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The Quiet Revolution: Breastfeeding Transformed With the Use of Breast Pumps

Kathleen M. Rasmussen, ScD and
Division of Nutritional Sciences, Cornell University, Ithaca, NY

Sheela R. Geraghty, MD, MS
Cincinnati Children's Center for Breast-feeding Medicine, Cincinnati, OH

Abstract

A quiet revolution has been taking place in the feeding of US infants in the form of women using electric breast pumps. This revolution in milk expression may be a boon for both mothers and infants if more infants are fed human milk or if they receive human milk for a longer period.

Milk expression may also be problematic for mothers, and it may be particularly problematic for infants if they are fed too much, fed milk of an inappropriate composition, or fed milk that is contaminated.

As a result, the time has come to determine the prevalence of exclusive and periodic breast milk expression and the consequences of these behaviors for the health of mothers and their infants.

Unbeknownst to most health professionals, a revolution is taking place in the way US infants are fed human milk. The recent development of efficient and effective double electric breast pumps has made it possible for many women to express their milk. In the 2005–2007 Infant Feeding Practices Study II (IFPS II), 85% of breastfeeding mothers of infants aged 1.5 to 4.5 months had successfully expressed milk at some time since their infant was born.[1] A high proportion of these women used a breast pump to express their milk regularly and over an extended period.[1] In addition, 5.6% of the mothers of these young infants never fed them at the breast; they fed them expressed milk exclusively. We believe that the possible benefits or harms resulting from this practice merit careful study and improved national data collection. We identify these research priorities and suggest ways to improve collection of relevant data.

Women have been expressing their milk to feed their infants since at least the 1500s,[2] and they have been using breast pumps to assist them with this for almost two centuries.[3,4] Until recently, most pumps on the market were manual, inexpensive, and often ineffective. As a result, they were frustrating to use, and few women used them for extended periods. Recent advances in pump design and effectiveness have allowed women to extract their milk

Correspondence should be sent to Kathleen M. Rasmussen, ScD, RD, Division of Nutritional Sciences, 111 Savage Hall, Cornell University, Ithaca, NY 14853 (kathleen.rasmussen@cornell.edu).

Contributors

K. M. Rasmussen led the writing of the article, which was completed jointly with S. R. Geraghty. Both authors conceptualized ideas, interpreted the literature, and revised drafts of the article.

Human Participant Protection

Collection of photographs of women pumping milk was approved by the institutional review board of the Cincinnati Children's Hospital Medical Center.

rapidly (in about 15 minutes using a double pump) and to continue to express their milk for weeks or months.[1,5] By necessity, infants are routinely fed expressed milk in cases of preterm birth[6] and multiple gestation.[7] Women also express milk when separated from the baby because of employment.[8–10] Even without barriers to directly latching their infant to the breast, women today frequently express their milk[1] and may even use breast pumps while doing other things, such as driving (Figure 1).

Lactating women who choose to pump differ systematically from those who do not. In the IFPS II, women who expressed their milk had more education and a higher household income than did those who did not express their milk. In addition, a higher proportion of women who expressed their milk were employed, did not participate in the federal Special Supplemental Nutrition Program for Women, Infants, and Children, and had not breastfed previously, compared with women who did not express their milk.[1] At present, the lay literature (e.g., magazine articles, Internet postings) remains a major source of information about maternal behavior related to milk expression, and some of these behaviors are of public health concern.

Women choose to express their milk with a pump for a variety of reasons. In the IFPS II, the ability to have someone else feed the baby was the predominant reason given for expressing milk.[1] Milk expression has been an important strategy that women have used to combine breastfeeding with employment and use of child care.[9] As suggested in Internet postings, some women actually prefer expressing their milk to feeding their infants at the breast.[11–13] Qualitative research is now needed to develop a more nuanced understanding of women's reasons for expressing their milk with a pump and their strategies for managing the integration of at-the-breast feeding with extended use of improved pumps.

POSSIBLE BENEFITS AND HARMS TO MOTHERS

With the improved electric pumps, women are able to express as much milk as their infants would remove in a comparable period of at-the-breast feeding.[14] Thus, it is possible that this quiet revolution in milk expression could benefit mothers. To the extent that the longer period of feeding infants human milk documented in the IFPS II[5] and suggested by the results of other studies[15–18] represents a net increase in milk production, this would create greater caloric expenditure for mothers that, like additional breastfeeding, could assist them in reducing post-partum weight.[19] As suggested in recent Internet postings, women may explicitly use milk expression as a weight-loss strategy regardless of whether they actually feed the expressed milk to their infants.[20] We do not know, however, whether milk expression actually leads to reduced postpartum weight or whether a longer period of expressing milk has the other benefits for maternal well-being (e.g., bonding with the infant) and health (e.g., extending the period of postpartum amenorrhea or reducing the risk of premenopausal breast cancer, ovarian cancer, type 2 diabetes, myocardial infarction, or metabolic syndrome)[21] that are associated with feeding the baby at the breast. These possible outcomes of milk expression should be studied.

Milk expression can also be problematic for the mother. Proper use of an electric pump requires instruction and fitting of the breast shield. Improper use of an electric pump can lead to mastitis, trauma, and nipple wounds.[18,22] Some women increase their milk supply too much by breast expression with a pump, which results in pain from overstretching of the breast. How frequently this occurs with daily use of a pump has not yet been documented well and warrants further study.

POSSIBLE BENEFITS AND HARMS TO INFANTS

Women's enthusiasm for using these better pumps may be a positive outcome for infants if it means that infants receive more human milk than they would if their mothers did not use a pump. This outcome is suggested in the Internet postings of women who had such difficulty with breastfeeding that they would have fed formula but were instead able to give their infants their milk with the assistance of a breast pump.[23] Women may choose to pump because they perceive that it will permit them to feed their infants their milk for a longer period.[18] Also, women's enthusiasm for pumping and their success in producing more milk than their own infants need may lead them to donate their excess milk to a milk bank, where it could benefit infants who might not otherwise have access to the many positive attributes of human milk. Despite these possibilities, it remains unknown whether infants whose mothers pump their milk actually receive more human milk than they would if their mothers had not chosen to pump their milk. This question should be evaluated carefully.

Conversely, substitution of milk expression for feeding the baby at the breast may be problematic for infants for several reasons. The most serious of these relate to the composition of expressed milk and the way it is fed to the infant. For example, expressed milk may become contaminated in the process of transferring it to the infant,[24] or the way it is stored may compromise its nutritional and anti-infective benefits. We discuss these possibilities in turn.

Milk expressed with a pump makes contact with nipple shields and valves during expression, and all expressed milk makes contact with a storage container or a feeding vessel before it is fed to the infant. Each of these items is a potential source of contamination if women pump in unsanitary conditions or if the pump and pump parts are not kept scrupulously clean[22,25] (Figure1). Some research has shown that bacterial counts are higher in milk expressed with a pump than in milk expressed by hand.[25,26] Women put their milk in a wide variety of containers (Figure 1), some of which are unsuitable for this use and can lead to the leaching of undesirable substances from the container into the milk or the degradation of key milk components during storage.[27] Glass is the container least destructive of milk components,[28,29] although women may use it infrequently. Research is needed to document the ways women handle and store their expressed milk before it is fed to their infants and how its composition changes during this process.

Women often store their milk in the refrigerator and various kinds of freezers for short or long periods.[30] This practice may lead to bacterial growth or degradation of milk components. It has long been known that when breast milk is stored at refrigeration temperatures, its ascorbic acid concentration is reduced,[31] as is its overall antioxidant activity.[32] When breast milk is stored at temperatures common in home freezers, lipids are hydrolyzed,[33] immunological cells are lyzed,[28] and antioxidant activity is reduced,[32] but antimicrobial proteins are unaffected.[34] Moreover, microwave thawing of frozen milk, which mothers do, causes a marked decrease in anti-infective factors in milk.[35] As a result, expressed milk may not deliver the same nutritional and anti-infective benefits of milk obtained at the breast. The consequences of these differences for infant health are unknown and warrant investigation.[27]

Expressed milk is most often fed to infants from bottles, and it is likely that caregivers treat human milk in a bottle the same way that they treat infant formula, that is, to encourage infants to finish the bottle. The IFPS II provides recent evidence to support this assertion; Li et al.[36] found that infants fed expressed milk in a bottle early in infancy were more likely to empty the bottle later in infancy than were infants who had been fed only at the breast. This effect did not depend on whether human milk or infant formula was in the bottle. More

research is needed to ascertain whether infants fed expressed milk are, on the whole, fed differently and thus grow differently[37] from those fed milk at the breast.

A final concern for infant health is clinical and comes from the management of milk expression relative to at-the-breast feeding. Milk changes composition over the course of a single feeding[38] and with infant age.[39,40] This finding is also true of expressed milk; its fat concentration increases with infant age.[41] It is not uncommon for mothers to feed their infants at the breast and then express their remaining milk with a pump. Thus, they feed their infants predominantly fore milk (which is high in carbohydrates) at the breast, and they store hind milk (which is high in fat) to feed to their infants later. Consequently, these infants sometimes develop diarrhea and fail to thrive, a result that is analogous to the situation that occurs when infants are overfed at the breast.[42] The frequency of this occurrence has not yet been documented and warrants further study.

DATA NEEDS

We are just beginning to learn the extent to which US women express their milk with pumps. Our source of nationally representative data on breastfeeding, the National Immunization Survey,[43] is adequate to determine how long infants receive human milk; unfortunately, however, it does not discriminate between feedings obtained at the breast or given as expressed milk. As a result, we do not know—and cannot determine by using routinely collected, nationally representative data—the extent to which women are feeding their infants expressed milk. This situation will only change if the National Immunization Survey is modified, which has been recommended for other reasons.[44] At a minimum, feeding at the breast should be distinguished from feeding expressed milk, and the durations of each practice should be ascertained.

Women who have expressed more milk than their infants need may donate it to milk banks, where it will be pasteurized before use. They may also give their untreated milk to family members, friends, or strangers on Internet donation sites,[45,46] or they may even sell it on the Internet.[47] To date, no information is available to describe how common these behaviors are, but they are certainly a cause for concern, as untreated milk can transmit disease. Thus, it is essential to investigate how women dispose of their unneeded expressed milk.

To characterize women's behavior related to milk expression, it may be necessary to develop a new vocabulary for breastfeed-ing so as to distinguish milk extracted from the breast by the baby from that extracted by a pump for feeding to the baby at a later time. In a previous study, we used a set of possible alternative terms to analyze data from the IFPS II[5] and suggested improved questions for use in research studies.[48] In particular, we suggested that descriptive studies of breast milk feeding rates should include questions that (1) separate the mother's milk extraction from the child's milk consumption, (2) distinguish between milk fed at the breast and milk hand-expressed or pumped, and (3) record the frequency of mothers feeding another mother's milk to their own infants.

RESEARCH NEEDS

Nationally representative descriptive information is needed on who is expressing their milk, how long they are expressing, and how expression of breast milk is both distinct from and intertwined with feeding infants at the breast. In addition, research is needed to document the consequences—good and bad—of milk expression as currently practiced for the health of infants and their mothers. This must involve developing a solid understanding of (1) women's motivations for expressing milk, (2) how milk expression affects women's health, (3) how milk expression relates to the overall pattern of infant feeding, and (4) the nutritional value, immunological value, and safety of expressed milk as it is fed to infants.

CHALLENGES AND CONCLUSIONS

The advent of electric double breast pumps raises many other issues that challenge public health professionals in their support for breastfeeding. Will separating the dyadic aspects of at-the-breast feeding from the feeding of human milk erode societal support for breastfeeding, which is already low in the United States? Is pumping such a burdensome addition to women's already complex lives that they will cease trying to feed their infants at the breast, as seems to be happening among the subgroup of women who are feeding their infants only pumped milk? Does the availability of these effective, efficient pumps make it more difficult to gather the requisite support for legislation to provide US mothers with paid maternity leave?

This quiet revolution in milk expression may be a boon for both mothers and infants if more infants are fed human milk or if they receive it for a longer period. Milk expression may also be problematic for mothers, and it may be particularly problematic for infants if they are fed too much, fed milk of an inappropriate composition, or fed milk that is contaminated. Congress recently enacted the Patient Protection and Affordable Care Act, which requires employers with 50 or more employees to provide "reasonable break time" for mothers of infants to express their milk.[49] This development adds urgency to the importance of determining the prevalence of exclusive and periodic milk expression and the consequences of these behaviors for the health of mothers and their infants.

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FIGURE 1.
Women use pumps and store milk under a variety of conditions, such as (a) while driving, (b) in unsanitary conditions, and (c) in a variety of containers.