Risks, Rights and Regulation

Communicating About Risks and Infant Feeding

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Introduction

Breastfeeding advocates have a responsibility to examine and critique the continuously accumulating evidence concerning breastfeeding and environmental toxins, and how this information is communicated to policy makers, advocacy groups, and the general public.

The paradoxes and contradictions concerning breastfeeding are most evident in an examination of the well-documented benefits of breastfeeding versus the potential harm caused by environmental toxins transmitted through breastmilk. This paper reviews medical, social science, and advocacy literature on this topic, and investigates how research about the risks of breastfeeding was fed back to community-based health advocacy groups .

Breastfeeding is a subject of great importance to women's health, providing well documented benefits for mothers and children. In Canada, policy makers and governments have invested modestly in promoting breastfeeding, with particular emphasis on promotional messages ("Breastfeeding -anytime, anywhere"). Neither provincial nor federal governments have taken steps to protect breastfeeding and infant feeding generally by acting on or legislating the WHO/UNICEF *International Code of Marketing of Breastmilk Substitutes* (1981).

Recently, there has been a convergence of interest by breastfeeding advocates, food safety activists, the women's health movement, and environmentalists with regard to what is transmitted through breastmilk. This paper also focuses on environmental risks associated with infant feeding, and how contradictory information about the risks of breastfeeding is communicated to policy makers, advocacy groups, and the general public. How do women's health groups, breastfeeding advocates, and environmentalists use this complex (and often contradictory) information to inform women of relative risks so that they can make informed choices about infant feeding?

This report further reviews, summarizes, and analyzes some of this research, examines what different constituent groups are doing with this information, and concludes with suggestions for future research and advocacy initiatives. It has been guided by the principle that whatever needs to be examined about breastfeeding in a polluted environment needs to be examined about alternatives to breastfeeding as well.

For most women in the world, breastfeeding is a natural continuation of the reproductive cycle following pregnancy and childbirth. In spite of the fact that there are many cultural practices that are not considered optimal by western health and nutritional standards (such as introducing foods to infants within the first few weeks after birth), the idea that many women of all social classes contemplate their infant feeding options and seriously consider suppressing lactation is probably a recent Euroamerican concept and practice (Fildes, 1986).

To think of breastfeeding as risky behaviour and artificial feeding as a way of saving children from their mother's contaminated milk (Baumslag and Michels, 1995) is a travesty brought about by new industrial processes, advances in technological surveillance and new ways of thinking about women's bodies. This approach provides occasions for more attacks undermining breastfeding, and more opportunities to confuse mothers. The decision for a breastfeeding advocate to discuss this issue now rather than "let sleeping dogs lie" is that one never knows how long they may lie; there is evidence they are waking.

The Nature of the Evidence

The literature on this subject is immense, with well over 1,000 papers published on environmental contaminants and milk production (Berlin and Kacew, 1997). It is challenging material for a non-specialist to absorb. The scientific evidence used in reviewing toxins and breastmilk comes primarily from three sources: animal studies, clinical research and case reports, and industrial accidents. Animal studies are done primarily on mice, rats, and monkeys but large species exhibit differences in sensitivity. Often evidence of toxicity only occurs when exceptionally large doses are given. However, "…effects such as carcinogenicity, immunosuppression, reproductive and behavioural effects, and enzyme induction have been reported in laboratory animals at dose levels equal to, or only one or two orders of magnitude higher than, the levels normally found in human milk in many industrialized countries" (Jensen and Slorach, 1991, p. 246).

Not surprisingly, there are no controlled human studies on the impact of undesirable chemical compounds on human health for ethical reasons. Because everyone carries a body burden of toxic chemicals, it would be impossible to find an unexposed population for a control group. It is equally impossible to find an individual woman with uncontaminated breastmilk to

act as control. Instead, researchers often use breastmilk as a gauge of human exposure. Many studies come from regulatory agencies that were interested in determining population exposure to contaminants, and breastmilk was the easiest, most accessible and cheapest way to obtain these samples. For example, the levels of PCBs in blood, hair, and urine are often too low to be measured; researchers prefer to use breastmilk fat since it is more easily obtained than more invasive techniques such as blood or tissue samples (Slorach and Jensen, 1991). This means that the human body's burden of environmental pollutants relies heavily on evidence from one age group and sex. However, it gives a good picture of population exposure to fat-soluble compounds over time. Mother's milk is thus an "attractive medium" for a research scientist, since "fat soluble pollutants are likely to be found in higher concentrations in milk than in blood or urine" (Pellizzari et al., 1982, p. 322). This "attractive medium" is therefore very well researched.

The evidence for many environmental contaminants is easiest to collect from breastmilk. But that does not mean that the means of obtaining and interpreting that evidence is without problems. Sometimes breastmilk samples are pooled, but results are interpreted as if all women who contributed to the pooled sample had equally contaminated breastmilk. The time lag between exposure and outcome is another problem. Most women with contaminants in their breastmilk have been exposed for years to chemicals, including during their pregnancy (Berlin and Kacew, 1997). Shrader-Frechette (1993) points out:

> …even if pathways of various toxins could be determined exactly, phenotypic variations among populations are such that one person could be two hundred times more sensitive to a chemical or to radiation than another, even when both received equal doses. (p. 36)

This makes setting acceptable limits on toxins particularly difficult. Setting limits is a different operation from monitoring exposure. Some systems such as the Global Environment Monitoring System (GEMS) assume an infant consumes 120 grams of breastmilk per kilogram body weight. They acknowledge that "routine analyses may not be reliable," and data reported is "from the literature and its reliability is unknown" (GEMS 1998, pp. 4-5). They warn that data from testing the breastmilk of individual mothers is easily misinterpreted and slow—around six weeks (GEMS, 1988).

However, the amount of fat soluble contaminants is difficult to measure because breastmilk composition varies among women, over the course of a single feeding, during the day and night, and from day to day. Residues are lower in colostrum than mature milk, but residues are higher in colostrum fat than the fat of mature milk. High levels of pesticides have been reported in colostrum fat from Italy (Jensen and Slorach, 1991). Other factors affecting the levels of residues in breastmilk include the age, weight, parity and dietary habits of the mother, seasonal differences, and smoking (due to pesticide residues in tobacco). It is hard to separate in utero affects from postnatal affects; however, since intrauterine contamination occurs at critical earlier stages of fetal development and is unavoidable, it is an important concern.

Comparisons are particularly difficult since testing procedures differ in different countries; special projects such as GEMS are set up internationally to overcome this. But as analytical methods improve statistics and rates become even less comparable over time. There is also the potential that private and government agencies might falsify data on toxicology tests, resulting in approval for insecticides and pesticides in Canada, United States and Sweden based on incorrect data (Jasanoff, 1990). Even political factors are relevant, as countries vie for evidence to show they have been regulating toxic wastes. For example, New Zealand boasted that pesticides in breastmilk were lower than in European and North American mothers. The vested interests of governments and industry are becoming more apparent in the face of privatisation. Researchers also have to consider the complex relation between free informed consent and socially beneficial research.

None of the studies reviewed consider the perspective of the breastfeeding mother who must weigh evidence and make a decision about infant feeding at a time when she is narrowly focused on childbirth and establishing a relation with her baby. If she is breastfeeding, she may be very sensitive to external criticism and threats, and unwilling to contemplate the possibility that there is something "wrong" with her milk. She may thus protect herself from unwelcome information until she has stopped breastfeeding.

Matter Out of Place

Because of the widespread pollution of rural and urban environments, some toxic substances such as PCBs, dioxins, phthalates, and heavy metals have been found in samples of breastmilk. As a result of bio-magnifica-

tion, chemical residues concentrate as they move up the food chain, until they appear in breastmilk. Fat-soluble toxins are removed from the bloodstream and stored in body fat because they are metabolized very slowly. Crash diets during lactation may release these stored toxins into the bloodstream and into breastmilk. Breastmilk incorporates contaminants from maternal body fat; in this way breastfeeding is also the main route for elimination of contaminants from the body of the mother. The most toxic contaminants present in the food supply and breastmilk include: halogenated hydrocarbons, pesticides and fungicides, dioxins and furans, industrial chemicals (halogenated biphenyls), and heavy metals.

Chlorinated pesticides include DDT, the first chemical seen to have an effect on the environment; it was banned in 1972 in the United States. However, rural women in India, China, Guatemala, and Mexico continue to have high levels of exposure. DDT was banned in Norway in 1970, but seven years later, nursing mothers still had detectable levels of DDT in their milk (Berlin and Kacew, 1997). DDT is still used for malaria control. While malaria kills more than a million people per year, DDT in breastmilk has unknown health consequences. DDT is not supposed to be used for agricultural uses, but is recognized as important in malaria control. For example, DDT is still used in Mexico, although it has been limited to malaria control since 1972. However, DDT still occurs in breastmilk and some children received over 13 times the acceptable daily intake. But global trends show a downward trend in DDT concentrations in breastmilk since 1970 (Smith, 1999). DDE is a derivative of DDT and may contribute to lactation failure or a shortened duration of lactation in some parts of the world where DDT and DDE are both present (Rogan, 1996). These chemicals are not generally a problem in North America. A number of insecticides have been found in human milk. Chlordane, heplachloc, aldrin and mirex are all pesticides, some used for termite control. Chlordane was used to control cotton boll weevils and termites, and lindane was used as insecticide in Nigeria (Berlin and Kacaw, 1997) (While revising this report, I cured an infestation of fleas and lice in my hair with a shampoo of lindane).

Dioxins and furans are by-products of many industrial processes including chlorine bleaching in pulp and paper mills, incineration of hazardous wastes, and herbicides. Dioxins refer to a family of 219 toxic chlo-rinated chemicals with varying degrees of toxicity. Two of the most hazardous are polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), formed in the manufacture of products such as insecticides, herbicides, fungicides, and wood preservatives (Guidotti and Gosselin, 1999). Agent Orange, widely used as a herbicide in Vietnam, is one of the best known dioxins. Vietnam veterans exposed to Agent Orange have an increased risk of having children with spinabifida. The explosion of a chemical plant in 1976 in Seveso, Italy, resulted in chloracne from high doses of dioxins. Exposure is usually low level through diet, particularly from food of animal origin, rather than through industrial accidents. Human infants can be exposed to dioxins prenatally and during breastfeeding; human thyroid regulation is affected by these dioxins (Berlin and Kacew, 1997). According to Steingraber (2001), there is no safe dose below which dioxin causes no biological effect; dioxin tampers with human thyroid, depresses the immune system, causes birth defects and cancer, and contributes to diabetes.

While many persistent organic pollutants are declining or leveling off, two industrial chemicals are increasingly found in the environment and in breastmilk—polybrominated diphenyl ethers (PBDEs), a class of flame retardants and aromatic amines, industrial chemicals used in the manufacture of dyes, plastic foams, pesticides and pharmaceuticals. These probable carcinogens may be recent additions to the chemical contaminants in our bodies, as they have been doubling every five years (Steingraber, 2001).

Few reports are available on heavy metals in breastmilk and their effects on children. Although there is heavy air pollution in cities like Mexico City from gasoline lead, consequences for breastfeeding are not clear. In the United States, infant lead intoxication has been caused by infant formula or environmental sources such as lead paint and not breastmilk (Berlin and Kacew, 1997). Lead levels in children require both medical and environmental evaluation and intervention. Less lead passes into breastmilk than across the placenta. Public health efforts aim to reduce mothers' exposure to lead. Heavy metals such as mercury, lead, arsenic, and cadmium are particular concerns in water, cow's milk, infant formulas, and particularly infant formula reconstituted with water. Mercury exposure is generally through industrial accidents and dietary exposure through seafood. In fish-eating populations in Canada, maternal ingestion of mercury-contaminated foods during pregnancy and lactation resulted in abnormal muscle tone in boys but not girls (Berlin and Kacew, 1997). Cadmium has been reported from industrial exposure, heavy smoking, and consumption

of contaminated rice, but no clear-cut cases of cadmium exposure through breastmilk have been reported, and heavy metal exposure in general is only relevant under conditions of industrial accidents.

Radioactive isotopes following exposure to radioactivity have been followed since the beginning of the nuclear age. For example, the deposition of strontium 90 in the deciduous teeth of infants in St Louis in 1964 was greater in infants fed with infant formula than those breastfed. Following the Chernobyl accident of 1986, breastmilk was found to be lower in strontium 90, radioactive iodine, and caesium than cow's milk, water, and parts of the food supply. Following Chernobyl, radioactive food imports such as infant formula, arrived in many countries, including Egypt, where government scientists tried to define safe levels of radiation (Morsey, 1998). Since there are links between low-level fallout and immune damage, there is no safe level of exposure to radiation for anyone. Nevertheless, the risk is greater for bottle-fed infants (Lawrence, 1997).

In June, 1998, world governments met to develop a treaty to eliminate persistent organic polutants (POPs). The United Nations Environment Programme (UNEP) targeted the following chemicals known as the "dirty dozen" for action; aldrin, chlordane, DDT, dieldrin, dioxins, endrin, furans, heplachlor, hexachlorobenzene, mirex, polychlorinated biphenyls (PCBs), and toxaphene. At the fifth session of the Intergovernmental Negotiating Committee (INC5) meeting in Johannesburg, South Africa in December, 2000, an internationally binding treaty to eliminate POPs was agreed upon by 122 countries. The treaty will control the production, disposal and use of the "dirty dozen." Some countries will continue to use DDT to combat malaria, pending the development of better technology. Countries will use precautionary measures to bring additional chemicals under the treaty, rather than demanding scientific proof of harm; the goal for all countries is to eliminate POPs. A network of NGOs (including WABA), the International POPs Elimination Network (IPEN), were effective lobbyists for achieving the goal of elimination and inserting strong precautionary language in the treaty. The treaty needs to be ratified by fifty countries to go into effect.

Industrial Accidents

Industrial and natural disasters have been occurring with increasing severity and frequency, signaling the failure of industrial society to "... adapt successfully to certain features of its natural and socially constructed environment in a sustainable fashion" (Oliver-Smith, 1996, p. 303). These industrial accidents provide powerful evidence of the potential of pollutants to be transmitted to humans. Many of the substances found in breastmilk following industrial accidents are substances found to cause cancer in laboratory animals. Industrial accidents are responsible for increasing the loads of contaminants in humans. In Michigan in 1974, PBBs entered the food chain after they were accidentally put in cattle feed. More than 90 percent of residents had measurable amounts of PBBs in their body fat and breastmilk; however, few women chose to wean their infants. Although the long-term consequences are unclear, Michigan continues to monitor the women and children who were exposed. In Turkey in 1957 during a famine, seed wheat treated with a fungicide was consumed, killing those exposed directly and those exposed through breastmilk.

Event victims feel the immediate physical impact of industrial accidents. For example, a mass poisoning occurred in 1968 in Japan due to an industrial accident that mixed PCBs into cooking oil. Lower weight, and height in Taiwanese children was traced to PCB contaminated cooking oil. In 1976, in Seveso, Italy, a pesticide plant exploded, releasing dioxins into the air. Compared to the general population, people living nearby had three times the rate of liver cancer and other cancers were elevated (Steingraber, 1997). In the years since the explosion, the ratio of males to females has decreased. Among children of men who were younger than 19 when the explosion occurred, only 38 per cent were male (Nutrition Action, 2000, p. 5). However, there was no follow-up on children who were breastfed by exposed women, and only three samples of breastmilk were analyzed. Nevertheless, exercise of political control following an accident may include orders not to breastfeed. Industrial accidents have provided much of the evidence concerning contaminants in breastmilk, although accidents tell us little about everyday contaminants in our environment.

Research on Exposure to Contaminants

Breasts are the parts of women's bodies where toxins are most concentrated. But they are also the parts of women's bodies under most stringent surveillance because they have been identified as risk-laden sites of virtual pathology (Morgan, 1998). Future work on contaminant exposure will need to examine semen and testicles as closely as breastmilk and breasts.

The breastmilk of women in industrialized countries, including Canada, has concentrations of PCBs and dioxins (probable carcinogens) higher than that of women in developing countries (depending where women live and work). Women in Vietnam, Turkey, Japan, and Taiwan have experienced high exposure through food contamination as a result of industrial accidents, described earlier. Chemicals that are readily metabolised and eliminated in mother's faeces and urine are unlikely to be secreted in significant quantities in breastmilk (Schreiber, 1997). Those that are eliminated slowly are more likely to be detected. Detailed studies on consequences of contamination come from the Netherlands and North Carolina.

Dutch Studies

Some of the most exhaustive studies of contaminants in breastmilk were conducted on the general Dutch population, a population exposed to the heaviest industrial pollution in Europe. Even the most careful toxicological studies acknowledge the difficulties of measurement and comparability in determining toxicity levels. In the Dutch studies, only 80 of 105 breastmilk samples could be measured with sufficient accuracy for PCB-dioxin. Prenatal exposure to toxins was measured by breastmilk toxins because "dioxins and dioxin-like PCBs could only be measured in human milk" (Koopman-Esseboom, 1996, p. 701). Using breastmilk as a proxy for prenatal exposure further complicates the task of separating pre from post-natal effects.

Since most studies examine contaminants in the fat in breastmilk, it is important to note that fat content changes during the process of lactation, during a feed and throughout day and night, and with the age of the baby. For example, in the Dutch PCB/Dioxin study, representative 24-hour breastmilk samples were collected two weeks after delivery (Koopman-Esseboom, 1996). A second study using the same data, found that although greater amounts of PCBs and dioxins are transferred during breastfeeding than in utero through transplacental transfer, lactational exposure to dioxins was not found to influence neurological condition in 18 month old toddlers; the authors concluded that although transplacental PCB passage has a small detrimental effect on neurological development in toddlers, breastfeeding had only a beneficial effect on fluency of movement (Huisman et al., 1995). However, later studies examining the immunological effects found subtle differences in the capacity of children to fight off infections. Children of women with the highest levels of PCB exposure were most affected, compromising the immunological benefits of breastfeeding (Weisglas-Kuperus et al., 2000).

In another Dutch study, the effects of low level concentrations of dioxins passed in utero and through breastmilk were studied in newborns. These laboratory studies confirmed that the liver of the newborn is affected by postnatal exposure to dioxins, and both intrauterine and postnatal exposure to dioxins might have subclinical effects on newborns. However, the authors state that the clinical significance of their findings is unclear (Pluim, 1994).

Patandin et al. (1999) explored the relative risk of PCB/dioxin exposure during breastfeeding and through food intake in the pre-school years. However, the breastfeeding data is complicated by the fact that the children were not exclusively breastfed; thus the accumulation of toxins will also reflect toxic exposure through water, cow's milk, infant formula and food in addition to breastmilk. They found that the main source of PCB and dioxins among the pre-school children were dairy products, followed by processed foods and meats. Although more than 10 percent of the cumulative toxic equivalent intake (TEQ) from birth until 25 years of age is due to breastfeeding (non-exclusive), the authors do not suggest limiting the duration of breastfeeding because of the general advantages of breastfeeding on the development of children; instead, they suggest: "Strategies should be directed toward reducing PCB and dioxin intake through the food chain at all ages and by lowering the consumption of animal products and processed foods, and not by discouraging breastfeeding" (Patandin et al., 1999, p. 51).

In a paper summarizing their theses research on the effects of exposure to contaminants, Lanting and Patandin concluded that "…no adverse effects of PCB and dioxin exposure were described via breastmilk. We even found a small beneficial effect of breastfeeding on the quality of movements in terms of fluency. This is in line with several other studies which also reported an advantageous effect of breastfeeding on brain development" (cited in WECF, 1999, p. 11). However, they do suggest that PCBs and dioxins may negatively influence human lactation, and therefore call for efforts to diminish these hazardous substances (cited in WECF, 1999, p. 12).

North Carolina Studies

Rogan and associates have provided evidence that

only extreme levels of contaminants in breastmilk represent more of a hazard than a failure to breastfeed. Recently, Rogan (1996) reviewed a much larger range of clinical and epidemiological literature on pollutants in breastmilk than reviewed here. Although he exhaustively reports every industrial accident that might have affected lactating women, he concludes that PCBs in breastmilk do not produce readily detectable damage to breastfed infants, but there are subtle effects on motor function and memory from transplacental exposure. Links to breast cancer are also considered in the article, since a relation has been shown between higher fat diets and breast cancer; lactation decreases the body burden of these pollutants, and thus lowers the risk of cancer among pre-menopausal women (Rogan, 1996).

PCBs are less potent carcinogens than dioxins, but occur at higher concentrations than other pollutants. There have been few long-term studies of the consequences for breastfed children exposed to PCBs through breastmilk. Rogan reviews in particular studies in Michigan where mothers likely consumed Great Lakes fish; studies in North Carolina where women faced no special exposure; and the Dutch studies discussed above. In spite of Rogan's conclusion that contaminants in breastmilk do not seem to damage breastfed infants, Rogan and Steingraber both state that breastmilk, if regulated like infant formula, would often violate FDA levels for deleterious substances in food and could not be sold (Rogan, 1996, p. 981). According to Steingraber (1997):

> …by 1976, roughly 25 percent of all U.S. breast milk was too contaminated to be bottled and sold as a food commodity, or exceeded the legal limit above which commercial formula is pulled from the shelves. (p. 238)

Most breastfeeding advocates warn against rapid weight loss during lactation; however, a recent study of exclusively breastfeeding women from California and North Carolina suggests that moderate weight loss among women with a low exposure to environmental contaminants such as PCB and DDT does not increase the contaminant concentration in breastmilk. A woman with greater fat reserves will have a lower concentration of contaminants in her fat than a leaner woman. Since lactation reduces the overall body burden of contaminants, we would expect lower concentrations in milk in later lactation than early postpartum (Lovelady et al., 1999). The North Carolina women were recent Hispanic immigrants from Mexico where pesticides, including DDT, are heavily used. The California group who lost weight did not increase the contaminant exposure of their infants. In the North Carolina group, there were no significant correlations between change in contaminant concentration and change in body weight (Lovelady et al., 1999).

Consequences of Exposure

All living beings contain traces of PCBs; contaminants will be in the breastmilk of women who have not had occupational or known exposure. Since contaminants are in the air, they are also absorbed through lungs and skin. It is hard to separate in utero effects from postnatal effects; however, since intrauterine contamination occurs at critical earlier stages of fetal development and is unavoidable, it is critically important to draw attention to this time period. Prenatal exposure is the most significant problem, as developmental toxicities are associated with prenatal, not postnatal, exposure (Korrick, 1998). Most women with residues in their breastmilk have been exposed for years to chemical contaminants, including during their pregnancy (Berlin and Kacew, 1997). However, levels of many of the pollutants found in breastmilk are falling.

Who may be at special risk? Women living near a waste disposal site, particularly one involved in accidental industrial spills, women who work with or consume high amounts of fish from contaminated lakes, and women who work with volatile chemicals. Breastfeeding is not advised and rarely possible for women who are going through chemotherapy, food poisoning, or toxic shock syndrome. There is no contraindication to breastfeeding for women exposed to herbicides, pesticides, mercury, cadmium, or low levels of lead (Lawrence, 1997).

At the international level, FAO/WHO committees provide reference standards for pesticide residues, veterinary drugs used in food-producing animals, food additives and environmental contaminants which—intentionally or unintentionally—become components of food. They establish the ADI (acceptable daily intake). However ADI is not applicable to neonates and infants up to 12 weeks of age, according to a WHO standard established in 1987. "This threshold of exclusion has been arbitrarily set and is not purely scientifically based" (GEMS, 1998, p. 3). Since thresholds cannot be found by experimenting on humans, the establishment of standards will always be somewhat arbitrary. Thus, even the UN regulatory agencies acknowledge that more research is needed before the consequences

of exposure to contaminants is fully understood. However, Steingraber (2001) reminds us that the need for more research does not equate with adjournment of action.

In summary, there is agreement that all our bodies carry heavy contaminant loads from man-made chemicals; there is agreement that breastfeeding is indispensable for human growth and development. There is not complete agreement on the health effects of contaminants in breastmilk on children. Through some mechanisms—known and unknown—breastfeeding always has a positive impact on child health, since breastmilk strengthens the immune system. However, heavy loads of environmental contaminants may threaten our capacity to reproduce immune-strengthening breastmilk. Most would probably agree with the Canadian policy: "Health professionals advise that the known benefits of breastfeeding outweigh the potential risk of exposing infants to PCBs in human milk" (Guidotti and Gosselin, 1999, p. 154).

Infant Feeding Products

Mothers have always had alternatives to maternal breastfeeding. Historically, many of these options resulted in high rates of infant death. Since the 1900s, proprietary milks or infant formulas have been commercially available in industrialized countries. The last few decades have seen them aggressively promoted in developing countries as well. Cow's milk, milk based infant formula and soy based infant formula are usually given to an infant through a feeding bottle. For this reason, some of the literature on infant feeding compares the risks of bottle-feeding to the risks of breastfeeding, without adequate consideration of the contents of bottles or the common practice of mixed feeding (breastfeeding combined with bottle-feeding). While cow's milk is not an adequate substitute for breastmilk, it is considered here because it is part of an infant's diet in many parts of the world; in addition some of the literature on contaminants considers cow's milk as an ingredient in infant formula. Bottle-feeding also takes place in a polluted environment using an industrially produced product subject to contamination and accidents. The product is usually reconstituted using tap or surface water, which may contain toxins and diarrhoea-causing pathogens. Since many products are delivered in feeding bottles, the risk from feeding bottles should also be considered. Hormone-disrupting chemicals such as phthalates, nonylphenols, and bisphenol-A have been found in plastic feeding bottles. While complementary foods are not recommended for use before six months of age, many infants are introduced to such foods much earlier; foods are also a source of contamination. Therefore these products are considered here in order to emphasize that breastmilk is just one of many sources of possible contamination, and that other infant feeding products and methods are far from risk-free.

Cow's Milk

Cow's milk, often promoted as "nature's perfect food," is a key ingredient in infant formula, and plays an important role in the diets of infants older than six months of age in many parts of the world. Cow's milk is not advised for feeding of infants below six months of age as it is a nutritionally unsuitable and easily contaminated species-specific product. It contains excessive protein and sodium, and inadequate iron, Vitamin C, and taurine, among other problems. It may contain too little or too much Vitamin D, depending on the kind of milk. Fresh milk may be contaminated with pathogenic organisms if stored unpasteurized at room temperature. While cow's milk can be processed so that it contains fewer PCBs and pesticide residues than breastmilk, concerns have been raised about chemical and hormone residues, radioactivity, and antibiotics in milk. Following the accident at Chernobyl in 1986 cow's milk (and probably milk-based infant formulas) contained 300 times more radioactive iodine and caesium than was found in breastmilk (Baumslag and Michels, 1995).

Non-fat dry milk (NFDM) is a product often used in emergency feeding and humanitarian aid. Only recently has the distribution of this product been made to comply with the International Code of Marketing of Breastmilk Substitutes, since the product may be locally perceived as a breastmilk substitute.

Cow's milk usually contains more pesticides than breastmilk since cows eat both the plants and the soil they grow in (Baumslag and Michel, 1995). Accidents have resulted in the contamination of the feed provided to cows. For example, insecticide from pineapple that was mixed in animal feed resulted in contaminated cow's milk (Rogan, 1996). Other concerns about cow's milk have been raised over Bovine Growth Hormone (rBGH) approved for use in the United States, although recently rejected for use in Canada. There was a moratorium on its use in Europe until 1999. Monsanto, through the United States, asked the WTO to rule the European ban illegal (Nottingham,

1998). Although Monsanto claims that no growth hormone can be detected in the milk, antibiotic residues show up from the large doses given to cows for mastitis following prolonged use of rBGH. Another concern is that rBGH induces an increase in IGF-1, the insulin growth factor related to human breast cancer (Baumslag and Michel, 1995).

Milk-Based Infant Formula

The risks associated with cow's milk discussed above may also be relevant to milk-based infant formula. Milk-based infant formulas are much improved from the early mixtures developed in the early 1900s. The manufacturers are constantly seeking ways to emulate some of the hundreds of components of breastmilk. For example, Wyeth, the makers of SMA, is developing a milk product … "where you would milk a cow and almost human milk would come out. We now have a mini-herd of transgenic cattle that are making human alphalact-albumen … in their milk;" according to a spokesperson from PPL Therapeutics in Virginia. Additions also include long chain polyunsaturated fatty acids to imitate those found in breastmilk and modified lactoferrin. Such efforts, while commendable, are doomed to failure since breastmilk is an unprocessed living substance, constantly changing in relation to the needs and environment of the breastfed infant, and cannot be commercially reproduced.

Milk-based infant formulas, like all industrially produced food, are subject to industrial accidents. (Two occurred during the preparation of this report. On March 19, 2000, Nestlé recalled batches of its ready-to-eat formula, because of "temperature fluctuations" during the manufacturing process. On June 9, 2000 a woman in Hamilton, Ontario found a key in a tin of formula.) Industrial accidents include the addition of excessive amounts of Vitamin D, aluminum, lead and iodine; insufficient amounts of chloride, zinc, Vitamins D, K, A, and B6; cans found to contain broken glass, live insects and worms; in addition to salmonella and bacterial contamination which circulate diarrhoea-causing pathogens. These problems resulted in 22 FDA recalls in the United States from 1983 to 1990 (Baumslag and Michels 1995:103; Appendix C, Walker 1998). Other risk factors include preparation errors, usually under or over concentration, in making up bottles.

Phthlatates, fat-soluble chemicals used in the production of plastics were found in 15 brands of infant formula tested in the United Kingdom. They were also found in ground water, rivers, and drinking water (MAFF, 1996; Jobling et al., 1995). These man-made chemicals that accumulate in body fat have been linked with cancer and a lowering of sperm counts in rats. Although the levels are below TDI (tolerable daily intake), government ministries have called for efforts to reduce phthalate levels in infant formula. Concentrations of phthalates would be higher in newborns than in older, heavier infants. Infant formulas contain negligible amounts of PCBs and dioxins when they are made from lipids of vegetable origin. Manufacturers of infant formula remove atrazine and other contaminants from the water used to make premixed, ready to feed formula. Expensive advanced filtration and separation processes purify the water in these products, making them considerably safer for infants than formula reconstituted with tap water. Generally, these products are much more expensive than powdered infant formulas that have to be reconstituted with water before use.

Children raised on infant formula absorb five times as much manganese as breastfed infants. Manganese lowers the levels of serotonin and dopamine, neurotransmitters associated with planning and impulse control. Masters et al. (1997) suggest possible links between altered brain chemistry and violent behaviour, an association that deserves careful consideration in combination with sensitive sociocultural research. Babies fed exclusively on infant formula have up to twice the risk of developing diabetes, compared with breastfed babies. The link between milk-based infant formula and type 1 juvenile diabetes is clear (Steingraber, 2001). Recently, concern has also been expressed over the use of peanut oil in infant formula, and the growing number of children with peanut allergies.

Soy-Based Infant Formula

Infants who are sensitive to milk-based infant formula are increasingly being fed with soy-based formulas. (In Canada, 20 percent of infants consume soy-based infant formula). As with milk-based infant formulas, consideration of risks must include the risks related to the water used to reconstitute the formulas. Soy-based products are also subject to industrial accidents and have been recalled for salmonella contamination, bacterial contamination, and Vitamin A and B6 deficiencies (Baumslag and Michel, 1995).

However, the risks most recently associated with these soy products concern the use of genetically modified (GM) soybeans. Monsanto's Roundup Ready

soybeans contain gene sequences from a virus, a bacterium and a petunia—none of which are recommended for infant feeding. Isomil, Carnation Alsoy, Similac Neocare and Enfalac Prosobee all tested positive for GM soy, although suppliers did not know the products contained GM soy (Burros, 1997). All soy-based infant formulas sold in Canada are manufactured with GM soybeans and are unlabelled as such. (Canada has a system of "voluntary labeling").

Plant geneticists have succeeded in adding cystine, an amino acid found in human breastmilk to Prolina, a soybean bred for animal feed. The body uses cystine to make taurine, a compound that promotes eye and brain development. The makers say the ingredient is sought after as an ingredient in soy based infant formula. When these soybeans, or the GM herbicide-resistant soybeans, are used to make infant formula, the risks are completely unknown. Transgenic ingredients pose the risk of introducing novel toxins, new allergies and increased antibiotic resistance in infants (Walker, 1998). The risks from consuming a product made from transgenic ingredients may be small, but they are unknown, unpredictable and irreversible. Consuming a product containing GM soy is much more likely to be significant for premature or rapidly growing infants than for adults. Infants fed soy formula can have circulating phytoestrogens 13,000-22,000 times higher than normal levels (Walker, 1998, p. 1). High levels of phytoestrogens in soy have been linked to premature puberty, and a number of reproductive problems for both men and women. One maker of soy formulas in Australia (Abbott) said that no adverse effects have been identified in infants fed soy-based infant formula. "A warning about phytoestrogens would raise public concerns," small comfort to mothers who have chosen soy formulas to avoid the perceived risks associated with cow's milk infant formulas or toxins in breastmilk. In critiquing an article that found no difference in maturation and growth between infants fed soy-based vs milk-based formula, Goldman, Newbold and Swan (2001)argue that "there is now ample reason to question the safety of soy proteins in the diet of infants."

While the U.S. FDA (1999) says GM soy is safe, a recent press conference on this topic in Canada generated little news coverage and no reassurances with regard to soy-based infant formula from government spokespersons who assure the public that GM foods are safe. During the press conference a reporter asked, "is this scare tactics or are you saying that these kids [fed soymilk or soy-based infant formula] are going to have some sort of warped adolescence"? Unfortunately, no one could answer the question. As with DES, a synthetic estrogen marketed in the 1960s to prevent miscarriages, and later found to increase reproductive cancers in the next generation, problems only become visible many years after the use of a particular product. Is this a lesson that may be applicable to soy and other GM foods used to feed infants?

Water

Water is also relevant to the discussion as it is used to reconstitute milk and soy based infant formula, and sometimes given unnecessarily to breastfed infants. (Breastfed infants do not need any water, even in hot climates.) Of particular concern is lead-containing water used to reconstitute infant formula (Shannon et al., 1992), and any lead in the water may be further concentrated by boiling. Lead builds up in the body over many years and can damage the brain, kidneys, and red blood cells (Nutrition Action, 2000). Chemicals leaching from fertilisers produce nitrate-contaminated water; if this water is used to reconstitute infant formula, the result is "blue baby syndrome" (Baumslag and Michels, 1995, p. 104). Mothers who use expensive bottled water to be "safe" may find that tap water has a greater range of valuable minerals (Baumslag and Michels, 1995); bottled water may contain bacteria, lead, and mercury or excessive fluoride, chloride, nitrate or sodium. Many impurities can be removed from tap water or well water with filters but the filters need to be changed regularly to be effective.

The dangers of nitrates in water used to reconstitute infant formula is seldom referred to in the media. As fertilizer use intensifies, there have been high levels of nitrates found in the drinking water in France, Belgium and Switzerland. In Lithuania, a three week old baby died of acute nitrate poisoning after nitrate polluted water was used to prepare infant formula (*Lietuvos Rytas*, 2001).

The Washington-based Environmental Working Group (EWG) reported that the Environmental Protection Agency underestimated the health risks of mixing infant formula with water contaminated by the weed killer, atrazine, by a factor of 15. The EPA set maximum safe levels of atrazine at three parts per billion (ppb). One study found that in 798 Midwestern communities tested by EWG, 10.4 million people were drinking tap water contaminated with atrazine. By 8 months of age, bottle fed infants in Kansas City can get their entire legal lifetime dose of atrazine if the

infant formula is reconstituted with tap water, creating cancer risks up to 20 times higher than federally mandated limits. The EPA and agricultural industry representatives say the study is merely a scare tactic, and that actual risks from atrazine are much lower than the EWG report states. But other federal agencies agree that the EPA made mistakes in calculating the risks for children and infants.

Recently, First Nations' communities have been made aware of the contamination in their environment and many groups have emphasized the need to publicize and organise around this issue. Women in a Sagkeeng First Nations community in Manitoba recognised this problem in relation to bottle-feeding. One woman stressed the convenience of breastfeeding, particularly in polluted environments:

> We worried more when we were using bottles. We were worried about germs, water. We always had to get water from other places, we couldn't drink this water here. You know this river's polluted, so why would we want to give our child that, right? So we were getting water from springs. Without that water we'd have to buy the stuff that's all ready made and that's really expensive. (Martens, 1994, lines 2553-2573)

Following the contamination of Milwaukee's municipal water supply with the parasite, *Crytposporidiym* in 1993, the American Academy of Pediatrics now recommends boiling water for infant formula to get rid of bacteria and parasites. The recent outbreak of *E.coli* in Walkerton, Ontario is a reminder that the safety of the water supply is not just a "third world" issue. Mothers who were breastfeeding would not have the added concern over the safety of water used to clean feeding bottles and teats, or to reconstitute infant formula.

Food and Risk

Placing food and risk in the same sentence is the unfortunate consequence of the paradox of food that food nourishes and comforts as well as sickens and kills. It is particularly distasteful to think of eating and feeding as risky behaviour. Food safety is a growing concern in Canada and elsewhere. Contaminated food is generally recognised as the main source of persistent environmental chemicals in the human body (Jensen and Slorach, 1991). Aflatoxin, produced by moulds, may also be present in foods such as peanuts, and has been found to be carcinogenic in animals.

Nutrition Action, the newsletter of the Washington-based Center for Science in the Public Interest, published their October 1999 newsletter on food safety. The issue opens with a reminder when "food safety simply meant no egg salad, coleslaw, or other mayonnaise- based dishes at your picnic." Increasing knowledge and changes in food processing techniques mean that almost any food could cause food poisoning. They comfort with the qualification: "Most food is safe, and most people don't get sick from eating low levels of contamination" (Nutrition Action, 1991, p. 1). Consideration of food and risk is relevant for discussions of women's diet during pregnancy, mother's diet when breastfeeding, and complementary foods for infants and toddlers.

There is a sizeable literature in anthropology on food prescriptions and proscriptions for pregnant women. This literature was not explored here since it focuses largely on symbolic pollution and social control rather than physical contamination. However, it is important to keep in mind that the discourse on symbolic pollution and social control may reinforce the scientific discourse on chemical pollutants and breastfeeding, a point explored further in the conclusion. Recently, the public has assumed the right to comment on pregnant women's behaviour with regard to alcohol, drugs, smoking and diet. Women's diet while breastfeeding used to be closely monitored by elders. Currently, women who are breastfeeding are encouraged to eat a balanced diet, drink plenty of liquids, and avoid any foods that seem to upset the baby. This trial and error process is unique to each mother-infant dyad. However, that does not stop others from drawing assumptions about diet and the quality of a woman's breastmilk. Martens (1994) cites a husband berating his wife in a Sagkeeng First Nations community in Manitoba:

> And he says, 'Look at all the things you eat. You're just giving her junk. It's healthier just to give her the bottle.' But my mom says your body does everything for you. It purifies that milk before you give it to your baby. (lines 1317-20)

> …He believed that everything that I'd eat she'd eat. Like if I was eating a greasy egg or greasy french fries, then the baby was getting greasy french fries and she was getting junk food. (lines 1425-8)

Another area of research explores whether toxins in breastmilk could be related to mother's diets. Koppe (1995) studied the diets of Dutch lactating mothers as a possible route for lowering the concentrations of dioxins and PCBs in their breastmilk. He concluded that short-term dietary measures would not be effective since the lowering of contaminant intake must take place years before pregnancy to be effective. Dairy products were responsible for half the mothers' exposure to PCBs and dioxins, and he thus recommends efforts be made to lower the level of contaminants in dairy products. While contamination from DDT is unlikely to be found in food grown in North America, food imported from developing countries may contain traces of DDT. For both mothers and infants, food is a significant source of contamination: "more than 90 percent of the total daily human exposure to PCBs and dioxins is made up of oral intake from food, whereas other routes, e.g., water, air and soil, contribute to less than 10 percent of total exposure" (Patandin et al., 1999, p. 45). However, what a mother eats while breastfeeding is not a serious source of contaminants in breastmilk. About 30 percent of fat in breastmilk comes from the maternal diet; about 60 percent from maternal fat stores; and about ten percent from new synthesis in the breast.

By six months of age, most infants receive other foods in addition to breastmilk. Some groups in Canada and elsewhere in the world provide small amounts of food to infants almost from birth, greatly increasing the opportunities for infections and the introduction of contaminants. Infant foods are of particular concern since infants and children consume fewer foods in proportionately larger quantities than adults, differ in their ability to detoxify and excrete contaminants, and face greater risks of damage when exposed at critical periods of development early in life. Baby foods therefore have more stringent requirements with lower tolerance levels for contaminants. Nevertheless, researchers found traces of 16 pesticides in eight different baby foods purchased in U.S. grocery stores, five of which were possible human carcinogens. Pesticide residues are particularly high in pears, peas and apple juice (Steingraber, 1997), three foods that are commonly given to infants.

GM foods and ecological risks have become a topic of scientific and advocacy debate. Following the CBC evening news Oct 4, 1999, callers were asked to express their opinions about GM foods;130 expressed concerns about GM foods, while 9 were supportive. One supportive caller referred to the foods as genetically enhanced, not genetically modified. Policy makers may call for strict regulations for field trials, or suggest they be carried out in third world countries. But accidental releases of GM organisms have occurred even when attempts are made to "control" risk by the creation of small-scale environments in greenhouses, and planting in caged areas. Once spread to the wider environment they may be impossible to eradicate. They are considered dangerous because of their rapid reproductive rate combined with difficulty of detection. Genetically engineered food crops may become weeds and their genes may be transferred to wild relatives whose hybrids may be detrimental to the environment. It is likely that transgenic foods are being interpreted as contaminated foods (Nottingham, 1998). Experimental evidence suggests that GM foods are unlikely to pose direct risks to human health (Nottingham, 1998). However, both allergic reactions and resistance to antibiotics may pose risks to some individuals. Allergies are imbalances in the immune system. Transferring Brazil nut genes to a soybean to make a transgenic product causes an allergic reaction in those allergic to nuts. We have not had enough experience with these foods to assess their risks—both predictable and unpredictable. For example, marker genes in GM foods have been used to track risk, but what if marker genes themselves are the risk? However, people's reactions to these foods are based on perception of risk, not just risk. For example, food irradiation was rejected by the public on perception of potential risk, not actual risk.

Our foods offer different levels of risk; most risk is in foods with live microorganisms such as lactic acid, with lower risks for cooked foods, and lower still for processed foods. Breastfeeding advocates complain that when government officials send industry representatives to negotiate food safety regulations at meetings such as the Codex Alimentarius where international standards on breastmilk substitutes and baby foods are set, commercial interests will influence food policy. With regard to GM foods, we are faced with the need to develop policy for dealing with unpredictability. Unfortunately, American newspapers and magazines are shutting out criticism of GM foods and crops from their opinion pages at the very moment when policy with regard to the production, sale, and labelling of GM foods is being made (Parker, 2002). People may accept risks and tradeoffs in composing their own meals. However, many are not prepared to accept the same risks for their children when mistakes have irreversible consequences.

Risk and Public Communication

The problem of environmental contaminants in breastmilk generates headlines that sensationalise and concretise very speculative conclusions in a rapidly changing research milieu where many questions remain unanswered or unasked. In these discussions, women's bodies are the subject of interest, and the cause of the problem is presented as localised in women's bodies. Often there is a simple solution offered to a complex problem—use infant formula. Infant formula industries profit each time that a woman chooses a commercial substitute because she fears her breastmilk is polluted.

Research on contaminants in breastmilk assumes that there is a clear boundary between body/self and the outside/external world. With the hostile polluted world invading the pure body, this discourse reinforces the idea that breastmilk may no longer be "safe" or "pure," but rather a vulnerable substance permeable to environmental toxins; this discourse blames the breastfeeding mother as the toxic source. It is thus very important to examine how this subject is presented to the public.

"The public" is not necessarily aware of the literature reviewed in the previous section of this report. It is specialised knowledge, mostly in the hands and heads of experts—medical researchers, toxicologists, ecologists, among others. "The public" has access to this specialised knowledge through newspaper stories, radio and television coverage, and books that `translate' science for public consumption. A number of accessible books draw on studies of breastmilk contamination to dramatise environmental pollution. Some of the key syntheses of literature on environmental hazards fail to place the evidence on contaminants in breastmilk in a broad perspective of costs and benefits to mothers. Others scare without suggesting solutions; most fail to discuss the risks of alternative feeding methods. This review considers first four popular works that discuss breastfeeding in the context of broader questions about environmental health risks, *Our Stolen Future* by Colborn, Dumanoski, and Myers (1996), *Mad Cows and Mother's Milk* by Powell and Leiss (1997), and *Living Downstream* and *Having Faith* by Steingraber (1997, 2001). Most authors writing on this topic refer to the importance of Rachel Carson's *Silent Spring* (1962) as the starting point for examining "matter out of place," in this case, insecticides in breastmilk. Carson wrote that "the breastfed human infant is receiving small but regular additions to the load of toxic chemicals building up in his body" (1962:23). Other writers have elaborated on this observation.

Our Stolen Future argues that "while prenatal exposure seems to pose the greatest hazard, health specialists also worry about the chemicals passed on in breastmilk because some sensitive developmental processes continue in the weeks immediately after birth. During breastfeeding, human infants are exposed to higher concentrations of these chemicals than at any subsequent time in their lives. In just six months of breastfeeding, a baby in the United States and Europe gets the maximum recommended lifetime dose of dioxin, which rides through the food web like PCBs and DDT. The same breastfeeding baby gets five times the allowable daily level of PCBs set by international health standards for a 150-pound adult" (Colborn, Dumanoski and Myers, 1996, p. 106-7). They note that the contamination of breastmilk has been particularly severe among indigenous people in the high Arctic, where many people still eat the wild food the land and sea provide. There, researchers have found that babies take in seven times more PCBs than the typical infant in southern Canada or the United States. Many of these statements are made without citations. Animal studies are crucially important to their argument.

> After birth, the transfer of contaminants to the offspring continues through the rich, fatty breastmilk. While nursing, a mammalian mother (including humans) draws down her fat stores, dumping not only the fat but also the persistent toxic chemicals she has accumulated in her body fat over the years into her milk. In this way, a load of contaminants that it has taken the mother decades to accumulate is passed onto her baby in a very short time. By the time a baby beluga stops nursing at two years of age, it will have acquired a toxic load that, relative to its size, far exceeds that of its mother. (Colborn, Dumanoski and Myers, 1996, p. 145-6)

The analogies to humans are then further developed:

> As with other animals, human infants take in heavy doses of PCBs and other contaminants in breastmilk, which exposes them to levels ten to forty times greater than the daily exposure for an adult. Several studies report that infertile men have higher levels of PCBs and other

> synthetic chemicals in their blood or semen, and one analysis found a correlation between the swimming ability of a man's sperm and the concentrations of specific members of the PCB family found in his semen. (Colborn, Dumanoski and Myers, 1996, p. 178)

One of the most widely cited statements in their book is that, "based on the concentrations in breastmilk fat of PCBs, some have estimated that at least five percent of babies in the United States are exposed to sufficient levels of contaminants to cause neurological impairment" (Colborn, Dumanoski and Myers, 1996, p. 188). While acknowledging the benefits of breastfeeding, which provides infants with important immune protection and substances that enhance development, they argue that breastfeeding exposes infants to disturbing levels of chemical contaminants, including a number of known hormone disrupters. "According to various studies of breast milk contamination, nursing babies take in the highest doses of contaminants they will experience in their entire lives—levels ten to forty times greater than the daily exposure of an adult. Breastfeeding is the only efficient way to remove these persistent chemicals from the human body" (Colborn, Dumanoski and Myers, 1996, pp. 215-16).

They conclude that too little is known to judge how the undeniable benefits of breastfeeding balance against the risks of transferring hormonally active contaminants. By saying that it is premature to advise women against breastfeeding, they have already raised fears, even though the transfer of contaminants before birth may have a greater impact than any transfer taking place during breastfeeding. They call for research to determine whether the concentrations of hormone-disrupting chemicals in human milk pose enough of a hazard to make breastfeeding inadvisable for some women, perhaps those having a first child later in life and who may have a high burden of persistent chemicals in your bodies. They write; "We cannot afford to ignore the pressing issue of persistent contaminants when weighing the merits of breastfeeding against alternatives such as bottle-feeding with a formula based on cow's milk" (Colborn, Dumanoski and Myers, 1996, p. 216). After making dramatic statements about the risks of contamination, they ask how much this matters if children born to mothers with contaminated breastmilk have already been exposed in the womb. Will the additional exposure through breastmilk greatly increase the risk? Are there breastfeeding regimens that can lower the transfer rate of contaminants from mother to baby while maintaining the benefits? (Colborn, Dumanoski and Myers, 1996).

Mad Cows and Mother's Milk provides six case studies of "poor risk communication" including mad cow disease, *E. coli* outbreaks, silicone breast implants, and contaminants in mother's milk. In the latter case study, Powell and Leiss (1997) document some PCB accidents that lead to toxic effects in humans. In 1985, about four hundred litres of PCB-contaminated oil spilled onto the Trans-Canada highway near Kenora. In 1988, fifteen hundred barrels of PCB-containing oil caught fire in a chemical storage warehouse near Montreal. Although the fire was quickly contained, there was concern about health risks. "The next day, nursing mothers were warned to stop breastfeeding," and the next month, they were told they could resume breastfeeding (Powell and Leiss, 1997, p. 186). These and other problems concerning the disposal of PCBs brought the problem to the public's attention. However, the authors acknowledge that the analysis and testing of PCBs is not always accurate and the scientific literature on PCBs is vast, complex, rich in qualifying statements and difficult to summarize, an assessment with which this author is in total agreement. Since 1982, PCBs in breastmilk in Canada compare favourably with those in other western countries, and are on the decline.

The authors use the case of the Canadian arctic where some Inuit communities living off marine resources such as seals, fish, walrus and whale were reported to have high body burdens of contaminants, including PCBs. Breastmilk, like other valued locally produced food, was considered superior to processed foods from the south. These strength-giving foods formed the basis of identity and social well being, placing Inuit in a double bind since fatty acids from marine animals may provide protection against cardiovascular diseases, and counteract mercury and PCB induced toxicity (Powell and Leiss, 1997).

On the other hand, studies from Laval University in the eighties confirmed very high concentrations of PCBs in the breastmilk of Inuit women—many times the amount of PCBs considered tolerable by Health Canada. Nevertheless, the Inuit made a policy decision that breast is best. But will continued monitoring of breastmilk and its effects on infants be just as detrimental as saying that there are high concentrations of PCBs in breastmilk? A resource committee to link scientists and the population will address this concern. Once doubts are cast on traditional practices like breastfeeding, eating traditional foods and hunting sea mammals, how is

confidence restored? Or is it like cutting down the last tree; confidence cannot be restored once it is gone. Continuing research on breastmilk fuels speculation that a problem exists (Powell and Leiss, 1997). Certainly research has not stopped on this population. Dewailly and colleagues (2000) have published another study on toxins and breastfeeding among the Inuit. The most recent study examines the susceptibility to infections and immune status in breastfed and bottle-fed Inuit infants exposed to organochlorines, concluding that prenatal exposure to organochlorines could contribute to the risk of ear infections (*otitis media*). However, there were few differences between breast and bottle-fed infants; breastfed infants experienced slightly fewer acute episodes of *otitis media* and pulmonary infections. This study contrasted ever-breastfed with never-breastfed infants, but provided no evidence on the role of exclusive breastfeeding. Prenatal exposure to pollutants was determined from breastmilk samples. The authors recommend that "a reduction of organochlorine body burden in Inuit women of reproductive age seems desirable," in addition to encouraging the use of traditional foods low in contaminants, such as red char (Dewailly et al., 2000, p. 210). Women were advised not to modify their breastfeeding practices.

Powell and Leiss (1997) also contrast contaminant information with contaminant gossip, almost as dangerous for Inuit mothers. The research cited raises the question of what concentration of PCBs, or any other substance in breastmilk, would constitute a threshold that would contraindicate breastfeeding. The issue is not what would contraindicate breastfeeding but how this information about risks impacts on mothers' decision-making process on infant feeding. For example, perhaps mixed feeding represents the worst of both worlds, so that the toxic load doubles. Without more information on exclusive breastfeeding and mixed feeding, these questions remain unanswered. Lack of exclusive breastfeeding means that an infant receives the toxins from breastmilk and the toxins from some uncalculated combination of water, cow's milk, and infant formula.

Sandra Steingraber's stunning analysis of cancer and the environment, *Living Downstream* (1997), uses toxic-release and cancer registry data to make the connections between environmental contaminants, the food we eat, and incidence rates of cancer. As an ecologist, she uses a vast range of evidence to document the environment's contribution to cancer. Breasts and breastmilk figure prominently in the story as the following quotes demonstrate: "Because of the immutable fact of biomagnification, human milk will always be more contaminated than soy or dairy milk as the machinery of the human breast distills its product from the plant and animal foods consumed by the nursing mother" (p. 9); breasts as "repositories for synthetic organic chemicals circulating within the female body…" (p. 93); 25 percent of breastmilk is "too contaminated to be bottled and sold as a food commodity" (p. 238); and "...during the intimate act of nursing, a burden of public poisons—insect killers, electrical insulating fluids, industrial solvents, and incinerator residues—is shifted from one generation into the tiny bodies of the next" (p. 238). To her, breastfeeding is both a window to find out toxic levels in women's bodies, and a "sacred landscape in need of protection." This is the story that Sandra Steingraber addresses in her new book, *Having Faith: The Ecology of Pregnancy, Childbirth and Breastfeeding* (2001). In it, she integrates the scientific evidence about how the environmental toxins threaten all stages of infant development from the moment of conception with her own experience of pregnancy, childbirth and breastfeeding. She exposes the dangerous disconnections between scientific knowledge of toxins and what pregnant women are told. In both books, Steingraber uses the language of body burden, the sum of total of exposures, including all routes of entry (inhalation, ingestion, and skin absorption) and all sources (food, air, water, workplace, home, etc.), thus drawing attention to all bodies, and not just female bodies. Because of the power and clarity of her writing and analysis, her statements about breastmilk contamination in *Living Downstream* and *Having Faith* may be cited out of context, instead of being used to bring the breastfeeding and environmental movements closer together.

Breastfeeding as a media subject is both sexy and emotional. It is an irresistible topic because every story has the potential to be sensational and controversial. The emotional ambivalence of breastfeeding expressed by many individuals and groups heightens the drama of stories. In the case of environmental pollution and toxins in breastmilk, there are both contradictory messages from the experts, as well as differences in interpretation by the media. Breastfeeding advocates are vulnerable if they ignore or deny potential risks associated with breastfeeding. They are also at times defensive, for they speak on behalf of a product—breastmilk—with no commercial endorsement, and on behalf of a life-sustaining process—breastfeeding. Advocates may react with appropriate (or in the case of emotional overreaction, perhaps inappropriate)

responses that will make a media splash, creating an even more sensational story. Breastfeeding mothers may be impervious to or overreact to perceived threats to breastfeeding because they are so immediately bound up in the protection of their breastfed infants. When mothers are no longer breastfeeding, and have more distance, they may well react with political action. As the workshop to be discussed below demonstrated, breastfeeding mothers in North America tend to turn "in," not "out" until they have ended breastfeeding. Since breastfeeding advocacy groups have had several decades of training in dealing with industry, they are now skilled in using the media. Consider, for example, the La Leche League response to Greenpeace, the work of IBFAN on Code Compliance, and WABA's World Breastfeeding Week.

Risk and the Media

How do different groups communicate about risk, and how do they act on information, which is often inaccessible and not "user friendly"? What are the interconnections between academic, policy and advocacy communication? For example, when the Laval studies confirmed the presence of toxins in the breastmilk of Inuit women, Greenpeace and other environmental advocacy groups drew media attention to contaminated mother's milk. Greenpeace uses mass media to change public opinion using the international news services and focussed political campaigns using direct action spectacles, mass media campaigning and diplomatic lobbying (Dale ,1996).

Breastfeeding advocacy groups worked to contain the damage done by the reports on contaminated breastmilk by publicizing the contamination of water and other foods. Similarly, when the *New York Times* accused breastfeeding advocates of suppressing "scientific evidence" about HIV/AIDS transmission through breastmilk, infant formula manufacturers offered to sell infant formula to Ministries of Health in affected countries. In this way, they "redeem" themselves in the public eye, for their aggressive promotion of their products in those same countries that now accept their offers of subsidized infant formula. Because of the political implications of all these messages, communicators must walk the fine line between "scare tactics" and "suppressing the evidence." Neither toxins in breastmilk nor HIV/AIDS and breastmilk are amenable to the 30-second sound bite required by many media sources.

In the nineties, breastfeeding advocates and NGOs documented and tried to publicize the hazards of infant formula as determined by clinical evidence provided by medical research. But this material is rarely publicized by the media, and is primarily circulated among breastfeeding advocates. Health professionals have generally not heeded warnings concerning the hazards of infant formulas, stressing instead their convenience and reliability particularly in comparison to post-war home-made mixtures. Consequently, medical training and practice since the fifties has stressed the equivalence of breast and bottle-feeding, of breastmilk and breastmilk substitutes.

Scientific research about the uniqueness of human milk as a living substance with long lasting effects extending well into adulthood (for example, reduction in allergies and asthma) has moved into public discourse through radio talk shows, TV, and magazines. Yet, media also draw attention to every example where mother's milk has failed to nurture with a vigour totally absent from discussions of the hazards of infant formula which remains a discourse developed and publicized by breastfeeding advocates. For example, *Newsweek* (Spring 1999) in a special supplement on Women's Health, devoted one page to breastfeeding, headlined "Nursing Trouble." The article discussed cracked nipples, engorgement, insufficient milk, and the death of breastfed infants by starvation and dehydration.

Breastfeeding is one point of entry for talking about the much broader questions of contamination, pollution, and environmental health. But there are often serious discrepancies in the way environmental pollution and breastfeeding are thought and talked about by environmentalists and breastfeeding advocates. The environmental literature speaks of breastmilk as a warning system for environmental exposure. But breastfeeding advocates speak of breastmilk as total nutrition for an infant from birth to 6 months. Breastfeeding advocates stress that breastfeeding provides some protection from breast cancer; while environmental groups point out the substances in breastmilk that are carcinogenic. Environmentalists accuse breastfeeding advocates of burying their head in the sand and suppressing information critical of breastfeeding. Headlines about polluted mother's milk signify ultimate sacrilege, but they seldom suggest solutions. Evidence of pollutants in breastmilk tell us about serious environmental problems for children. It does not, however, tell us about serious environmental problems caused by breastfeeding, as the previous research review demonstrated.

Michel Odent, founder of Primal Health Research (London), argues that intrauterine pollution represents the most serious health risk. Intrauterine contamination occurs earlier, is inevitable and is therefore of more concern. He argues that human livers are unable to detoxify these new chemicals that they have not been exposed to during evolution, and proposes that women should mobilize fat-soluble pollutants by fasting before conception. He also draws attention to recent research suggesting the importance of male-mediated developmental toxicity, caused by paternal exposure to man-made chemicals. Animal studies showed effects such as birth defects, tumours, and increased stillbirth and neonatal deaths, with some effects transmitted to second and third generations (Infante-Rivard and Sinnett, 1999).

The World Wildlife Fund (WWF) UK report, *Chemical Trespass: A Toxic Legacy* (1999) reviewed the potential effects of global contamination on humans. Following many pages of tables of research results showing dangerous chemicals found in human body fat, the report highlights contaminants in human milk, and the levels of contamination in UK breastmilk. The recommendations include investigating the extent of human breastmilk contamination. The report received wide media coverage in Europe and worldwide. As a result of raised public awareness about pollutants, the European Union made a political decision to adopt the precautionary principle rather than demanding more research studies to prove that pollutants are at a level to cause harm. The decision resulted in use restrictions on a flame retardant, pentaBDE, considered to be an endocrine disrupting chemical. While the European Union acknowledged that more information was required, the precautionary principle was invoked to begin risk reduction activities immediately (National Toxics Network, Australia). The report was intended to raise awareness about environmental pollution not to undermine breastfeeding. WWF says breastfeeding advocates should communicate about the hazards of infant formula, environmentalists should communicate about toxins in breastmilk. They are "clean" as long as they say breast is best. But the most important story is in the placing of breastfeeding in a broader environmental health context.

Responding to the WWF-UK report, Ros Coward (1999)begins her newspaper article entitled "If breast isn't best" with a statement few in the women's health movement could dispute: "Media health scares come and go, doing little apart from inducing anxiety and confirming existing prejudices." This statement assumes that the dispute is about discourse not about dioxins. She argues that breastfeeding is a contested area with vested interests; however, the vested interests of not breastfeeding are more significant. Her article accuses breastfeeding advocates of "preventing further discussion" because they don't like to talk about problems with breastfeeding. Similarly newspaper reports accused UNICEF of suppressing information on HIV/AIDS transmission through breastmilk.

Newspaper headlines do not always reflect article content. Nevertheless, these headlines from European and North American newspapers collected by GIFA (Geneva Infant Feeding Association) from 1980-2000 provide a sample to demonstrate the way information about contaminants in breastmilk is presented (compared with problems with infant formula, much more rarely discussed):

The Hidden Dangers in Mother's Milk
Many Poisons in Mother's Milk
Dioxins in Breast Milk Reach Alarming High
Poisons Threat to Breastfed Babies
Babies in Poison Peril From Breastfeeding
Scientists Find Deadly Toxins in Mothers' Milk
Breastfeeding Isn't Always Picture Perfect
Call For Action Over Polluted Breastmilk
Mum's Milk "Poison Risk"
If Breast Isn't Best
Is Breast Best?
Breast Was Best
Breastfeeding Mothers May Pass Toxins to Babies
Poisons Found in Breast Milk
Alarm Over Toxins in Mothers' Milk
New Study into Tainted Breast Milk is Launched
New Swedish Study on Contaminants in Breast Milk: Breastfeeding Increases the Risk of Childhood Cancer
Pollutants that "Put Breast-Fed Babies at Risk."

In contrast, these headlines related to problems in infant formulas and baby foods make no reference to toxins or poisons:

Cover-Up on Baby Milk – Chemical in Baby Milk Formula
Opening Another Can of Worms (Baby Milk Formula)

No Use Crying Over Baby's Milk
Delay Over Baby Milk Findings a "Shambles"
Pesticides in Baby Food
Aluminum in Baby Milk (No Problem)
Aluminum in Powdered Baby Milk is "Too High"
Three Countries Ban Chemicals at Centre of Baby Milk Alert
Our Milk Formula Safe For Consumption, Say Two Companies.

Popular media do not write about conflicting discourses nor muse about discursive formations. This is the domain of academic rhetoric. Nevertheless, discourses matter in a very policy-relevant way. Newspaper articles can have direct immediate policy consequences. A newspaper article in the *Bangladesh Observer* on toxins that pass through breastmilk and the placenta included the following: "with new information on the hazards of breastfeeding and the link between dioxins and cancer, it may be necessary to review our position on advocating breastmilk..." (*Bangladesh Observer*, Sept. 13, 1989). Bangladesh has an infant mortality rate of 69.68 per 1000 live births (Dowling, 2000); any decline in breastfeeding would significantly increase that mortality rate.

Endometriosis is a condition affecting many Canadian women of reproductive age. It has been a focus of women's health advocacy. *The Endometriosis Association Newsletter* (1992) contained the following:

> What about breastfeeding? One wonders whether there are testing services available as there are for water. If indeed one's breastmilk is contaminated, would it make sense to pump it and dispose of it (as hazardous waste presumably)? (And don't forget to hold that baby close when bottle-feeding her/him to help create the emotional closeness of breastfeeding!) The true tragedy of toxic pollution is clear in an issue like breastfeeding … pollution could rob us of the ability to have children and to engage in something as beautiful and powerful as breastfeeding! (p. 5)

Many of the scientific reports about toxins in the breastmilk of Inuit women were also reported in newspapers and television. The news that their breastmilk contained chemicals left some Inuit women frightened and desperate. One mother decided to stop nursing in an effort to protect her new baby. After several weeks of being bottle-fed a mixture of water and Coffee-mate, the baby was hospitalized (Colborn, Dumanoski and Myers, 1996).

Who should be translating scientific and policy language into "user friendly" language? Certainly corporations contributing to contamination or producing products affecting women's health should not be translating "science" for the general public. Journalists present their versions of scientific research with an aim to making it understandable to the public, but without careful consideration of the importance of breastfeeding, they often raise unnecessary fears. First Nations communities are particularly sensitive to this issue since media have focussed attention on the high rates of contamination in Inuit and First Nations women's breastmilk, particularly because of their reliance on subsistence fishing and hunting. Yet in the video produced by the Indigenous Environmental Network and Greenpeace, *Drumbeat for Mother Earth*, the issue of pollutants was handled in a sensitive manner, highlighting not only the pollution in breastmilk, but pollution throughout the food chain and the body burden shared by all indigenous peoples.

Breastfeeding and HIV/AIDS

In some parts of the world, breastmilk is regarded as a potential source of destruction as well as nurturance. Although highly valued, breastmilk is considered vulnerable and susceptible to being tainted by spirits, the evil eye, black magic, pregnancy, or the mother's behavior, including her emotions and diet. Women know they and their breastmilk may be blamed for a child's sickness and death. A conversation in Toronto with an old shopkeeper from Eastern Europe was a powerful reminder of a public perception concerning breastfeeding and breastmilk that may be quite widespread, although seldom articulated. On seeing my WABA button promoting breastfeeding, he lectured me:

> *… in my day women could breastfeed because they ate pure food, lived in a pure environment and were pure … sexually … then they produced pure milk … now they eat bad food, live in a dirty environment and are sexually loose … so they can't produce good breastmilk and should use pure commercial milks.*

This distrust of women is also reflected in the HIV/AIDS discourse. Traditional healers in Africa claim that AIDS has become epidemic because women no

longer observe the old sexual customs such as fidelity and ritual bathing following intercourse. Tradition has been reinvented to control women (Schoepf, 1998).

There is some congruence between blaming mothers for the quality of breastmilk, and contemporary concerns about a number of substances that may pass from mother to child through breastmilk, including HIV and chemical residues. Both subjects require a careful weighing of public health risks and attention to the needs of mothers. In both cases, there are significant information gaps, and widely contested claims. For example, we do not know the rate of HIV transmission in exclusively breastfed, formula fed and mixed fed babies, nor the mortality rates in infected and uninfected babies by feeding methods. In the case of chemical residues in breastmilk, the long term health consequences for infants and children are unclear. Yet both topics may be presented by the media in ways that reduce women's right to accurate information and undermine public health support for breastfeeding.

HIV/AIDS transmission from mother to child can occur through breastfeeding, although there is a greater chance of transmission during pregnancy and delivery; as with chemical contamination. It is difficult to distinguish between intrauterine, perinatal and postnatal transmission. A child breastfeeding from a woman who is HIV positive has about a 15 percent risk of infection through breastfeeding when neither mothers nor babies receive any anti-retroviral drug treatment. Considering communities with a 20 percent HIV infection rate, only three infants out of 100 are likely to be infected through breastfeeding, leaving 97 infants who would benefit from breastfeeding. For HIV positive mothers who have chosen to breastfeed or for whom breastfeeding is the only option available (particularly in resource-poor settings, where mothers cannot bottle feed safely), it is possible to promote safer breastfeeding. Women can be informed of the dangers of mixed feeding and supported to breastfeed exclusively, breast problems can be prevented or treated early, and the use of condoms can help avoid further transmission of HIV during the period of lactation (Linkages, 1998). Other options include the use of heat-treated expressed breastmilk. But HIV/AIDS policy making is deeply political and not solely based on whose science is right; in some countries women are advised or told not to breastfeed. Yet some studies suggest that exclusive breastfeeding has as good an outcome as exclusive use of infant formula (Coutsoudis et al., 1999).

The media focus great attention on the transmission of HIV through breastfeeding, particularly in developing countries. A study in Thailand on older people's knowledge about HIV/AIDS transmission confirmed that about 85 percent of the study population agreed "somewhat" that a person will contract the AIDS virus from breastfeeding (Im-Em, Vanlandingham, Knodel & Saengtienchai, 2001, p. 23). The headlines are by now familiar: Is Breast Always Best? Infant feeding and HIV (cover story in *The Health Exchange*, April, 2001). Although formula companies agreed not to exploit the HIV crisis, they have positioned themselves as the protectors of infant health by providing free infant formula for distribution to HIV positive mothers. In South Africa, Nestle offers Pelargon brand infant formula instead of the UN advised generic formula, a public relations windfall and an opportunity for increasing sales of Pelargon in a country with low rates of infant formula use. Until breastfeeding advocacy groups publicised it, Nestle claimed that Pelargon "killed bacteria from contaminated water" (cited in Greiner, 2002, p. 9). Where is the evidence that exclusive use of infant formula will improve the survival and health of infants born to HIV positive mothers? For complex and contested topics such as HIV/AIDS and environmental contamination, care must be taken on the way relative risks are communicated to mothers.

Speaking the Same Language

When there are contradictory messages, powerful interests can promote one message over another and further polarize complex issues into either/or options, benefiting corporations that both pollute and offer a "solution" to the problem of pollution. This further reduces the possibilities for coalition building between environmental groups, breastfeeding advocates and women's health activists. But these groups are co-travellers who must travel together to advocate for social change. Of concern here is how they can travel further together.

What are the elements of a shared discourse among advocates for women's health, cancer prevention, environmental protection, and breastfeeding promotion? What is the relation between these constituencies? Can a shared discourse motivate action strategies for local, national and international campaigns without damaging other constituencies? Splitting these natural allies only helps toxic industries and infant formula companies—an outcome damaging to all advocacy concerns. Women's reproductive rights groups are increasingly interested in the influence of endocrine disruptors on

reproductive health. This is an interest shared with environmental groups.

Environmental groups and breastfeeding support groups can work together and produce messages that further multiple objectives. For example, a feminist group in Costa Rica active in breastfeeding support, provided an example of a public service ad from Pro Eco (Programa Ecologico en Centroamerica) urging readers to take their cars to be checked for lead emissions, with visuals showing a feeding bottle filled with lead pellets. This group recognized that communicating about environmental toxins does not have to target breastmilk as a source of pollution.

The Center for Health, Environment, and Justice in Falls Church, Virginia developed from the advocacy work of mothers following the Love Canal chemical exposure. The center provides information and referral services to empower citizens and communities to prevent or eliminate exposure to hazardous chemicals. They work to translate science into accessible user-friendly knowledge through the distribution of fact sheets and guidebooks. The newspaper ads in papers such as the New York Times, March 15, 2000, called on the United States to support international efforts to negotiate a treaty to phase out POPs, with the slogan: "when it comes to children's health, America should be leading the way, not standing in the way." More detailed brochures produced by a coalition of environmental groups made specific reference to breastmilk, stressing the dangers of prenatal exposure. They list the toxins found in adipose tissue, brain, blood, cyst fluid, liver, placenta, semen, and umbilical cord blood as well as breastmilk. Inside the brochure, they address the fact that breastmilk is the most frequently tested fluid, while reiterating the claim that with the levels of dioxins found in breastmilk in most countries, it would be too contaminated to be legally sold as food in Belgium, Netherlands, and France. However, they do conclude with a paragraph that this does not mean that women should stop breastfeeding. The Center for Health, Environment, and Justice also provides a comprehensive list of studies of human contamination. The list of contaminants by country and medium shows breastmilk as the medium in nearly two-thirds of the cases. It would have been helpful to include a paragraph to explain that the predominance of breastmilk as a medium reflects the fact that it is convenient and cheap to test, not that it is "more toxic" than other substances. It is clear that breastfeeding advocacy groups could work together with these groups to create integrated messages with regard to environmental pollution and breastfeeding. Cooperation might involve the following principles:

- Acknowledge what is known about contaminants in breastmilk.
- Stress prenatal exposure as contributing to the body burden of all babies, not just breastfed babies.
- Identify the source of the pollution (chemical industries), not the source of evidence (breastmilk).
- Stress the risks associated with artificial breastmilk substitutes and the risks of not breastfeeding when communicating about contaminants in breastmilk.
- Draw attention to alternatives to toxic products not alternatives to breastmilk.
- Avoid metaphors of downloading toxins from one body to another.
- Avoid "pump and dump" as a solution to concern about breastmilk.
- Make clear in media reports that any testing of breastmilk is done for bio-monitoring programs not for advising individual mothers on the condition of their breastmilk.
- Draw attention to contaminated milk not contaminated mothers
- Suggest practical actions to reduce contaminant loads, such as limiting consumption of fatty meats, fish from polluted lakes, and dairy products.

What is a balanced view of a subject so complex? One that considers what is wrong with alternative infant feeding products, one that considers social and cultural context more carefully. UNICEF presents a balanced view by calculating the number of days of life expectance lost by breastfeeding and not breastfeeding. These calculations are unlikely to be helpful to the public because they are easily misinterpreted. It will be critical to consider the purpose in communicating about toxins in breastmilk; is it to uncover previously unknown facts? To shock? To correct misunderstandings? To undercut industrial capitalism? To incite action? To change our environmental protection laws?

The Canadian Royal Commission on New Reproductive Technologies (RCNRT) (1993) recognized that exposure to harmful agents in the workplace can delay conception or reduce fertility, but stressed that there is no evidence on the effects of "more common levels of exposure" (p. 9). Policies in this

area concentrated on removing at-risk workers; other approaches include using exposure standards, regulatory measures, education of workers, and improved health and safety legislation. Breastfeeding was not considered in their report.

A number of breastfeeding advocacy groups, including INFACT, La Leche League, IBFAN and WABA, have produced brochures for public education on this issue. The 1997 WABA folder, *Breastfeeding: Nature's Way,* argued in general terms that breastfeeding is natural, sustainable, and not polluting. It included examples of how the production of infant formula has proved vulnerable to contamination by bacteria, radioactivity, chemicals and foreign bodies, listing specific recalls and accidents. (For example in 1997, UK Milumil was withdrawn from sale after being linked with salmonella infection.) Water for mixing infant formula provides additional opportunities for contamination. It did not draw attention to breastmilk contamination, raising the issue briefly under the header, "Breastfeeding is Preferable to any Alternative." Referring to the fact that PCBs and other pollutants have been found in some samples of cow's milk and breastmilk, it pointed out that WHO concluded that the advantages of breastmilk far outweigh any possible risks. Finally, it reassures the reader by pointing out that levels of toxins found in breastmilk fell by around 35 percent in Europe between 1988 and 1994.

Why have breastfeeding mothers not been at the forefront of advocacy action about pesticides, toxins, and industrial accidents? What is the difference between the Love Canal response where mothers acted because their children were at risk, and the response of breastfeeding mothers to information on pollutants in breastmilk? The experience from breastfeeding support groups suggest that mothers may be constrained by a misplaced bodily-based guilt, since contaminants are coming from mothers' bodies not from mothers' backyards. Breastfeeding mothers are unlikely to be able to address evidence on environmental toxins when they are breastfeeding; instead they will confront the full impact after the fact and react with anger, bitterness, and a feeling that it is "too late" for them. This may turn some breastfeeding mothers into activists. But the "Love Canal" scenario with breastfeeding mothers leading the advocacy fight against environmental pollution is less likely (cf Rosenberg, 2000). Victims of toxic contamination often seek redress by making the problem public, organizing group actions, and mobilizing political allies (Reich, 1991). It is difficult to act when users may not know the name of the pesticides they are using and consequently the active ingredients, and can only suspect who or what may be responsible for contamination. Media reports of this issue seldom stress the message that it is not mothers who are poisoning their babies, but chemical companies and identifiable industrial processes. Print media in particular take every opportunity to put breastfeeding groups on opposite sides of controversies about chemical contamination and breastfeeding, since there are real differences in emphasis and interpretation of evidence on the subject. Yet we do not have evidence about how media reports about "contaminated breastmilk" affect mothers' infant feeding decisions. We will never know who decided not to breastfeed "just to be safe."

Conclusions

Reaching a consensus about contaminants and breastfeeding will not be easy. Acting and communicating in the face of scientific uncertainty and highly charged emotions is particularly challenging. The unknowns of immediate relevance concern both breastfeeding and toxins. There is no agreement on how exposure to toxins affects infants, breastfed infants, and adults (Jensen and Slorach, 1997). All agree that the effects may be very subtle and hard to measure. If breastfeeding in a polluted world were more dangerous than bottle-feeding in a polluted world, one would expect to see increased incidence of cancers among adults who were breastfed as infants. In fact, the opposite may be true. Breastfeeding appears to mitigate affects of prenatal toxic exposure. How? By what mechanisms? Even medical researchers do not agree on how breastmilk actually protects infants. "Although many components of breast milk have been identified, the honest answer is that we do not fully know" (Schreiber, 1997, p. 136; cf Cunningham et al., 1991). While the toxicologists and medical researchers work out the biological mechanisms and establish standards of acceptable risk, there is a great need for gender-sensitive social science research on the application of the scientific knowledge produced. Three inter-related topics emerging from this review require particular attention from social scientists: the interpretation of risk, time, and embodiment.

The Meaning of Risk

Risk, according to the experimental sciences, is an estimation of the chance that undesirable effects may occur and it is assessed from past experience, based on

the familiarity principle (Nottingham, 1998). Risk may also be interpreted as opportunity or recklessness, and risk-taking as bravery (Steingraber,1997). Thai men refusing to use condoms when they visit prostitutes in the context of HIV/AIDS is an example of risk-taking interpreted as bravery. Others consider hazards as basic to human/environment systems, rather than as extreme and unpredictable events. Risk and uncertainty are integral to the human condition, The distinction between risk and uncertainty is often blurred. Policy makers are concerned with risk management involving cost-benefit tradeoffs. But risk management is only possible when the consequences are already known and measurable. Risk-benefit analyses offer no solutions and imply that as long as breastfeeding is less dangerous than failure to breastfeed, we should take that option. The narrow duality of risk-benefit analysis "… leaves no room for the proposition that feeding our infants industrial poisons is unacceptable" (Steingraber, 2001, p. 274).

Risk assessments are often presented as if they were objective and quantitative statistical constructs based on measurable characteristics, ignoring the subjective and political side to risk assessment. "Scientific" risk assessment is followed by risk management or policy making. Some argue that risk assessment cannot be separated from risk management (Shrader-Frechette, 1993). But even the most sophisticated systems of risk assessment and risk management cannot determine the probability of certain events occurring. Generally, the media fails to place risks in a broad ecological context and time frame. Nowhere is that more obvious than with reporting on breastmilk and environmental toxins. The role of media in risk amplification also needs further study, particularly since measures (and reports of measures) taken to prevent hypothetical consequences to infants (such as recommendations to stop breastfeeding) may do more harm than good. Thus, interventions also carry with them an element of risk.

Disciplines approach risk from different perspectives. In a review of disaster research in anthropology, Oliver-Smith (1996) recognizes three interconnected perspectives: the behavioural response approach, the social change approach, and the political economic/environmental approach. These theoretical perspectives require different definitions of risk. For example, breastfed infants could be conceptualized as a vulnerable natural resource dependent community whose existence is based on the utilization of a renewable natural resource—breastmilk. This resource is threatened by increasing environmental pollution, since some chemical contaminants interfere with milk production and thus directly threaten breastfeeding.

To anthropologists, the necessary scientific research concerning risk assessment needs to be combined with analyses of risk perception. Individuals and groups hold different perceptions about what is harmful and what harm matters. According to Douglas and Wildavsky (1983), people make a distinction between risks they undertake knowingly and risks that are imposed on them, and they have a greater sense of outrage at involuntary risks. Whenever information on toxins in breastmilk is deliberately withheld from the public, then breastfeeding has the potential for being interpreted as presenting an involuntary risk for an infant. But it is important to remember that it is not just information about toxins in breastmilk that may be withheld; Steingraber (2001) notes that environmental threats to pregnancy are also ignored. "There is some kind of disconnect between what we know scientifically and what is presented to pregnant women seeking knowledge about prenatal life" (p. 105). Risk and perception of risk need to be considered in the context of power. Broadening the approach to risk might encourage asking different kinds of questions. Are risks associated with bottle-feeding and breastfeeding undertaken knowingly, or is the distinction between voluntary and involuntary a constantly shifting boundary? To what extent is the focus on toxins and breastmilk a response to "objective" physical/biological/environmental threats, and to what extent is it a crystallisation of more complex forces and realities" (Wynne, 1996, p. 44)? As Beck (1992) notes, there is a pervasive sense of risk gripping industrial society, when even eating is high-risk behaviour.

The question of who should bear the burden of proof is addressed by the concept of the precautionary principle—always err on the side of caution regardless of complete scientific evidence if there is potential for harm, or in ignorance, abstain. Industries demand 'proof of harm' before agreeing to regulation, but often "scientific" levels of proof are not available. Activists cannot wait for full scientific evidence to be assessed before calling for better regulations. Consider the Minamata case where scientific proof was available but ignored until citizen activism demanded action against the companies who were dumping methylmercury into Minamata Bay (Steingraber, 2001). Nash and Kirsch (1988) point out that "…the ability to direct scientific inquiry toward proving that materials such as PCBs are hazardous, rather than that they are safe for human ecosystems, places the onus on the people affected by

the hazard…"(p. 170). Fortunately, the Stockholm Convention signed in May 2001 uses the precautionary principle when selecting new chemicals to the list of banned substances. Environmental groups should not have to prove that pollutants are hazardous before protective legislation can be put in place; mothers should not have to prove that their breastmilk is safe. How did the burden of proof shift from corporations and governments that allow contamination, to breastfeeding mothers who worry whether they should have their breastmilk tested for contaminants?

Time and Toxins

Risk cannot be considered apart from time frames. Three temporal dimensions are particularly important to consider when discussing toxins and breastfeeding. The first is the chronological order in which chemical contaminants were developed, used, researched, and regulated. The second is the intergenerational effects of toxins. Third and most important is the time in the life cycle when the individual was exposed to toxins, prenatally, postnatally, or as an adult.

New technology continually reveals new contaminants. Some contaminants like DDT were discovered early, researched, and eventually regulated in North America. Products like DDT were then marketed in countries with much less stringent regulations, but with a need for cheap products. As these contaminants were researched and reported in the scientific literature, information about them entered public discourse. Meanwhile, tests for recognizing minute quantities of new contaminants were perfected. Regulations may indeed be enforced, products phased out, and the risks reduced. However, the culprits are by now well known to the public. To communicate to the public, researchers may make reference to substances most widely known to be toxic, such as DDT, first found in breastmilk in 1950. When chemical contaminants are found to be declining in foods or in breastmilk, for example, it is not reported because it is no longer news. For example, the WWF-UK report noted that the levels of organochlorine pesticides and dioxin compounds in breastmilk were declining in the UK; other reports confirm the decline in contaminants in Canada.

New contaminats may be in more minute quantities and may or may not be as lethal as those revealed by earlier methods. Their effects may be less understood and more subtle; they are harder to test for and regulate; and they may require rethinking causality and bioaccumulated risk. Standards and regulations may have been set at a time when measurement techniques were less sensitive. Products such as endocrine disrupters, for example, may be interpreted by the public by analogy with earlier generations of contaminants such as DDT which are now on the decline. Similarly, dioxins such as Agent Orange tend to "stand for" all POPs in media reports. By analogy, the public may assume that all POPs are as toxic as dioxins.

The need to consider the chronology of scientific discoveries is further complicated by the time lag between exposure and outcome. Causes in one generation may produce results in the next. We need to explore new ways to measure and assess cross-generational effects of contaminants. This would be facilitated by the possibility of tracking exclusive breastfeeding across generations and perhaps by a sensitive breastmilk monitoring program. Stockholm monitors breastmilk and can show that when persistant organic pollutants are banned, their levels in breastmilk fall dramatically (Steingraber, 2001). Information about contaminants has not discouraged Swedish women from breastfeeding. Breastmilk monitoring as a scientific and political tool can provide useful information to protect the health and well-being of our infants and our communities, particularly when combined with the political will to act on the information.

More attention also needs to be paid to the differential susceptibility to contaminants of infants and children compared to adults. For example, pregnancy, childbirth, and lactation provide different environmental contexts. Prenatal exposure, breastfeeding, and complementary foods offer different routes for contamination. Time of conception may even be important. In Minnesota, children conceived in spring when pesticide use was highest were more likely to have birth defects than children conceived at other times of the year (Steingraber, 2001). Information about contaminants has not discouraged Swedish women from breastfeeding. Breastmilk monitoring as a scientific and political tool can provide useful information to protect the health and well-being of our infants and our communities, particularly when combined with the political will to act on the information.

Woman as Canary: The Sentinel Gender

Time and risk are also relevant to the social science literature on embodiment. The body as a focus of research has not figured prominently in discussions of breastfeeding and pollution. Nevertheless the unspoken discourse in much of this literature on contaminants in

breastmilk is premised on the body as a source of pollution and impurity. Pollution, defilement, contagion, and impurity implies some harmful interference with natural processes, or the abnormal intrusion of foreign elements (Douglas and Wildavsky, 1983), matter out of place. But as suggested by the story of the Eastern European shopkeeper who believed that women were no longer pure enough to breastfeed, impurity and pollution are easily interpreted as moral transgression.

Breastfeeding is accomplished by a gendered body; women's bodies are seen as risky environments, places where problematic processes occur, where too much or too little food is consumed, where too much or too little estrogen regulates hormonal function. And breasts are a particularly problematic site on these bodies. Too big, too small, diseased or healthy, capable of producing life-giving or life-taking fluids. Women's breasts are conceptualized as risk-laden sites of virtual pathology in need of risk management (Morgan et al., 1992) (or as expressed by a reporter for the *Toronto Star*, September 29, 2000, "breasts as disease-disaster areas"). Instead of the metaphor of a strong body battling the invaders, the literature on contaminants and breastmilk assumes a woman's body is taken over by poisons and dangerous substances, her immune system broken down and useless against the invaders; more destructively still, she passes these poisons into the even purer body of her newborn child—an act of perfidy, evil personified. It is particularly difficult for feminists and breastfeeding advocates to hear about breasts, markers of female identity, referred to as toxic waste dumps. Similarly, the idea of "pump and dump" breastmilk, or non-stop closely spaced pregnancies from an early age (Steingraber, 2001, pp. 277-8) or accepting the trade-off of miscarriages as a means to deplete women's bodies of contaminants is misogynist and obscene. Although the literature on body burdens and chemical contaminants is gender-neutral, there is generally less focus on male-mediated developmental toxicity (cf Sever, 1995).

Emily Martin's 1994 book, *Flexible Bodies*, explores the complexity of defending the self against the non-self. The boundaries become more blurred when another self—the fetus—is growing inside the maternal self, or when "self" becomes food for the "other" in the form of breastmilk. What would a feminist model of contamination look like without the sharp divisions between self and other, without the war metaphors, without the fetus as tumour that the maternal body attempts to destroy or tolerates, without technological metaphors of downloading contaminants from mothers' bodies into children's bodies (cf Martin, 1994)? Clearly, this research topic requires searching for new metaphors, new images of breastfeeding, based on models of flexible adaptation, and a political economy of nurture and care.

Martin (1994) cites a pamphlet that describes complex systems held together by communication and feedback, not divided by category and hierarchy. Lactation is a complex process sensitive to fluctuation and change, both in the external environment and the internal environment. The father-in-law who thinks breastfeeding belongs in the bathroom can devastate a system by an ill-timed frown. And yet breastfeeding survives under adverse conditions including emergencies and industrial accidents.

> Imagine a person who has learned to feel at least partially responsible for her own health, who feels that personal habits like eating and exercise are things that directly affect her health and are entirely within her control. Now imagine such a person gradually coming to believe that wider and wider circles of her existence—her family relationships, community activities, work situation—are also directly related to personal health. (Martin, 1994, p. 122)

The belief that individuals are responsible for their personal health is particularly disturbing in the case of breastfeeding and chemical contaminants. Breastfeeding does not exist in isolation from the whole reproductive cycle of men and women, nor from the processes of globalization that tolerate, or even encourage industrial pollution. This is why the issue is so disturbing and emotional to discuss. Messages that warn about breastfeeding and toxins suggest the horror of total system breakdown, the horror of a system turning toxic to itself (Martin, 1994). To understand why science and media focus particular attention on breasts and breastfeeding as sources of contamination, the concept of risky environments and the fear of total system breakdown must be explored in more detail. Women are blamed for exposing their children to contaminants, poisoning themselves and their children, downloading contaminants from their bodies to their children's bodies, in a dangerous slippage between contaminated mothers and contaminated milk. The blame is understandable because we so desperately want a simple solution to the problem of environmental pollution and human health. The solution will not be

simple, but will take the concerted efforts of environmentalists and health activists applying political and economic pressure, including

> DDT style bans, tighter regulations, incinerator closings, emission reductions, permit denials, right-to-know laws, recycling initiatives, and tough environmental enforcement at both local and national levels. (Steingraber, 2001, p. 278)

The search for a solution should enable breastfeeding advocates to reposition breastfeeding as both metaphor and practice more securely within the environmental movement.

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