

# Benefits of Breastfeeding

Department of Health and Human Service Office on Women's Health

## ■ ABSTRACT

Infants who are breastfed experience fewer incidences of infectious and noninfectious diseases and less severe cases of diarrhea, respiratory infections, and ear infections. This article reviews the benefits to mother and child of breastfeeding and provides information for situations in which breastfeeding should not be implemented. *Nutr Clin Care*. 2003;6:125-131 ■

**KEY WORDS:** breastfeeding, infectious disease resistance, nutritional benefits

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## INTRODUCTION

Extensive research on the biology of human milk and on the health outcomes associated with breastfeeding has established that breastfeeding is more beneficial than formula feeding. Breastfed infants experience fewer cases of infectious and noninfectious diseases as well as less severe cases of diarrhea, respiratory infections, and ear infections<sup>1-15</sup>. Mothers who breastfeed experience less postpartum bleeding, earlier return to pre-pregnancy weight, and a reduced risk of ovarian cancer and pre-menopausal breast cancer<sup>16-26</sup>. Furthermore, breastfeeding is cost-beneficial to families<sup>9</sup>. Based on this evidence, the American Academy of Pediatrics has stated that "The breastfed infant is the reference or normative model against which all alternative feeding methods must be measured with regard to growth, health, development, and all other short- and long-term outcomes"<sup>27</sup>. Thus, human milk is uniquely suited for human infants.

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## RESISTANCE TO INFECTIOUS DISEASES

Human milk contains an abundance of factors that are active against infection. Since the infant's immune system is not fully mature until about 2 years of age, the transfer of these factors from human milk provides a distinct advantage that infants fed formula do not experience. Specifically, human milk contains immunologic agents and other compounds, such as secretory antibodies, leukocytes, and carbohydrates that act against viruses, bacteria, and parasites<sup>28-29</sup>. Overall, research shows that breastfeeding may decrease the incidence of several acute bacterial and viral infections in infants (Table 1).

## ENHANCED IMMUNE SYSTEM

Breastfed infants, compared with formula-fed infants, produce enhanced immune responses to polio, tetanus, diphtheria, and *Haemophilus influenzae* immunizations, and to respiratory syncytial virus infection, a common infant respiratory infection<sup>28,30-31</sup>. Human milk contains anti-inflammatory factors and other factors that regulate the response of the immune system against infection<sup>28</sup>. There is also evidence that breastfeeding results in earlier development of the infant immune system<sup>32</sup>. Protection against infection is strongest during the first several months of life for infants who are breastfed exclusively<sup>2,4,12,33-36</sup>. Several studies suggest that the benefits continue even after breastfeeding ceases<sup>2,4,37</sup>, and a few studies have found that breastfeeding into the second 6 months of life protects against infection<sup>12-13,38</sup>. Longer durations of breastfeeding may provide an even stronger protective effect<sup>2,4,39,37,40</sup>. Finally, children who were breastfed exclusively have fewer illnesses than those who were never breastfed<sup>2,33,35</sup>.

**Table 1.** Infections That Are Lower in Incidence or Severity in Breastfed Infants Than in Formula-fed Infants

- Diarrhea<sup>18,21,29-30,46</sup>
- Respiratory tract infection<sup>18,21,46-49</sup>
- Otitis media<sup>19,29,50-51</sup>
- Pneumonia<sup>52-53</sup>
- Urinary infection<sup>54-55</sup>
- Necrotizing enterocolitis<sup>56-57</sup>
- Invasive bacterial infection<sup>44,59-61</sup>

## NUTRITIONAL AND GROWTH BENEFITS

Human milk contains a balance of nutrients that more closely matches human infant requirements for growth and development than does the milk of any other species<sup>41</sup>. For example, compared to cow's milk, human milk is low in total protein and low in casein, making it more readily digestible and less stressful on immature infant kidneys. The lipids and enzymes in human milk promote efficient digestion and utilization of nutrients<sup>41-42</sup>. Scientific evidence suggests that the normal pattern for breastfed infants is to gain less weight and to be leaner at 1 year of age than formula-fed infants, while maintaining normal activity level and development<sup>43</sup>. This early growth pattern may influence later growth patterns, resulting in less overweight and obesity among children who were breastfed<sup>43-51</sup>. Despite the finding that many African American infants are premature or small at birth, premature babies fare better when breastfed compared to premature babies who are fed formula<sup>44,52</sup>.

## REDUCED RISK FOR CHRONIC DISEASES

Many studies in infant feeding have found lower rates of several chronic childhood diseases among children who were breastfed. Recent findings suggest that breastfeeding may reduce the risk of type 1 and 2 diabetes<sup>53-56</sup>, celiac disease<sup>57-60</sup>, inflammatory bowel disease<sup>61-63</sup>, childhood cancer<sup>11,64-65</sup>, and allergic disease/asthma<sup>15,66-70</sup>. Mixed results from some studies suggest that further research is needed to establish some of these benefits<sup>71-74</sup>.

## DEVELOPMENTAL BENEFITS

Considerable interest has been raised about the potential effect of breastfeeding on cognitive development<sup>75-81</sup>. Long-chain polyunsaturated fatty acids, available in breast milk, are important for brain

growth and development<sup>77-81</sup>. Observations in some studies on neurological and cognitive outcomes in breastfed children have led to a hypothesis that the early visual acuity and cognitive function of these children is greater than in non-breastfed children<sup>75,78-79</sup>. However, this hypothesis has not been conclusively proven<sup>76,80</sup>.

## IMPROVED MATERNAL HEALTH

Breastfeeding has several positive hormonal, physical, and psychosocial effects on the mother. Breastfeeding increases levels of oxytocin, a hormone that stimulates uterine contractions, helping to expel the placenta, to minimize postpartum maternal blood loss, and to induce a more rapid uterine involution<sup>82-83</sup>. Breastfeeding, particularly exclusive breastfeeding, delays the resumption of normal ovarian cycles and the return of fertility in most women<sup>84</sup>. Mothers who breastfeed their infants may also experience psychological benefits, such as increased self-confidence and facilitated bonding with their infants<sup>85-87</sup>. Studies have shown that breastfeeding for longer time periods (up to 2 years) and among younger mothers (early 20s) may reduce the risk of premenopausal and possibly postmenopausal breast cancer<sup>18-23,88</sup>. In addition, the risk of ovarian cancer may be lower among women who have breastfed their children<sup>24-26</sup>.

## SOCIOECONOMIC BENEFITS

Breastfeeding provides economic and social benefits to the family, the health care system, the employer, and the nation<sup>89</sup>. Families can save several hundred dollars over the cost of feeding breast milk substitutes, even after accounting for the costs of breast pump equipment and additional food required by the nursing mother<sup>90</sup>. Breastfed infants typically require fewer sick care visits, prescriptions, and hospitalizations, especially if breastfed exclusively or almost exclusively<sup>9</sup>. Consequently, total medical care expenditures were about 20% lower for fully breastfed infants than for never-breastfed infants<sup>91</sup>. Because of the high occurrence of poverty among African Americans, these families would benefit substantially from breastfeeding their infants<sup>92</sup>. Employers also benefit when their employees breastfeed. Breastfed infants are sick less often; therefore, maternal absenteeism from work is significantly lower in companies with established

lactation programs<sup>93</sup>. In addition, employer medical costs are lower and employee productivity is higher.

## CAUTIONS ABOUT BREASTFEEDING

Human milk provides the most complete form of nutrition for infants, including premature and sick newborns, with rare exceptions<sup>27</sup>. When direct breastfeeding is not possible, expressed human milk, fortified when necessary for the premature infant, should be provided<sup>27</sup>. Professional health care advice against breastfeeding or recommendations about premature weaning should be based on a careful consideration of the general benefits of breastfeeding, the risks of not receiving human milk, and the most up-to-date information about the following situations.

Under certain conditions, women should not breastfeed:

- HIV-infected women in the United States should not breastfeed or provide their breast milk for the nutrition of their own or other infants because of the risk of HIV transmission to the child<sup>94-96</sup>. In countries with populations at increased risk for other infectious diseases and nutritional deficiencies resulting in infant death, the mortality risks associated with not breastfeeding may outweigh the possible risk of transmission of HIV infection<sup>27</sup>.
- Women with human T-cell leukemia virus type 1 (HTLV-1) should not breastfeed because of the risk of transmission to the child<sup>97</sup>.

Under certain conditions, a case-by-case assessment should be made of whether or not breastfeeding is advisable or should be temporarily suspended. A physician should evaluate cases involving:

- Environmental Exposures: During the last 30 years, environmental chemicals, such as polychlorinated biphenyls (PCBs), DDT, dioxin, methyl mercury, and lead have appeared in breast milk without occupational or even known exposure on the part of the woman<sup>98</sup>. Although most women have detectable levels of these agents, there are no established "normal" or "abnormal" values for clinical interpretation; therefore, breast milk is not routinely tested for these environmental pollutants. Thus far, effects on the nursing child have been seen primarily in poisonings where the mother herself was clinically ill<sup>99</sup>. Advisories are issued by the states, U.S. territories, Native American tribes, and the Environmen-

tal Protection Agency to inform residents of potential health risks from consuming contaminated non-commercially caught fish and wildlife. These advisories identify specific fish and wildlife species from specific water bodies<sup>100</sup>. These fish advisories should be followed.

- Hepatitis C: Transmission of hepatitis C through breast milk has not been established. The risk of infection among infants of infected mothers is the same whether breast or bottle fed. However, bleeding or cracked nipples on the breast of a woman positive for hepatitis C may put a breastfeeding infant at risk for transmission of hepatitis C<sup>101</sup>.
- Illicit Drugs: Amphetamines, cocaine, heroin, marijuana, and phencyclidine should not be ingested by the nursing mother. Not only are they hazardous to the nursing infant, but also they are detrimental to the physical and emotional health of the mother. This list is not complete; no drug of abuse should be ingested by nursing mothers even in the absence of adverse reports in the literature<sup>102-103</sup>.
- Implants and Breast Surgery: It is not known whether breastfeeding by women who have breast implants has an effect on the nursing infant<sup>104</sup>. Many women with implants lactate successfully. Women who have had reduction mammoplasty may not be able to lactate if the glandular tissue has been removed or the connection between it and the nipple is interrupted.
- Metabolic Disorders: An infant born with galactosemia cannot metabolize lactose, a sugar found in all mammalian milk. Such infants must be fed plant-derived formula<sup>105</sup>. Infants with phenylketonuria can be successfully breastfed, but doing so requires special clinical management<sup>106</sup>.
- Pharmaceutical Drugs: For most prescribed and over-the-counter medications taken by women, the risk to the nursing infant is unknown. A few medications make it necessary to discontinue breastfeeding. For example, cyclophosphamide, cyclosporin, doxorubicin, ergotamine, methotrexate, and radioactive isotopes are prohibited during lactation<sup>27,102</sup>. Pharmaceutical drugs that effect the central nervous system, such as anti-anxiety, anti-depressant, and anti-psychotic agents, are of special concern when taken by nursing mothers<sup>102</sup>. Some pharmaceutical agents such as bromocriptine and possibly estrogens in contraceptive doses make breastfeeding more difficult because they decrease breast milk production and consequently shorten breastfeeding

duration<sup>102</sup>. A woman taking any of those drugs should not breastfeed without first consulting her health care provider.

- Tobacco and Alcohol Consumption: Alcohol appears in breast milk<sup>107-108</sup>. For this reason, and for the general health of the mother, if alcohol is used, intake should be limited. The American Academy of Pediatrics Committee on Drugs lists alcohol as "usually compatible with breastfeeding"<sup>102</sup>. Nursing mothers should not smoke. Nicotine is present in the breast milk of smokers and may adversely affect milk volume<sup>109</sup>. However, for women who cannot or will not stop smoking, breastfeeding is still advisable, since the benefits of breast milk outweigh the risks from nicotine.

### Acknowledgment

This document presents the consensus of the members and reviewers on the HHS Subcommittee on Breastfeeding; it does not necessarily reflect the policy of the non-federal representative organizations.

In March 1998, the Environmental Health Policy Committee, which is chaired by the Surgeon General of the United States, requested that the HHS Office on Women's Health lead the Subcommittee on Breastfeeding in preparing the HHS Blueprint for Action on Breastfeeding. Federal representatives throughout the Department of Health and Human Services worked in partnership with the Department of Agriculture, the Environmental Protection Agency, and the U.S. Agency for International Development to develop this report. The Federal Liaison Members on the Subcommittee on Breastfeeding represent individuals with a broad range of expertise in breastfeeding: leaders of nonprofit breastfeeding organizations; representatives from major hospital, medical, and nursing organizations; private sector experts; and university-based researchers.

### REFERENCES

1. Beaudry M, Dufour R, Marcoux S. Relation between infant feeding and infections during the first six months of life. *J Pediatr* 1995;126:191-197.
2. Duncan B, Ey J, Holberg CJ, Wright AL, Martinez FD, Taussig LM. Exclusive breast-feeding for at least 4 months protects against otitis media. *Pediatrics* 1993;91(5):867-872.
3. Frank AL, Taber LH, Glezen WP, Kasel GL, Wells CR, Paredes A. Breast-feeding and respiratory virus infection. *Pediatrics* 1982;70(2):239-245.
4. Howie PW, Forsyth JS, Ogston SA, Clark A, du V Florey C. Protective effect of breast feeding against infection. *BMJ* 1990;300:11-16.
5. Kovar MG, Serdula MK, Marks JS, Fraser DW. Review of the epidemiologic evidence for an association between infant feeding and infant health. *Pediatrics* (Suppl.) 1984;74:S615-S638.
6. Popkin BM, Adair L, Akin JS, Black R, Briscoe J, Flegler, W. Breast-feeding and diarrheal morbidity. *Pediatrics* 1990;86(6):874-882.
7. Saarinen UM. Prolonged breast feeding as prophylaxis for recurrent otitis media. *Acta Paediatrica Scandinavica* 1982;71:567-571.
8. Moreland J, Coombs J. Promoting and Supporting Breast-feeding. *Am Fam Physician* 2000, 61:1093-1100, 2103-2104.
9. Ball TM, Wright AL. Health care costs of formula-feeding in the first year of life. *Pediatrics* (Suppl.) 1999;103(4):870-76.
10. Davis MK, Savitz DA, Graubard BI. Infant feeding and childhood cancer. *Lancet* 1988;2(8607):365-368.
11. Davis MK. Review of the evidence for an association between infant feeding and childhood cancer. *Int J Cancer* (Suppl.) 1998;11:29-33.
12. Dewey KG, Heinig MJ, Nommsen-Rivers LA. Differences in morbidity between breast-fed and formula-fed infants. *J Pediatr* 1995;126(5):696-702.
13. Duffy LC, Byers TE, Riepenhoff-Talty M, La Scolea LJ, Zielezny M, Orga PL. The effects of infant feeding on rotavirus-induced gastroenteritis: a prospective study. *Am J Public Health* 1986;76(3):259-263.
14. Heinig MJ, Dewey KG. Health advantages of breast feeding for infants: a critical review. *Nutrition Research Reviews* 1996;9:89-110.
15. Wright AL, Holberg, CJ, Taussig LM, Martinez, FD. Relationship of infant feeding to recurrent wheezing at age 6 years. *Arch Pediatr Adolesc Med* 1995;149:758-763.
16. Chua S, Arulkumaran S, Lim I, Selamat N, Ratnam SS. Influence of breastfeeding and nipple stimulation on postpartum uterine activity. *Br J Obstet Gynecol* 1994;101:804-805.
17. Dewey KG, Heinig MJ, Nommsen LA. Maternal weight-loss patterns during prolonged lactation. *Am J Clin Nutr* 1993;58:162-166.
18. Newcomb PA, Storer BE, Longnecker MP, et al. Lactation and a reduced risk of premenopausal breast cancer. *N Engl J Med* 1994;330(2):81-87.
19. Enger SM, Ross RK, Paganini-Hill A, Bernstein L.

Breastfeeding experience and breast cancer risk among postmenopausal women. *Cancer Epidemiol Biomarkers Prev* 1998;7(5):365-369.

20. Marcus PM, Baird DD, Millikan RC, Moorman PG, Qaqish B, Newman B. Adolescent reproductive events and subsequent breast cancer risk. *Am J Public Health* 1999;89(8):1244-1247.

21. Weiss HA, Potischman NA, Brinton LA, et al. Prenatal and perinatal risk factors for breast cancer in young women. *Epidemiology* 1997;8(2):181-187.

22. Brinton LA, Potischman NA, Swanson CA, et al. Breastfeeding and breast cancer risk. *Cancer Causes and Control* 1995;6:199-208.

23. Newcomb PA, Egan KM, Titus-Ernstoff L, et al. Lactation in relation to postmenopausal breast cancer. *Am J Epidemiol* 1999;150(2):174-182.

24. Gwinn ML, Lee NC, Rhodes PH, Layde PM, Rubin GL. Pregnancy, breast feeding, and oral contraceptives and the risk of epithelial ovarian cancer. *J Clin Epidemiol* 1990;43(6):559-568.

25. Whittemore AS, Harris R, Itnyre J, and the Collaborative Ovarian Cancer Group. Characteristics relating to ovarian cancer risk: collaborative analysis of 12 US case-control studies. II. Invasive epithelial ovarian cancers in white women. *Am J Epidemiol* 1992;136(10):1184-1203.

26. Rosenblatt KA, Thomas DB, and the WHO Collaborative Study of Neoplasia and Steroid Contraceptives. Lactation and the risk of epithelial ovarian cancer. *Int J Epidemiol* 1993;22(2):192-197.

27. American Academy of Pediatrics. Policy Statement: Breastfeeding and the Use of Human Milk (RE9729). *Pediatrics* 1977;100(6):1035-1039.

28. Goldman AS. The immune system of human milk: antimicrobial, antiinflammatory and immunomodulating properties. *Pediatr Infect Dis J* 1993;12(8):664-672.

29. Goldman AS, Goldblum RM, Hanson LA. Antiinflammatory systems in human milk. *Adv Exp Med Biol* 1990;262:69-76.

30. Hahn-Zoric M, Fulconis F, Minoli I, et al. Antibody responses to parenteral and oral vaccines are impaired by conventional and low protein formulas as compared to breast-feeding. *Acta Paediatr Scand* 1990;79:1137-1142.

31. Pabst HF. Immunomodulation by breast-feeding. *Pediatr Infect Dis J* 1997;16(10):991-995.

32. Garofalo RP, Goldman AS. Expression of functional immunomodulatory and anti-inflammatory factors in human milk. *Clin Perinatol* 1999;26(2):361-377.

33. Scariati PD, Grummer-Strawn LM, Fein SB. A longitudinal analysis of infant morbidity and the extent of breastfeeding in the United States. *Pediatrics* 1997;99(6):5.

34. Raisler J, Alexander C, O'Campo P. Breast-feeding and infant illness: a dose-response relationship? *Am J Public Health* 1999;89(1):25-30.

35. Cushing AH, Samet JM, Lambert WE, et al. Breastfeeding reduces risk of respiratory illness in infants. *Am J Epidemiol* 1998;147(9):863-870.

36. Istre GR, Conner JS, Broome CV, Hightower A, Hopkins RS. Risk factors for primary invasive Haemophilus influenzae disease: increased risk from day care attendance and school-aged household members. *J Pediatr* 1985;106(2):190-195.

37. Takala AK, Eskola J, Palmgren J, et al. Risk factors of invasive Haemophilus influenzae type b disease among children in Finland. *J Pediatr* 1989;115(5):694-701.

38. Levine OS, Farley M, Harrison LH, et al. Risk factors for invasive pneumococcal disease in children: a population-based case-control study in North America. *Pediatrics* 1999;103(3):28.

39. Owen MJ, Baldwin CD, Swank PR, Pannu AK, Johnson DL, Howie VM. Relation of infant feeding practices, cigarette smoke exposure, and group child care to the onset and duration of otitis media with effusion in the first two years of life. *J Pediatr* 1993;123(5):702-711.

40. Nafstad P, Jaakola JJK, Hagen JA, Botten G, Kongerud J. Breastfeeding, maternal smoking and lower respiratory tract infections. *Eur Respir J* 1996;9:2623-2629.

41. Picciano MF. Human milk: nutritional aspects of a dynamic food. *Biol Neonate* 1998;74:84-93.

42. Hernell O, Blackberg L. Human milk bile salt-stimulated lipase: functional and molecular aspects. *J Pediatr* 1994;125(5)(Pt 2):S56-S61.

43. Dewey KG. Growth characteristics of breast-fed compared to formula-fed infants. *Biol Neonate* 1998;74:94-105.

44. Meier PP, Brown LP, Hurst NM. Breastfeeding the preterm infant. Chapter 14 In Auerback K, Riordan J. *Breastfeeding*. Gaithersburg, MD: Aspen, 1998, pp. 449-480.

45. Von Kries R, Koletzko B, Sauerwald T, et al. Breast feeding and obesity: cross sectional study. *BMJ* 1999;319:147-150.

46. Ravelli AC, van der Meulen JHP, Osmond C, Barker DJP, Blekes OP. Infant feeding and adult glucose tolerance, lipid profile, blood pressure, and obesity. *Arch Dis Child* 2000;82(3):248-252.

47. Kramer MS. Do breast-feeding and delayed introduction of solid foods protect against subsequent obesity? *J Pediatr* 1981;98(6):883-887.

48. Strbak V, Skultetyova M, Hromadova M, Randuskova A, Macho L. Late effects of breast-feeding and early

weaning: seven-year prospective study in children. *Endocrine Regulation* 1991;25:53-57.

49. Hamosh M. Does infant nutrition affect adiposity and cholesterol levels in the adult? *J Pediatr Gastroenterol Nutr* 1988;7(1):10-16.

50. Elliott KG, Kjolhede CL, Gournis E, Rasmussen KM. Duration of breastfeeding associated with obesity during adolescence. *Obes Res* 1997;5(6):538-541.

51. Oken E, Lightdale JR. Updates in pediatric nutrition. *Curr Opin Pediatr* 2000;12(3):282-290.

52. Centers for Disease Control and Prevention. Pediatric Nutrition Surveillance, 1997 full report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 1998.

53. Perez-Bravo F, Carrasco E, Gutierrez-Lopez MD, Martinez MT, Lopez G, Garcia de los Rios M. Genetic predisposition and environmental factors leading to the development of insulin-dependent diabetes mellitus in Chilean children. *J Mol Med* 1996;74:105-109.

54. Hammond-McKibben D, Dosch H-M. Cow's milk, bovine serum albumin, and IDDM: can we settle the controversies? *Diabetes Care* 1997;20(5):897-901.

55. Norris JM, Scott FW. Meta-analysis of infant diet and insulin-dependent diabetes mellitus: do biases play a role? *Epidemiology* 1996;7(1):87-92.

56. Pettitt DJ, Forman MR, Hanson RL, Knowler WC, Bonnett PH. Breastfeeding and incidence of non-insulin-dependent diabetes mellitus in Pima Indians. *Lancet* 1997;350:166-168.

57. Greco L, Auricchio S, Mayer M, Grimaldi M. Case control study on nutritional risk factors in celiac disease. *J Pediatr Gastro & Nutr* 1997;7(3):395-399.

58. Auricchio S, Follo D, de Ritis G, et al. Does breast feeding protect against the development of clinical symptoms of celiac disease in children? *J Pediatr Gastro & Nutr* 1983(3):2:428-433.

59. Falth-Magnusson K, Franzen L, Jansson G, Laurin P, Stenhammar L. Infant feeding history shows distinct differences between Swedish celiac and reference children. *Pediatr Allergy Immunol* 1996;7(3):1-5.

60. Ivarsson A, Persson LA, Nystrom L, et al. Epidemic of celiac disease in Swedish children. *Acta Paediatr* 2000;89:165-171.

61. Acheson ED, Truelove SC. Early weaning in the aetiology of ulcerative colitis: a study of feeding in infancy in cases and controls. *BMJ* 1961;2:929-933.

62. Whorwell PJ, Holdstock G, Whorwell GM, Wright R. Bottle feeding, early gastroenteritis, and inflammatory bowel disease. *BMJ* 1979;1:382.

63. Koletzko S, Sherman P, Corey M, Griffiths A, Smith C. Role of infant feeding practices in development of Crohn's disease in childhood. *BMJ* 1989;298:1617-1618.

64. Shu XO, Linet MS, Steinbuch M, et al. Breastfeed-

ing and risk of childhood acute leukemia. *J Natl Cancer Inst*. 1999;91(20):1765-1772.

65. Smulevich VB, Solionova LG, Belyakova SV. Parental occupation and other factors and cancer risk in children: I. study methodology and nonoccupational factors. *Int J Cancer* 1999;83:712-717.

66. Saarinen UM, Kajosaari M. Breastfeeding as prophylaxis against atopic disease: prospective follow-up study until 17 years old. *Lancet* 1995;346:1065-1069.

67. Kramer MS. Does breastfeeding help protect against atopic disease? Biology, methodology, and a golden justice of controversy. *J Pediatr* 1988;112(2):181-190.

68. Oddy WH, Holt PG, Sly PD, et al. Association between breast feeding and asthma in 6 year old children: findings of a prospective birth cohort study. *BMJ* 1999;319:815-819.

69. Bjorksten B, Kjellman N-IM. Perinatal environmental factors influencing the development of allergy. *Clin Exper Allergy* 1990;20 Suppl (3):3-8.

70. Burr ML, Limb ES, Maguire MJ, et al. Infant feeding, wheezing, and allergy: a prospective study. *Arch Dis Child* 1993;68:724-728.

71. Ascher H, Krantz I, Rydberg L, Nordin P, Kristiansson B. Influence of infant feeding and gluten intake on celiac disease. *Arch Dis Child* 1997;76:113-117.

72. Gilat T, Hacoheh D, Lilos P, Langman MJS. Childhood factors in ulcerative colitis and Crohn's disease: an international cooperative study. *Scand J Gastroenterol* 1987;22:1009-1024.

73. Gruber M, Marshall JR, Zielezney M, Lance P. A case-control study to examine the influence of maternal perinatal behaviors on the incidence of Crohn's disease. *Gastroenterology Nursing* 1996;19(2):53-59.

74. Rigas A, Rigas B, Glassman M, et al. Breastfeeding and maternal smoking in the etiology of Crohn's disease and ulcerative colitis in childhood. *Ann Epidemiol*. 1993;3(4):387-392.

75. Anderson EW, Johnstone BM, Remax DT. Breastfeeding and cognitive development: a meta-analysis. *Am J Clin Nutr* 1999;70:525-535.

76. Jacobson SW, Chiodo LM, Jacobson JL. Breastfeeding effects on intelligence quotient in 4- and 11-year-old children. *Pediatrics* 1999;103(5):71.

77. Jensen RG. Lipids in human milk. *Lipids* 1999;34(12):1243-1271.

78. Lucas A, Morley R, Cole TJ, Lister G, Leeson-Payne C. Breast milk and subsequent intelligence quotient in children born preterm. *Lancet* 1992;339:261-264.

79. Jorgensen MH, Hernell O, Lund P, Holmer G, Michaelsen KF. Visual acuity and erythrocyte docosa-hexaenoic acid status in breast-fed and formula-fed term

- infants during the first four months of life. *Lipids* 1996;31(1):99-105.
80. Richards M, Wadsworth M, Rahimi-Foroushani A, Hardy R, Kuh D, Paul A. Infant nutrition and cognitive development in the first offspring of a national UK birth cohort. *Dev Med Child Neurol* 1998;40:163-167.
81. Hamosh M, Salem N. Long-chain polyunsaturated fatty acids. *Biol Neonate* 1998;74:106-120.
82. Institute of Medicine. Nutrition During Lactation. Washington, DC: National Academy Press, 1991, pp. 24-25, 161-171, 197-200.
83. Heinig MJ, Dewey KG. Health effects of breast feeding for mothers: a critical review. *Nutrition Research Reviews* 1997;10:35-56.
84. McNeilly, AS. Lactational amenorrhea. *Endocrinol Metab Clin North Am* 1993;22 (1):59-73.
85. Kuzela AL, Stifter CA, Worobey J. Breastfeeding and mother-infant interactions. *J Reprod Infant Psychol* 1990;8:185-194.
86. Windstrom AM, Wahlberg V, Matthiesen AS, et al. Short-term effects of early suckling and touch of the nipple on maternal behavior. *Early Hum Dev* 1990;21:153-163.
87. Virden SF. The relationship between infant feeding method and maternal role adjustment. *J Nurs-Midwif* 1988;33(1):31-35.
88. Newcomb PA, Egan KM, Titus-Ernstoff L, et al. Lactation in relation to postmenopausal breast cancer. *Am J Epidemiol* 1999;150:174-182.
89. Riordan JM. The cost of not breastfeeding: a commentary. *J Hum Lact* 1997;13(2):93-97.
90. Montgomery DL, Splett PL. Economic benefit of breast-feeding infants enrolled in WIC. *J Am Diet Assoc* 1997;97:379-385.
91. Hoey C, Ware JL. Economic advantages of breast-feeding in an HMO setting: a pilot study. *Am J Man Care* 1997;3(6):861-865.
92. U.S. Department of Commerce. Poverty 1998. Washington, DC: U.S. Department of Commerce, Census Bureau, 1999. [www.census.gov/hhes/poverty](http://www.census.gov/hhes/poverty).
93. Cohen R, Mrtek MB, Mrtek RG. Comparison of maternal absenteeism and infant illness rates among breast-feeding and formula-feeding women in two corporations. *Am J Health Promot* 1995;10(2):148-153.
94. Centers for Disease Control and Prevention. Public Health Service task force recommendations for the use of antiretroviral drugs in pregnant women infected with HIV-1 for maternal health and for reducing perinatal HIV-1 transmission in the United States. *MMWR* 1998(RR-2); 47:1-30.
95. American Academy of Pediatrics Committee on Pediatrics AIDS. Evaluation and medical treatment of the HIV-exposed infant (RE97-21). *Pediatrics* 1997;99(6):909-917.
96. American Academy of Pediatrics Committee on Pediatrics AIDS. Human milk, breastfeeding, and transmission of human immunodeficiency virus in the United States (RE9542). *Pediatrics* 1995;96(5):977-979.
97. Lawrence, RA. A review of the medical benefits and contraindications to breastfeeding in the United States. Maternal and Child Health Technical Information Bulletin. Arlington, VA: National Center for Education in Maternal and Child Health, 1997, pp. 3-38.
98. American Academy of Pediatrics Committee on Environmental Health. Chapter 16. Human Milk. In Handbook of Pediatric Environmental Health. Elk Grove Village, IL: American Academy of Pediatrics, 1996, pp. 155-162.
99. Rogan WJ. Pollutants in breast milk. *Arch Pediatr Adolesc Med* 1996;150:981-990.
100. Environmental Protection Agency. Update: National Listing of Wildlife Advisories. Washington, DC: Environmental Protection Agency, 1998. <http://www.epa.gov/ost/fish>.
101. Centers for Disease Control and Prevention. Recommendations for prevention and control of hepatitis C virus (HCV) infection and HCV-related chronic disease. *MMWR* 1998;47(RR-19):1-39. <http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/00055154.htm>.
102. American Academy of Pediatrics Committee on Drugs. The transfer of drugs and other chemicals into human milk. *Pediatrics* 1994;93(1):137-150.
103. Wilton JM. Breastfeeding and the chemically dependent woman. *NAACOG's Clinical Issues* 1992;3(4):667-672.
104. The Institute of Medicine. Safety of Silicon Implants. Washington, DC: National Academy Press, 2000, pp. 248-263.
105. Neal P. Special feeds for special infants 2: feeding the preterm baby. *Prof Care Mother Child* 1995;5(6):151-155.
106. Motzfeldt K, Lilje R, Nylander G. Breastfeeding in phenylketonuria. *Acta Paediatr Suppl.* 1999;432:25-27.
107. Mennella JA, Beauchamp GK. The transfer of alcohol to human milk. Effects on flavor and the infant's behavior. *N Engl J Med* 1991;325(14):981-985.
108. Little RE, Anderson KW, Ervin CH, Worthington-Roberts B, Clarren SK. Maternal alcohol use during breast-feeding and infant mental and motor development at one year. *N Engl J Med* 1989;321(7):425-430.
109. Mennella JA, Beauchamp GK. Smoking and the flavor of breast milk. Letter. *N Engl J Med* 1998;339(21):1559-1560.

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