Milk sharing and formula feeding: Infant feeding risks in comparative perspective?

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REVIEW

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Abstract

The advent of Internet forums that facilitate peer-to-peer human milk sharing has resulted in health authorities stating that sharing human milk is dangerous. There are risks associated with all forms of infant feeding, including breastfeeding and the use of manufactured infant formulas. However, health authorities do not warn against using formula or breastfeeding; they provide guidance on how to manage risk. Cultural distaste for sharing human milk, not evidenced-based research, supports these official warnings. Regulating bodies should conduct research and disseminate information about how to mitigate possible risks of sharing human milk, rather than proscribe the practice outright.

Key Words
Infant formula, breast milk, health policy, wet nursing, food contamination

Background

When it comes to infant feeding, what is risky behaviour and what is not? When risks to certain forms of infant feeding are recognised, why are some more prominent than others even though they are not proven to be more dangerous?

These questions are raised as provocations that guide the analysis that follows. The exigence for this investigation of human milk sharing has been provided by the U.S. Food and Drug Administration (FDA), Health Canada, and the Agency for the Hygiene Safety of Health Products in France (AFSSAPS) all of which have issued warnings to parents against obtaining human milk from other mothers[1-3]. The Internet has provided the opportunity for mothers in need of additional milk to easily connect with lactating women willing and able to donate in what is called peer-to-peer milk sharing. The largest milk sharing network is "Human Milk 4 Human Babies" which has 128 Facebook forums and claims to provide "a space where women can share their milk in a safe, ethical manner and where families can make informed choices".[4] The emergence of internet-based peer-to-peer human milk sharing has garnered considerable interest from news media and the number of Internet sites devoted to milk sharing is growing.

The concern of the FDA, Health Canada, and the AFSSAPS seems to be that direct sharing of human milk is unquestionably dangerous and that its risks cannot be mitigated. However, similar problems attend the use of manufactured infant formulas but are not targeted as unavoidable risks. In evaluating infant feeding methods, all relevant risks should be considered contextually and comparatively.

Discussion

Infant feeding options

In order that infants and young children grow and develop normally, the World Health Organization (WHO) recommends that infants be exclusively breastfed for the first six months of life and then continue to be breastfed, with the addition of complementary foods, for up to two years or more.[5] Where infants are unable to receive all of their requirement for milk directly from their mother's breast, various alternatives are possible. The Global Strategy for Infant and Young Child Feeding states that "for those few health situations where infants cannot, or should not, be breastfed, the choice of the best

alternative – expressed breast milk from an infant's own mother, breast milk from a healthy wet-nurse or a human-milk bank, or a breast-milk substitute…depends on individual circumstances".[5] In resource-rich settings such as Western Europe, the United Kingdom, Australia, the United States and Canada, it is generally assumed that the alternative to a mother's own milk will be infant formula. The vast majority of infants in resource-rich settings consume infant formula in the first year of life, even where breastfeeding initiation rates are high e.g. Australia, the UK and Italy.[6,-8] Formula feeding however, has associated and inherent risks. Many of these risks are paralleled by comparable risks associated with human milk sharing. Each of the risks identified by health authorities as applying to milk sharing will be addressed in turn as will the corresponding risks associated with formula feeding.

Contamination of milk with pathogens

The FDA, Health Canada, and the AFSSAPS stated that peer-to-peer shared human milk is risky because the milk could be contaminated with pathogens. It is true that a number of pathogens can enter into human milk if a mother is infected. These pathogens include the viruses Hepatitis B and C, Human T-Cell Leukaemia Viruses (HTLV1 and 2), Cytomegalovirus (CMV), Epstein-Barr Virus, Human Immunodeficiency Virus (HIV), as well as the bacteria *Salmonella* and Group B *Streptococcus.*[9] However, few diseases can be transmitted through human milk itself. For example, Hepatitis B and C infections do not occur when infants are fed human milk containing the viruses.[10] Notable exceptions to this rule are HTLV, HIV, and CMV, all of which can be transmitted via breast milk. A majority of mothers are infected with CMV, however, and the presence of CMV in human milk is only a problem for premature infants.[11] Additionally, although HIV and HTLV can be transmitted via breastfeeding they are not transmitted easily; repeated exposure over a long period of time is generally required in order for infection to occur (for example, while a single transfusion with HIV positive blood will infect 89% of receiving individuals,[12] only 0.6-4% of infants who are exclusively breastfed from birth to six months by HIV positive mothers will contract HIV despite potentially receiving many thousands of doses of HIV-infected breast milk).[13,14] Most women in resource-rich settings are tested for HIV and HTLV during pregnancy and thus aware of their status. However, a woman can become infected with HIV or HTLV subsequent to prenatal testing. Fortunately, HTLV can be deactivated by freezing[15] and HIV by flash heating.[16] Rarely, the bacteria Group B *Streptococcus*, *Salmonella spp*., and *Listeria* have infected infants via human milk.[9] Holder pasteurisation destroys all pathogens known to infect infants via human milk.[17]

Infant formula can also be contaminated with pathogens. Bacteria found to contaminate powdered infant formula include *Enterbacter sakazakii*, *Salmonella spp*., *Pantoea agglomerans*, *Escherichia vulneris*, *Hafnia alvei*, *Klebsiella spp*., *Citrobacter spp*., *Enterobacter cloacae*, *Bacillus cereus*, *Clostridium spp*., *Staphylococcus aureus* and *Listeria monocytogenes.*[18] Despite the large number of bacterial species that have been found in powdered infant formula, the infection of infants via such contamination has only been convincingly shown for *Enterobacter sakazakii* and *Salmonella enteric*. Health authorities require that infant formula be tested for the presence of *Salmonella spp.,*[19] yet outbreaks of Salmonellosis in infants have been caused by contaminated formulas.[20, 21] A certain level of contamination of powdered infant formula with *Enterobacter sakazakii* is allowable and between 3 and 14% of tins of powdered infant formula have been found to be contaminated with it.[19] Infection of infants with *Enterobacter sakazakii* can result in meningitis, bacteraemia, necrotising enterocolitis, and encephalitis, particularly in premature and young infants.[19] Infant deaths associated with the use of infant formula contaminated with *Enterobacter sakazakii* have been recorded.[22, 23] Using water which has been heated to 70-90^{o}C to reconstitute powdered infant formula deactivates *Enterobacter sakazakii*[23] and it is recommended by the WHO that hot water be used to reconstitute powdered infant formula,[24] although few parents do so.[25]

Milk may be contaminated with chemicals

Both the FDA and Health Canada stated that peer-to-peer sharing of human milk is risky because the milk could be contaminated with chemical contaminants such as prescription and non-prescription drugs. Many drugs consumed by women will be excreted into their milk. In most instances such excretion has not been shown to harm the infant consuming the milk.[26] Information on the excretion and consequences of drugs in human milk is readily available from drug information services and professional publications (e.g. Hale).[27] Human milk can also be contaminated with environmental contaminants. In fact, the level of contamination of human milk acts as a marker for measurements of overall environmental contamination.[28] There is wide variation in the level of contamination of women's bodies based on the levels of contamination in their food supply but it is rare for contamination of human milk to be so severe that breastfeeding is contraindicated.[29]

Infant formula can also be contaminated with chemicals or other substances that may be harmful to infants. In 2008, contamination of infant formula with melamine

caused hundreds of thousands of infants in China to become sick and several infants died. It was found that melamine had been added to milk in order that protein levels appear to be inflated. The FDA originally stated that no level of contamination of infant formula with melamine could be considered safe; however, when low levels of melamine were found in locally produced infant formulas, a revised opinion was released in which it was stated that the levels of melamine found in U.S. formulas were not dangerous.[30] Infant formula has also been contaminated with glass particles and PVC plastic. Most recently, more than one million containers of powdered infant formula in the US were recalled because they contained beetle body parts.[31]

Contamination of infant formula with environmental chemicals is also a significant issue. Perchlorate has been found in infant formulas,[32] and fluoridation of water supplies means that infants fed formula that has been reconstituted with tap water may consume excessive levels of fluoride[33]. Deficiencies and toxicities of various formula ingredients have also occurred. In the US, recalls were issued for formula that was deficient in protein and vitamin C.[31] In Israel, infant formula that was deficient in thiamine resulted in brain damage and deaths.[34]

Poor hygiene in milk preparation and improper storage of milk

Health Canada, the AFSSAPS, and the FDA expressed concern that peer-to-peer shared human milk poses a risk to infants because poor hygiene in milk expression and improper storage can result in contamination of the milk. Analysis of expressed milk by human milk banks has found that the type of bacteria and bacterial content varies widely between individual mothers.[35, 36] Generally the bacteria found in human milk are normal skin flora[37, 38] and not considered problematic for imbibing infants[38]. However, other pathogenic or potentially pathogenic bacteria such as *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus spp.*, and Group B *Streptococcus* have also been found in expressed human milk.[17, 37, 39] Despite the presence of these bacteria, it has been not been determined that such contamination is harmful to infants.[35, 37] Unlike other types of milk, fresh human milk contains antibacterial ingredients that are active after expression. The bacterial counts of fresh milk stored in a refrigerator have been found to decrease over several days.[37] In addition, unpasteurised human milk resists bacterial growth under a variety of storage conditions and copes well with storage at room temperature for some hours, as well as repeated freeze and thaw cycles.[40] Guidelines on the safe expression and storage of human milk are readily available;[41] however, the degree to which mothers and caregivers follow these guidelines is unknown.

Poor hygiene in the preparation of infant formula, inadequate cleaning of bottles, and poor storage of infant formula have all been documented as problems associated with formula feeding. Infant formula that is reconstituted from powder can be contaminated with bacteria during the preparation process. Even in hospitals, bacterial contamination during formula preparation is common[42] and has resulted in outbreaks of disease.[43] Research has repeatedly found that in the home environment, recommendations for the safe and hygienic preparation of infant formula are not followed.[25, 44] Most parents do not always wash their hands before they prepare formula for feeding[45, 46] and reconstitution of powdered infant formula with warm tap water is common.[47] Ineffective cleaning of preparation and feeding implements may also be a source of contamination.[48] A study in the UK found that more than 60% of "cleaned" bottles sampled were contaminated with bacteria (including *Staphylococcus aureus*) at a level such that they could not be considered clean.[49] Infant formula provides an excellent medium for bacterial proliferation and, when stored inappropriately, multiplication of bacteria may result in an infectious dose being provided to the infant.[50] Inappropriate storage appears to be common practice. For example Herbold *et al.* found that 60% of mothers did not keep prepared bottles of infant formula cool during transport.[46]

In addition to bacterial contamination occurring with infant formula preparation, over- and under-dilution of infant formula also appears to be common.[47, 51, 52] Under-dilution of infant formula can result in hypernatraemic dehydration and over-dilution in hyponatraemia (water intoxication), both of which are potentially fatal.[53, 54]

Risks associated with the use of infant formula

Formula feeding has risks that are not associated with feeding human milk to infants. It is presumably these risks that mothers using peer-to-peer shared human milk wish to avoid. Formula feeding is associated with increased risk of infectious diseases including gastrointestinal disease and respiratory tract infections. In resource-rich countries, children who are fed infant formula are up to five times more likely to be hospitalized in infancy than children who are fully breastfed[55]. Some of the mechanisms by which formula feeding might facilitate infection are understood; for example, ingestion of foreign protein such as dairy protein in infant formula can inflame and damage the protective mucous membrane of the intestine assisting colonisation by pathogens.[56, 57] The use of infant formula is also associated with an increased risk of non-infectious diseases such as allergic diseases and type 1 and 2 diabetes;[58, 59] again, the early exposure

to "foreign" foods is thought to be a factor in the development of these illnesses.[60, 61] In addition, formula feeding is associated with impaired cognitive development, perhaps because infant formula lacks many ingredients thought to be involved in brain development.[62, 63] Finally, formula feeding is associated with an increased risk of death due to Sudden Infant Death Syndrome (SIDS) that is 3.7 times that of breast fed babies,[64] and a peptide in dairy formula has been identified as a possible contributor to SIDS.[65]

Considering HIV and milk sharing

While there may be similar types of risks in milk sharing and formula feeding, this does not necessarily mean that the risks will be similar in magnitude. The magnitude of risk will vary depending on the context and the actions taken by individuals to manage or reduce risk. While it is not possible to discuss in detail the ways in which all of the potential risks associated with milk sharing can be managed, it is worth providing some special consideration of the risk of HIV transmission via milk sharing. It appears that this outcome is the worst-case scenario that is of particular concern to many health professionals and mothers.

The incidence of HIV varies widely between countries. In countries where HIV is extremely rare and antenatal testing for HIV routine, some may consider the probability of HIV transmission to be so tiny that HIV is not a concern requiring that specific action be taken to avoid it. In Australia for example, HIV is a rare disease. Approximately 28 children are exposed to HIV perinatally each year out of nearly 300 000 births (0.009% of women being HIV positive during pregnancy or becoming infected after birth).[66] Furthermore, routine antenatal testing for HIV means that 98% of women are identified as HIV positive before or during pregnancy and, as a result, do not breastfeed.[66] Thus, the risk of woman in Australia not knowing her positive status and donating her milk to another mother is very, very small regardless of any selection process.

In addition, potential milk recipients can screen potential donors and so reduce their risk further. Milk recipients may decide to screen donors using similar criteria to those used by blood banks, including questions about sexual history, overseas travel, tattoos and piercings, and place of birth. For milk recipients in Australia, restricting acceptance of donations to only those women who have been born in Australia would reduce the already minute risk to one that is microscopic; less than one child of an Australian-born mother is exposed to HIV perinatally each year in Australia.[66]

Regular testing of milk donors is another way of reducing the risk of HIV transmission. In another country with a low HIV prevalence rate, Norway, milk banks manage risk through assessment of the risk profile of potential donors and testing of donors every three months.[67] Norwegian milk banks generally do not pasteurise donor milk. A regime of screening and testing of milk donors is a strategy that could be applied by peer-to-peer milk recipients in countries with a low HIV prevalence to reduce risk to an acceptable level. However, in countries with medium to high prevalence of HIV, simple screening and regular testing of milk donors may not be deemed sufficient to reduce the risk of HIV transmission to an acceptable level.

Heat treatment of donor breast milk can be used to inactivate any HIV present in milk. Holder pasteurisation is the treatment most commonly applied to milk in donor milk banks and involves heating the milk to 62.5^{o}C for 30 minutes.[68] This treatment inactivates HIV whilst retaining most of the protective factors present in human milk.[68, 69] Flash heating is the treatment more commonly targeted at prevention of HIV transmission via breast milk because of the ease of the procedure. Flash heating involves placing milk in a glass container that is then placed in water. The water is heated to a rolling boil before the jar is removed and allowed to cool.[70] Flash heating has been found to inactivate any HIV present in breast milk[71] while having only a small impact on the nutritional and immunologic properties of the milk.[16] In countries with a medium to high HIV prevalence rate, a combination of screening, testing and heat treatment would minimise the possibility of an infant being exposed to HIV via donor milk.

Given information about the magnitude of the context-specific risk posed and the ways by which the risk can be reduced, parents may decide that the risks posed by the possibility of HIV in donor milk are ones they are prepared to take. As discussed in this paper, there are some serious risks associated with formula feeding that may be more common in a given context than the possibility of HIV infection. In their "Guidelines on HIV and Infant Feeding 2010" the WHO, UNAIDS, UNFPA and UNICEF state that, *"prioritization of prevention of HIV transmission needs to be balanced with meeting the nutritional requirements and protection of infants against non-HIV morbidity and mortality."*[72] As in even the most developed countries formula feeding carries risk, this dictum is applicable to the consideration of donor milk as a choice over infant formula.

Serious morbidity due to infection is a common risk associated with formula feeding in developed countries. For example, in Spain 5.6% of a cohort of infants were hospitalised with diarrhoea or respiratory tract infections. It was calculated that more than half of these

hospitalisations could have been prevented if all infants had been fully breastfed for four months.[55] Similarly, in the U.K. the Millennium Cohort Study found that 4.5% of infants were hospitalised with lower respiratory tract infections or diarrhoea. It was estimated that 53% of hospitalisations for diarrhoea and 27% of hospitalisations for lower respiratory tract infections could have been prevented by exclusive breastfeeding.

Even in developed countries, higher mortality rates are associated with formula feeding. In the U.S.A., it has been conservatively estimated that between 700 and 900 infant deaths annually can be attributed to formula feeding and other non-exclusive breastfeeding practices.[73, 74]

A balanced assessment of risk would address the difference between routine and rare risks. HIV is held out to be a deal breaker for practices like milk sharing, because it appears to represent the worst-case scenario that everyone fears. Yet in many instances of milk sharing, the risks of HIV transmission are probably lower than many routine risks that we accept every day, like driving in a car. The issue at stake is who gets to make the decision about risk, and on what terms.

Despite known risks associated with using infant formula neither the FDA, Health Canada, or the AFSSAPS warn parents not to feed their babies formula. Instead, these agencies provide parents with information to assist them in the management of some of the risks. For example, Health Canada provides information on safe preparation and storage of powdered infant formula and the FDA and AFSSAPS provides details of infant formula recalls. It is worth noting that while the FDA, Health Canada, and AFSSAPS direct parents in need of additional milk to obtain it from a human milk bank, such a practice is usually possible only in exceptional circumstances. The small number of human milk banks and the high cost of processing the milk means that banked human milk is usually available only to very sick infants.[35, 75]

Cultural reasons may help explain the stance of these health authorities. There is a well recorded historical legacy of suspicion concerning mothers and their milk.[76-78] In its current iteration, this suspicion leads to the conclusion that corporations are considered more trustworthy than women to provide healthful nutriment to infants.

All cultures practice risk selection. Given a wide range of palpably dangerous practices, specific cultures choose particular ones as actual risks. Usually, the identified risks are metaphorically linked to core institutions and beliefs in the culture.[79] The association of breastfeeding with risk in the U.S. has been previously examined.[80] It has been proposed that infant formulas are not selected as risks in the US because the economy demands that female workers move in and out of the workforce as needed. Paid employment is a primary impediment to breastfeeding.[81] As a result, breastfeeding is perceived as a risk to livelihood, while infant formulas solve problems for mothers, employers and society as a whole. In this paradigm, risks associated with feeding formula to infants are identified as a bad batch or manufacturing glitch, while risks associated with breastfeeding are represented as problems that any or all breastfeeding infants might face.

In addition, sharing human milk between women and babies is perceived to be like sharing other bodily fluids or tissue. Because the practice of transfusion and of organ transplantation are heavily regulated by medicine (and for good reason), a culture that considers human milk to be another regulated bodily substance can only conceive of milk sharing as an activity that occurs rarely and under medical supervision. But human milk is not a medicine and, while it is a bodily fluid, it is not like blood. Human milk is a substance created in one body that is excreted in order to be ingested by another body. As such, human milk is *sui generis*, and it is in part because it is unique that there are such stringent cultural proscriptions on its articulations. Ultimately, the FDA, the AFSSAPS, and Health Canada seem to be operating under what philosopher Rhonda Shaw has identified as the "Yuk Factor"—responding to the dominant cultural meaning of milk sharing rather than the medical issues associated with milk sharing.[82]

Historical breastfeeding practices contributed to women's social networks as well as their physical well being by sharing domestic labour, building social ties, and solidifying community bonds—in addition to feeding infants.[78] The extent to which modern industrialized societies have stigmatized shared breastfeeding and made the informal trading of human milk seem disgusting may only be a reflection of distaste for personal dependency. Modernity means, in part, that individuals prefer to depend on corporations and experts rather than neighbours, friends, and compatriots.[83] Mothers who seek out other lactating mothers for their milk, using whatever social networking tools are available to them (including Internet-based social media), are replicating older social formations and practices that provided meaningful support and concrete material benefits for both mothers and babies.[78] Such a development suggests a desire to return to alternative economies of embodied relationship. Feminist commitments to women's freedom encourage us to follow their lead rather than restrain them.

In industrialized societies women are trusted to make all sorts of decisions about their bodies and their babies. It is considered rude to question women's decisions about how they feed their babies because women are thought capable of making good choices. Women have shared milk for with one another for millennia. A blanket proscription against peer-to-peer human milk sharing will not prevent the practice from continuing. If regulating bodies desire to minimise the risks of milk sharing they should disseminate common-sense information about how to mitigate possible risks of infection and contamination that can occur when human milk is shared. Education about the importance of breastfeeding and the risks of using infant formula has led women with a shortage of breast milk to seek breast milk from other sources; the Internet has provided a modern twist on an age-old solution. Such women require information on risk minimisation, especially because outright condemnation is not likely to prevent them from sharing milk with one another.

Conclusion

Health authorities have warned parents against peer-to-peer sharing milk sharing networks stating that sharing breast milk is dangerous. However, analogous and additional risks exist for using infant formula. Historical and cultural reasons underlie the distaste for the sharing of human milk that is reflected in this condemnation of milk sharing. Instead of proscribing peer-to-peer milk sharing, health authorities should provide parents with guidance on how to manage and minimize the risks of sharing human milk.

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CONFLICTS OF INTEREST

KDG has previously published research on non-maternal breastfeeding, namely adoptive breastfeeding and foster breastfeeding, and has conducted a study of the perception and management of risk of donors and recipients in peer-to-peer milk sharing (as yet unpublished). She has also published papers on the risks associated with formula feeding. BLH is a feminist scholar who has previously published research on risk perceptions, HIV infection, and breastfeeding, as well as more general research exploring cultural impediments to breastfeeding and the social meanings of motherhood.