Global Perspectives in Breast Milk Contamination: Infectious and Toxic Hazards

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Breast milk is the natural and optimal food for infants. In addition to meeting nutritional needs, breast milk provides numerous immunologic, developmental, psychologic, economic, and practical advantages. It is postulated that breast-feeding may also be related to the prevention of some adult health problems such as diabetes and coronary heart disease. Malnutrition among infants and young children, which remains one of the most severe global public health problems, is among the main reasons that the World Health Organization (WHO) so strongly supports breast-feeding. However, WHO recognizes the growing concern expressed by scientists, health professionals, environmentalists, and mothers about the potential risks posed by the presence of toxicants and infectious agents in breast milk. In this paper we review the main infectious hazards (tuberculosis, hepatitis B, and human immunodeficiency virus) and selected chemical hazards (tobacco, persistent contaminants) and the activities undertaken by WHO. We conclude that in cases where there is a high degree of pollution from chemical sources occurring simultaneously in a bacterially contaminated environment, the choice is not simply between polluted breast milk and risk-free substitutes. Rather, informed choice is based on assessing the known and unknown risks of artificial feeding versus the unknown, but potential, risks of chemical contamination of breast milk. Clearly, the possible toxicity of compounds requires further investigation. Of much greater importance, however, are effective measures to protect the environment for the entire population by controlling the use of these toxic products. Current scientific evidence does not support altering WHO's global public health recommendation of exclusive breast-feeding for 6 months followed by safe and appropriate complementary foods, with continued breast-feeding, up to 2 years of age or beyond. *Key words:* **breast milk, chemicals, dioxins, infectious agents, hepatitis B, HIV, human immunodeficiency virus, pollutants, tuberculosis.** *Environ Health Perspect* **110:A349–A351 (2002). [Online 13 May 2002]**
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Breast milk is the natural and optimal food for infants. In addition to meeting nutritional needs, breast milk provides numerous immunologic, developmental, psychologic, economic, and practical advantages (*1*). Appropriate feeding practices are essential for the growth, development, health, nutrition, and survival of infants and children everywhere (*2*). It has been postulated that breast-feeding may also be related to the prevention of some chronic diseases (e.g., diabetes, obesity) (*3,4*). Malnutrition among infants and young children, which remains one of the most severe global public health problems, is among the main reasons that the World Health Organization (WHO) so strongly supports breast-feeding. Malnutrition is responsible, directly or indirectly, for fully 60% of the 10.9 million deaths annually among children under 5 years of age (*5*).

To protect breast-feeding from commercial influences, in 1981 WHO adopted the International Code of Marketing of Breast-milk Substitutes, which is now being implemented worldwide. Together with the United Nations Children's Fund (UNICEF), in 1991 it launched the Baby-friendly Hospital Initiative so that maternity services can effectively protect, promote, and support breast-feeding. In a recent recommendation, WHO urged its member states to strengthen activities "to protect, promote and support exclusive breast-feeding for 6 months as a global public health recommendation, and to provide safe and appropriate complementary foods, with continued breast-feeding for up to 2 years of age or beyond" (*6*).

WHO recognizes the growing concern expressed by scientists, health professionals, environmentalists, and mothers about the potential risks posed by the presence of toxicants and infectious agents in breast milk. WHO programs dealing with chemical safety, food safety, reproductive health and research, human immunodeficiency virus (HIV)/AIDS, nutrition, vaccines and immunization, communicable diseases, and child and adolescent health and development currently address these issues. A number of studies are promoted, guidelines are issued, and recommendations made on matters related to potential infectious and toxic risks.

For example, WHO has prepared guidance on breast-feeding and hepatitis B, tuberculosis, and HIV transmission, which are among the main global infectious disease threats to human health. In addition, a number of studies have been promoted and recommendations made concerning selected environmental pollutants; additional information is available on the WHO Homepage on the Internet (*7*). A brief overview follows.

Main Infectious Hazards

In all cases of maternal tuberculosis, mothers should be treated with an appropriate therapy such as the standard short-course regime with isoniazid, rifampicin, pyrazinamid, and ethambutol (which are safe during pregnancy and breast-feeding); infants should not be separated from their mothers, and breast-feeding should be encouraged (*8*). Additional recommendations depend on the timing of diagnosis. When maternal tuberculosis is diagnosed > 2 months before delivery, and if the sputum smear is negative just before delivery, the infant should be immunized with BCG (*Mycobacterium bovis* Bacillus Calmette-Guerin) as soon as possible, but preventive chemotherapy should not be given. However, if the smear is positive, the infant should receive isoniazid for 6 months and be immunized with BCG after stopping isoniazid. When maternal tuberculosis is diagnosed 2 months before or after delivery, the infant should receive isoniazid for 6 months and be immunized with BCG after stopping isoniazid. When maternal tuberculosis is diagnosed > 2 months after delivery, the infant should receive isoniazid for 6 months and be immunized with BCG if it was not given at birth (*9*).

Hepatitis B virus infection (HBV) is of major public health importance: there are > 350 million chronic carriers, and complications kill about 1 million people annually. In highly endemic areas (Southeast Asia and sub-Saharan Africa), transmission occurs mainly perinatally or through close contact between children. In areas of low endemicity (including Western Europe and North America), perinatal transmission is less common (*10*). Even though the HBV antigen has been detected in breast milk, there is no evidence that breast-feeding increases the

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risk of mother-to-child transmission (*11,12*). The risk associated with breast-feeding is negligible compared to the high risk of exposure to maternal blood and body fluids at birth. Some concern exists about breast pathology (cracked or bleeding nipples, lesions with exudates) that could expose the infant to infectious doses of HBV. Immunization can prevent development of the persistent carrier state in 70–90% of infants of carrier mothers, and protection can increase to 85–90% when hepatitis B immunoglobulin (HBIg) is administered within 24 hr of birth together with the first dose of vaccine (*13*). WHO recommends that all infants receive hepatitis B vaccine as part of routine childhood immunization, the first dose to be given within 48 hr of birth when feasible. Breast-feeding remains the recommended method of feeding (*14*).

It has been estimated that 800,000 children younger than 15 years of age were newly infected in 2001 and that > 90% were due to mother-to-child transmission (MTCT) (*15*). Breast-feeding is associated with an increased risk of transmission, depending on duration and other risk factors. In untreated women who continue breast-feeding after the first year, the absolute additional risk of transmission is 10–20% (*16,17*). This risk must be balanced against the increased risk of morbidity and mortality due to malnutrition and diarrheal or other infectious diseases associated with replacement feeding (*2*). In addition, evidence from one study suggests that exclusive breast-feeding in the first 3 months of life may carry a lower risk of HIV transmission than partial breast-feeding (*18*). A three-pronged strategy is recommended by United Nations agencies for the prevention of MTCT, which includes the primary prevention of HIV infection among expectant parents, the prevention of unwanted pregnancies in HIV-infected women, and the prevention of viral transmission with antiretroviral regimens, improved obstetric care, and safer feeding practices. Interventions such as long and complex courses of zidovudine, cesarean section, and avoidance of breast-feeding have shown to reduce HIV transmission from mother to child (*19*). However, these measures are not always practical or safe in resource-limited settings.

A technical consultation on the prevention of MTCT convened by WHO/UNICEF/UNAIDS (Joint United Nations Programme on HIV/AIDS) in October 2000 (*20*) made the following recommendations: only when replacement feeding is acceptable, feasible, affordable, sustainable, and safe is avoidance of all breast-feeding by HIV-infected mothers recommended; otherwise, exclusive breast-feeding is recommended during the first months of life. Mothers should be advised to discontinue breast-feeding as soon as possible, taking into consideration local circumstances, the situation of the mother, and the risks associated with replacement feeding. For women who are HIV negative or whose status is unknown, exclusive breast-feeding for 6 months, with adequate complementary feeding and continued breast-feeding thereafter, should be encouraged.

Selected Chemical Hazards

A number of drugs, industrial chemicals, and environmental contaminants can be present in breast milk. Reports on the potential effects resulting from exposure to toxic substances in breast milk are found in the medical literature and in statements by scientific bodies. For example, antianxiety drugs, antidepressants, neuroleptics, nicotine, and silicones have been considered recently by the American Academy of Pediatrics (*21*).

Smoking represents a special hazard. It increases the exposure of mothers and infants to many chemical compounds, including pesticide residues and known carcinogens. It is associated with increased levels of chemical contaminants in milk as well as reduced duration of breast-feeding and increased levels of infant distress ("colic"). Women who smoke should be encouraged to breast-feed and to eliminate, or at least reduce, cigarette smoking during pregnancy and lactation.

In the last decade, major concern has been expressed and there has been some debate about the presence of environmental contaminants such as heavy metals (e.g., mercury, lead), pesticides, and persistent organic pollutants in breast milk and their potential effects on the health and development of infants. In some instances, mothers with known or suspected high levels of contaminants in breast milk due to acute or chronic exposure have been advised to reduce or interrupt breast-feeding. For example, workers exposed to polychlorinated biphenyls (PCBs), women consuming high fish diets in highly polluted areas, women affected by the Yusho incident in Japan who ingested rice oil contaminated with PCBs and furans, and women affected by the Yu-cheng incident in Taiwan where cooking oil was contaminated by PCBs and other polychlorinated compounds, have been advised to reduce or interrupt breast-feeding. Exposure to PCBs and dioxins has been associated with a greater susceptibility to infectious diseases in infants (e.g., middle-ear infections, chickenpox) and a lower prevalence of allergic reactions.

WHO's Regional Office for Europe (WHO/EURO) coordinated two studies (1987–1989 and 1991–1993), in collaboration with other organizations, to evaluate the levels of dioxins in mother's milk (as a surrogate measure for body burden). A third study is in progress. These studies aimed to assess the possible health risks, especially in infants, and to control and prevent environmental exposure to those contaminants. The studies included the consideration of polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), dioxin-like PCBs, and other PCBs. In March 1994, the Bilthoven Division of WHO/EURO organized a consultation to review the available results of the first two studies and concluded that *a*) levels of PCDDs and PCDFs were not increasing, although the situation for PCBs was unclear (noncomparable analytic methods had been used); *b*) primary preventive measures to limit environmental pollution were the most effective way to limit exposures; and *c*) breast-feeding should be encouraged and promoted due to its multiple benefits for the overall health and development of infants.

Based on available evidence, the WHO/EURO consultation noted that infant exposure through breast milk was considerably less important than exposure *in utero*. Risk management should thus aim to limit intake of contaminated food by the mother rather than restrict breast-feeding.

In 1998, the Global Environment Monitoring System, Food Contamination Monitoring and Assessment Programme assessed the risk of selected organochlorine contaminants in breast milk. Data were reviewed on breast-milk levels of DDT complex, hexachlorobenzene (HCB), γ-hexachlorocyclohexane (γ-HCH; lindane), isomeric mixtures of HCH (aldrin and dieldrin) and PCBs. The reported levels of residues in human milk of the HCH isomers aldrin and dieldrin were close to reference intake values (few reported higher values). DDT was reported in higher concentrations in developing countries, and HCB levels were high in industrialized countries. The levels of PCBs in breast milk raised greatest concern. In industrialized countries, concentrations exceed the reference intake of 1 μg/kg of body weight; however, levels over time were stable or only slowly decreased.

The overall conclusions from this assessment were that *a*) responsible authorities should consider incorporating into national risk assessment procedures mechanisms to assess potential health risks posed by breast-milk contaminants; *b*) decision making for any contemplated intervention should include a quantitative estimate of risk-based reference intakes for breast-milk contamination and take into account the well-established benefits of breast-feeding as well as socioeconomic factors; and *c*) under most circumstances authorities can and should reassure mothers that breast milk is by far the best food for their babies.

Conclusion

In cases where there is a high degree of pollution from chemical sources occurring simultaneously in a bacterially contaminated environment, the choice is not simply between polluted breast milk and risk-free substitutes. Rather, informed choice is based on assessing the known and unknown risks of artificial feeding versus the unknown, but potential, risks of chemical contamination of breast milk. Clearly, the possible toxicity of compounds requires further investigation. Of much greater importance, however, are effective measures to protect the environment for the entire population by controlling the use of these toxic products.

The subtle effects observed in studies are associated more with transplacental exposure rather than with exposure through breast-feeding. Current scientific evidence does not support altering WHO's recommendation for exclusive breast-feeding for 6 months as a global public health recommendation and the provision of safe and appropriate complementary foods, with continued breast-feeding for up to 2 years of age or beyond.

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