Health Study (NHS) and 73,418 mothers in the Nurses' Health Study II (NHS II), and determined that each year of breastfeeding reduced the mother's risk of diabetes by 15%.

Stuebe AM, Rich-Edwards JW, Willett WC. Duration of lactation and incidence of type 2 diabetes. *JAMA* 294: 2601-2610, 2005

## Risks of Formula Feeding A BRIEF ANNOTATED BIBLIOGRAPHY

The International Code of Marketing of Breastmilk Substitutes requires that parents be informed about the health hazards of unnecessary or improper use of infant formula. This brief annotated bibliography from INFAC Canada gives some examples from the extensive body of research documenting the importance of breastfeeding and in turn the associated risks of formula feeding. The World Health Organisation (WHO) recommends exclusive breastfeeding for six months and introducing nutritious complementary foods at six months and continued breastfeeding for two years and beyond.

### FOR INFANT AND CHILDREN

1. Increased risk of asthma
2. Increased risk of allergy
3. Reduced cognitive development
4. Increased risk of acute respiratory disease
5. Increased altered occlusion
6. Increased risk for infection from contaminated formula
7. Increased risk of nutrient deficiencies
8. Increased risk of childhood cancers
9. Increased risk of chronic diseases
10. Increased risk of diabetes
11. Increased risk of cardiovascular disease
12. Increased risk of obesity
13. Increased risk of gastrointestinal infections
14. Increased risk of mortality
15. Increased risk of otitis media and ear infections
16. Increased risk of side effects of environmental contaminants

### FOR MOTHERS

1. Increased risk of breast cancer
2. Increased risk of overweight
3. Increased risk of ovarian cancer and endometrial cancer
4. Increased risk of osteoporosis
5. Reduced natural child spacing
6. Increased risk of rheumatoid arthritis
7. Increased risk of stress and anxiety
8. Increased risk of maternal diabetes

## Risks of Formula Feeding FOR INFANT AND CHILDREN

### 1 INCREASED RISK OF ASTHMA

A study of 2184 children done by the Hospital for Sick Children in Toronto determined that the risk of asthma and wheeze was approximately 50 per cent higher when infants were formula-fed compared to infants who were breastfed for nine months or longer.

Dell S, To T. Breastfeeding and Asthma in Young Children. *Arch Pediatr Adolesc Med* 155: 1261-1265, 2001

Researchers in West Australia studied 2602 children to determine the development of asthma and wheeze at six years of age. Not breastfeeding increased the risk of asthma and wheeze by 40 per cent compared to infants who were exclusively breastfed for four months. The authors recommend exclusive breastfeeding for at least four months to reduce the risk of asthma.

Oddy WH, Peat JK, de Klerk NH. Maternal asthma, infant feeding, and the risk for asthma in childhood. *J Allergy Clin Immunol*. 110: 65-67, 2002

The reviewers looked at 29 studies to evaluate the protective effect of breastfeeding on asthma and atopy. After applying strict criteria for assessment, 15 studies remained in the review. All 15 showed a protective effect of breastfeeding. They concluded that the evidence is clear and consistent that not breastfeeding puts infants at risk for asthma and atopy.

Oddy WH, Peat JK. Breastfeeding, Asthma and Atopic Disease: An Epidemiological Review of Literature. *J Hum Lact* 19: 250-261, 2003

A longitudinal prospective study of 1246 healthy infants in Arizona, USA, aimed to determine the relationship between breastfeeding and recurrent wheeze. The results showed that non-atopic children at the age of six years, who had not been breastfed, were three times more likely to have recurrent wheezing.

Wright AL, Holberg CJ, Taussig LM, Martinez FD. Relationship of infant feeding to recurrent wheezing at age 6 years. *Arch Pediatr Adolesc Med* 149: 758-763, 1995

### 2 INCREASED RISK OF ALLERGY

Children in Finland who had been breastfed the longest had the lowest incidence of atopy, eczema, food allergy and respiratory allergy. At 17 years of age, the incidence of respiratory allergy for those who had little breastfeeding was 65 per cent and for those who were breastfed the longest 42 per cent.

Saarinen UM, Kajosari M. Breastfeeding as a prophylactic against atopic disease: Prospective follow-up study until 17 years old. *Lancet* 346: 1065-1069, 1995

Infant with a maternal history of respiratory allergy or asthma were assessed for atopic dermatitis during the first year of life. Seventy-six Dutch children and 228 children without atopic dermatitis were examined. Exclusive breastfeeding for the first three months of life was found to have a protective effect against dermatitis.

Kerhof M, Koopman LP, van Strien RT, et al. Risk factors for atopic dermatitis in infants at high risk of allergy: The PIAMA study. *Clin Exp Allergy* 33: 1336-1341, 2003

The effects of maternal dietary vitamins C and E on breastmilk antioxidant composition to protect against the development of atopy in infants were assessed. Mothers with atopic disease kept four-day food records and breastmilk samples were collected at the infants' age of 1 mo.

Results showed that maternal intake of vitamin C in her diet but not as a supplement determined the concentration of vitamin C in breastmilk. A higher concentration of vitamin C in



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breastmilk was associated with a reduced risk of atopy in the infant. Vitamin E had no consistent relationship with atopy. Thus a maternal diet rich in natural food sources of vitamin C during breastfeeding can reduce the risk of atopy in high-risk infants.

Hoppu U, Rinne M, Salo-Vaeeanaenen P, Lampi A-M, Piironen V, Isolauri E. Vitamin C in breast milk may reduce the risk of atopy in the infant. *Eur J of Clin Nutr* 59: 123-128, 2005

### 3 REDUCED COGNITIVE DEVELOPMENT

A total of 3880 Australian children were followed from birth to determine breastfeeding patterns and later cognitive development. Those breastfed for six months or more scored 8.2 points higher for females and 5.8 points higher for males in vocabulary tests over those who had never been breastfed.

Quinn PJ, O'Callagan M, Williams GM, Najman JM, Anderson MJ, Bo W. The effect of breastfeeding on child development at 5 years: a cohort study. *J Paediatr Child Health* 37: 465-469, 2001

School-aged children (439) who weighed less than 1,500 g. at birth and were born in the USA between 1991 and 1993 were given a variety of cognitive tests. The very low-birth weight infants who had never been breastfed were found to have lower test scores in overall intellectual function, verbal ability, visual-spatial and motor skills than those who had been breastfed.

Smith MM, Durkin M, Hinton VJ, Bellinger D, Kuhn L. Influence of breastfeeding on cognitive outcomes at age 6-8 year follow-up of very low-birth weight infants. *Am J Epidemiol* 158:1075-1082, 2003

To determine the impact of exclusive breastfeeding on cognitive development for infants born small for gestational age, this US based study evaluated 220 infants, using the Bayley Scale of Infant Development at 13 months and the Wechsler Preschool and Primary Scales of Intelligence at five years. The researchers concluded that exclusively breastfed (without supplements) small for gestational age infants had a significant advantage in cognitive development without compromising growth.

Rao MR, Hediger ML, Levine RJ, Naficy AB, Vik T. Effect of breastfeeding on cognitive development of infants born small for gestational age. *Arch Pediatr Adolesc* 156: 651-655, 2002

Children of socioeconomic disadvantaged Filipino mothers were followed from birth through to middle childhood and assessed for cognitive ability at 8.5 and 11.5 years of age. After controlling for confounding variables, children who had been breastfed for 12 to 18 months had higher scores on the Philippines Nonverbal Intelligence Test. The effects were even greater for low-birth weight infants (1.6 and 9.8 points respectively). The authors conclude that long-term breastfeeding is important after the introduction of complementary foods, and even more so for low-birth weight infants.

Daniels M C, Adair L S. Breast-feeding influences cognitive development of Filipino children. *J Nutr*. 135: 2589-2595, 2005

Breastfeeding has potentially long-term beneficial effects on a person's life through its influence on childhood cognitive and educational development concludes this UK study. Regression analysis was used to determine that breastfeeding was significantly and positively associated with educational levels obtained by age 26 as well as cognitive abilities at age 53 years.

Richards M, Hardy R, Wadsworth ME. Long-term effects of breast-feeding in a national cohort: educational attainment and midlife cognition function. *Publ Health Nutr* 5: 631-635, 2002

### 4 INCREASED RISK OF ACUTE RESPIRATORY DISEASE

Brazilian children not breastfed were 16.7 times more likely to be diagnosed with pneumonia than children who had received only breastmilk as infants.

Cesar JA, Victora CG, Barros FC, et al. Impact of breastfeeding on admission for pneumonia during postneonatal period in Brazil: Nested case-controlled study. *BMJ* 318: 1316-1320, 1999

To determine the modifiable risk factors for acute lower respiratory infection in young children, this Indian hospital-based study compared 201 cases to 311 controls. Breastfeeding was one of the key modifiable risk factors for lower respiratory infection in children under five years of age.

Broor S, Pandey RM, Ghosh M, Maltreyi RS, Lodha R, Singhal T, Kabra SK. Risk factors for severe acute lower respiratory tract infection in under-five children. *Indian Pediatr* 38: 1361-1369, 2001

A number of sources were used to examine the relationship between breastfeeding and risk of hospitalisation for lower respiratory tract disease in healthy full-term infants with access to adequate health facilities. Analysis of the data concluded that in developed countries, infants who were formula-fed experienced more than three times the severity of respiratory tract illness and required hospitalisation compared to infants who had been breastfed exclusively for four months or more.

Bachrach VRG, Schwarz E, Bachrach LR. Breastfeeding and the risk of hospitalisation for respiratory disease in infancy. *Arch Pediatr Adolesc Med*. 157: 237-243, 2003

### 5 INCREASED ALTERED OCCLUSION

Breastfeed for straight teeth is the message from this research on feeding, sucking and dentition. This retrospective study of 1130 preschool children (3 to 5 years of age) looked at the impact of the type of feeding and non-nutritive sucking activity on occlusion in deciduous dentition. Detailed infant feeding and non-nutritive sucking activity history was collected by questionnaire in addition to an oral examination by a dentist.

Non-nutritive sucking activity has a substantial effect on altered occlusion, while the effect of bottle feeding is less marked. Posterior cross-bite was more frequent in bottle-fed children and in those with non-nutritive sucking activity. The percentage of cross-bite was lower in breastfed children with non-nutritive sucking activity (5%) than in bottle-fed children with non-nutritive sucking activity (13%). In conclusion, the data demonstrates that non-nutritive sucking activity in the first months of life is the main risk factor for development of altered occlusion and open bite in deciduous dentition. Children with non-nutritive sucking activity and who were bottle-fed had more than double the risk of posterior cross-bite, while breastfeeding seems to have a protective effect on development of posterior cross-bite in deciduous dentition.

Viggiano D. et al. Breast feeding, bottle feeding, and non-nutritive sucking: effects on occlusion in deciduous dentition. *Arch Dis Child* 89: 1121-1123, 2004

### 6 INCREASED RISK FOR INFECTION FROM CONTAMINATED FORMULA

Case report from a recent US based outbreak of Enterobacter sakazakii in a neonatal intensive care unit documents the death of a 20 day old infant who developed fever, tachycardia, decreased vascular perfusions and seizures at 11 days. The infant died at day 20. E. sakazakii cultures were identified from the spinal fluid and traced to contaminated powdered infant formula used in the NICU.

Weir E., Powdered infant formula and fatal infection with Enterobacter sakazakii. *CMAJ* 166, 2002

A Belgian-based outbreak of necrotizing enterocolitis (NEC) is traced back to infant formula contaminated with Enterobacter sakazakii. A total of 12 infants developed NEC during the outbreak and two infants (twin brothers) died.

Van Acker J, de Smet F, Muylderemans G, Bougateg A, Naessens A, Lauwers S. Outbreak of necrotizing enterocolitis associated with Enterobacter sakazakii in powdered infant formulas. *J Clin Microbiol* 39: 293-297, 2001

### 7 INCREASED RISK OF NUTRIENT DEFICIENCIES

Infants fed the same soy-based infant formula brand in Israel during 2003 were hospitalized in intensive care units with severe encephalopathy. Two died of cardiomyopathy. Analysis showed that the thiamine level of the formula was undetectable.

The soy-based formula-fed infants admitted with symptoms indicating thiamine deficiency experienced a rapid improvement when treated with thiamine.

Fattal-Valovski A, Kessler A, Seal B, Nitzan-Kaluski D, Rotstein M, Mestermen R, Tolendano-Alhadeif H, Stolovitch C, Hoffman C, Globus O, Eshel G. Outbreak of Life-Threatening Thiamine Deficiency in Infants in Israel Caused by a Defective Soy-Based Formula. *Pediatrics* 115: 223-238, 2005

### 8 INCREASED RISK OF CHILDHOOD CANCERS

Lack of breastfeeding is known to increase the risk of cancer. This novel study found a significant level of genetic damage in infants aged 9 to 12 months who were not breastfed. The authors speculate that the genetic damage may play a role in the development of cancer in childhood or later life.

Dundaroz R, Aydin HA, Ulucan H, Baltac V, Deniz M, Gokcay E. Preliminary study on DNA in non-breastfed infants. *Ped Internat* 44: 127-130, 2002

The UK Childhood Cancer Study analysed 3500 childhood cancer cases and the relationship to breastfeeding. Results showed a small reduction for leukemia and for all cancers combined when infants had "ever been breastfed".

UK Childhood Cancer Investigators. Breastfeeding and Childhood Cancer. *Br J Cancer* 85: 1685-1694, 2001

A case controlled study, in the United Arab Emirates looked at 117 cases of acute lymphocytic leukemia and 117 controls. They found that the breastfeeding duration of those with leukemia was significantly shorter than the breastfeeding duration of the controls. They concluded that breastfeeding duration of six months or longer may protect against childhood acute leukaemia and lymphomas.

Bener A, Denic S, Galadari S. Longer breast-feeding and protection against childhood leukaemia and lymphomas. *Eur J Cancer* 37: 234-238, 2001

This systematic review to look at the evidence for the effect of breastfeeding on the risk of developing childhood leukemia examined 111 studies from which they identified 32 eligible articles. Of these they reviewed 10 and found that four had quality evidence regarding the association between breastfeeding and leukemia. In the two largest and highest-quality studies breastfeeding was associated with a significant risk reduction and in one of these studies, longer durations reflected greater protection. They note that in the US approximately 1.4 billion dollars are spent annually to treat childhood leukemia.

Guise JM et al. Review of case-controlled studies related to breastfeeding and reduced risk of childhood leukemia. *Pediatrics* 116: 724-731, 2005

### 9 INCREASED RISK OF CHRONIC DISEASES

A review of infant feeding practices and childhood chronic diseases shows increased risk for Type I diabetes, celiac disease, some childhood cancers, and inflammatory bowel disease associated with artificial infant feeding.

Davis MK Breastfeeding and chronic diseases in childhood and adolescence. *Pediatr Clin North Amer* 48: 125-141, 2001

Celiac disease may be triggered by an autoimmune response when an infant is exposed to a food containing gluten proteins. Ivarsson and her team of researchers looked at the breastfeeding patterns of 627 children with celiac disease and at 1254 healthy children to determine the effect of breastfeeding during the time of introduction of gluten-containing foods on the outcome of the development of celiac disease.

An astounding 40 per cent risk reduction was reported for the development of celiac disease in children at two years of age or younger for those who were breastfed when dietary gluten was introduced. The effect was even more pronounced in infants who continued to be breastfed after dietary gluten was introduced, the authors noted.

Ivarsson, A. et al. Breast-Feeding May Protect Against Celiac Disease *Am J Clin Nutr* 75:914-21, 2002

To determine the effect of early infant feeding practices (i.e. the impact of breastfeeding versus no breastfeeding; the

duration of breastfeeding; and the effect of breastfeeding while introducing gluten-containing foods) on the development of celiac disease (CD), the authors reviewed the literature available on breastfeeding and CD.

They found that children with CD were breastfed for a significantly shorter period of time. Children being breastfed at the time of gluten reduction had a 52 per cent reduction of risk for developing CD compared with children who were not breastfeeding at the time of introduction.

The authors pose two potential mechanisms for the protective effect. Firstly, that continued breastfeeding limits the actual amounts of gluten received. Secondly that breastfeeding protects against intestinal infections. Infections can increase the permeability of the infant's gut and therefore allow the passage of gluten into the lamina propria.

Others have suggested that breastmilk IgA may reduce the immune response to ingested gluten or immune modulation may occur through specific T-cell suppressive effects.

Akobeng A K et al. Effects of breast feeding on risk of coeliac disease: a systematic review and meta-analysis of observational studies. *Arch Dis Child* 91: 39-43, 2006

Inflammatory bowel disease and Crohn's disease are chronic gastrointestinal conditions that are more frequent for those who are formula-fed. A meta-analysis on 17 relevant studies supports the hypothesis that breastfeeding is associated with lower risks of Crohn's disease and ulcerative colitis.

Klement E, Cohen RV, Boxman V, Joseph A, Reif s. Breastfeeding and risk of inflammatory bowel disease: a systematic review with meta-analysis. *Am J Clin Nutr* 80: 1342-1352, 2004

### 10 INCREASED RISK OF DIABETES

To determine the link between cow's milk (and cow's milk based infant formula) consumption and the development of antibody response to cow's milk protein, Italian researchers measured the antibody response of 16 breastfed and 12 cow's milk-fed infants under four months of age. Cow's milk fed infants had elevated levels of beta-casein antibodies when compared to breastfed infants. They concluded that breastfeeding for the first four months prevented the production of antibodies and could have a preventive effect on the development of Type 1 diabetes.

Monetini L, Cavallo MG, Stefanini L, Ferrazzoli F, Bizzarri C, Marietti G, Curro V, Cervoni M, Pozzilli P, IMDIAB Group. Bovine beta-casein antibodies in breast-and bottle-fed infants: their relevance in Type 1 diabetes. *Hormone Metab Res* 34: 455-459, 2002

In this case-controlled study, 46 native Canadian Type II diabetes patients were matched with 92 controls. Pre- and postnatal risk factors were compared. Breastfeeding was found to reduce the risk of Type II diabetes.

Young TK, Martens PJ, Taback SP, Sellers EA, Dean HJ, Cheang M, Flett B. Type 2 diabetes mellitus in children: prenatal and early infancy risk factors among native Canadians. *Arch Pediatr Adolesc Med* 156: 651-655, 2002

Early introduction of infant formula, solids and cow's milk are factors shown to increase the incidence of Type I diabetes later in life. Swedish (517) and Lithuanian (286) children aged 0 to 15 years who were diagnosed with Type I diabetes were compared to non-diabetic controls. The results showed that exclusive breastfeeding for five months and total breastfeeding for longer than seven or nine months are protective against diabetes.

Sadauskaitė-Kuehne V, Ludvigsson J, Padaiga Z, Jasinskienė E, Samuel U. Longer breastfeeding is an independent protective factor against development of type 1 diabetes mellitus in childhood. *Diabet Metab Res Rev* 20: 150-157, 2004

Data was collected via questionnaires in this case-controlled study consisting of 868 diabetic Czech children and 1,466 controls. This study too confirms that the risk for type I diabetes decreases with increased duration of breastfeeding. Not breastfeeding was associated with an increased risk – OR of 1.93. Breastfeeding for 12 months or longer reduced the risk significantly – OR of 0.42.

Malcove H et al. Absence of breast-feeding is associated with the risk of type 1 diabetes: a case-control study in a population with rapidly increasing incidence. *Eur J Pediatr* 165: 114-119, 2005

### 11 INCREASED RISK OF CARDIOVASCULAR DISEASE

To confirm links between infant nutrition and health risks in later life, British researchers measured blood pressure at 13 to 16 years of age of 216 children who had been born prematurely. For those who had received preterm infant formula or routine infant formula, blood pressure was higher than for those who had received breastmilk during infancy. The authors concluded that for children born prematurely, breastfeeding lowers blood pressure in later life and that this conclusion can be extended to term infants as well.

Singhal A, Cole TJ, Lucas A. Early nutrition in preterm infants and later blood pressure: two cohorts after randomized trials. *The Lancet* 357: 413-419, 2001

This UK study looked at the cholesterol levels of 1500 children aged 13 to 16 years and determined that breastfeeding may have long term benefits for cardiovascular disease by reducing levels of total cholesterol and low-density lipid cholesterol. The research suggests that early exposure to breastmilk may program fat metabolism in later life, resulting in lower blood cholesterol levels and therefore a lower risk of cardiovascular disease.

Owen GC, Whippcup PH, Odoki JA, Cook DG. Infant feeding and blood cholesterol: a study in adolescents and systematic review. *Pediatrics* 110: 597-608, 2002

A prospective study followed 7276 term UK infants for 7.5 years. Full data was available for 4763 children. For those not breastfed both systolic and diastolic pressures were found to be higher than for those who were breastfed at age 7 years. There was a 0.2mm Hg reduction for each 3 months of breastfeeding. The authors suggest there may be significant benefits during adulthood as a 1% reduction in population systolic blood pressure is associated with a 1.5% reduction in overall mortality.

Martin RM, Ness AR, Gunnelle D, Emmet P, Smith GD. Does breastfeeding in infancy lower blood pressure in childhood? *Circulation* 109: 1259-1266, 2004

### 12 INCREASED RISK OF OBESITY

To determine the impact of infant feeding on childhood obesity, this large Scottish study looked at body-mass index of 32,200 children aged 39 to 42 months. After elimination of confounding factors, socioeconomic status, birthweight and sex, the prevalence of obesity was significantly higher in the formula-fed children, leading to the conclusion that formula feeding is associated with an increase in childhood obesity risk.

Armstrong, J. et al. Breastfeeding and lowering the risk of childhood obesity. *Lancet* 359:2003-04, 2002

German researchers collected height and weight data of 9375 school children to determine the impact of early childhood feeding on the development of obesity. The prevalence of obesity was found to be 4.5 per cent – nearly 40 per cent higher – in those who had never been breastfed compared to 2.8 per cent for those who had been exclusively breastfed.

Von Kries R. Breastfeeding and obesity: cross sectional study. *BMJ* 319: 147-150, 1999

In order to determine factors associated with the development of overweight and obesity, 6650 German school-aged children between the ages 5 to 14 years of age were examined. Breastfeeding was found to be protective against obesity. The protective effect was greater when the infants were exclusively breastfed.

Frye C, Heinrich J. Trend and predictors of overweight and obesity in East German children. *Int J of Obesity* 27: 963-969, 2003

Active follow-up of 855 German mother and baby pairs was used to determine the relationship between not breastfeeding and increased risk of overweight and obesity. After a two year follow-up 8.4 per cent of children were overweight and 2.8 per cent severely overweight: 8.9 per cent were never breastfed, while 62.3 per cent were breastfed for at least six months.

Children who were exclusively breastfed more than three months and less than six months had a 20 per cent reduction

risk, while those who had breastfed exclusively for at least six months had a 60 per cent risk reduction for becoming overweight compared to those who were formula fed.

Weyerman M et al. Duration of breastfeeding and risk of overweight in childhood: a prospective birth cohort study from Germany. *Int J Obes advance online publication* February 28, 2006.

### 13 INCREASED RISK OF GASTROINTESTINAL INFECTIONS

Seven hundred and seventy-six infants from New Brunswick, Canada were assessed for the relationship between respiratory and gastrointestinal illnesses and breastfeeding during the first six months of life. Although the rates of exclusive breastfeeding were low, the results showed a significant protective effect against total illness during the first six months of life. For those breastfed, the incidence of gastrointestinal infections was 47% lower; the rate of respiratory disease was 34% lower than those who were not breastfed.

Beaudry M, Dufour R, Marcoux S. Relationship between infant feeding and infections during the first six months of life. *J Pediatr* 126: 191-197, 1995

A comparison between infants who received primarily breastmilk during the first 12 months of life to infants who were exclusively formula-fed or who were breastfed for three months or less found that diarrheal disease was twice as high for the formula-fed infants then for those who were breastfed.

Dewey KG, Heing MJ, Nommsen-Rivers LA. Differences in morbidity between breast-fed and formula-fed infants. *J Pediatr* 126: 696-702, 1995

Breastfeeding promotion in Belarus significantly reduced the incidence of gastrointestinal infections by 40 per cent.

Kramer MS, Chalmers B, Hodnett ED, et al. Promotion of Breastfeeding Intervention Trial (PROBIT): A randomized trial in the Republic of Belarus. *JAMA* 285: 413-420, 2001

### 14 INCREASED RISK OF MORTALITY

The authors of this review discuss the global impact of breastfeeding on child spacing and estimate that exclusive breastfeeding can lead to decreased mortality of 20 per cent when infants are spaced at least two years apart.

Thapa S, Short RV, Potts M. Breast feeding, birth spacing and their effect on child survival. *Nature* 335: 679-682, 1988

Compared with exclusive breastfeeding, children who were partially breastfed had a 4.2 times increased risk of death due to diarrheal disease. Not breastfeeding was associated with a 14.2 times increased risk for death due to diarrheal disease in Brazilian children.

Victoria CG, Smith PG, Patrick J, et al. Infant feeding and deaths due to diarrhea: A case-controlled study. *Amer J Epidemiol* 129: 1032-1041, 1989

Infants in Bangladesh who were partially breastfed or not breastfed had a risk of acute respiratory infection death 2.4 times greater than exclusively breastfed infants. If children were predominantly breastfed the risk of death due to acute respiratory infection was similar to that of exclusively breastfed children.

Ariteen S, Black RE, Atbeknab G, Baqui A, Caulfield L, Becker S. Exclusive breastfeeding reduces acute respiratory infection and diarrhea deaths among infants in Dhaka slums. *Pediatrics* 108: e67, 2001

The researchers examined 1204 infants who died between 28 days and 1 year from causes other than congenital anomaly or malignant tumor and 7740 children who were still alive at 1 year to calculate mortality and whether or not the infant was breastfed as well as the duration-response effects.

Children who were never breastfed had a 21% greater risk of dying in the postneonatal period than those who were breastfed. Longer breastfeeding was associated with lower risk. Promoting breastfeeding has the potential to save ~720 postneonatal deaths in the United States each year. In Canada this would be ~ 72 deaths.

Chen A, Rogan WJ. Breastfeeding and the risk of postneonatal death in the United States. *Pediatrics* 113: 435-439, 2004