

Prevalence of Breast Milk Expression and Associated Factors

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ABSTRACT

OBJECTIVES. Our goal was to describe the prevalence of any, occasional, and regular breast milk expression, mothers' reasons for expressing their milk, and sociodemographic factors associated with breast milk expression.

PARTICIPANTS AND METHODS. Breastfeeding mothers participating in the 2005–2007 Infant Feeding Practices Study II formed the cohort for these analyses, which were conducted among those with infants in 3 age groups: 1.5 to 4.5 months ($n = 1564$); >4.5 to 6.5 months ($n = 1128$); and >6.5 to 9.5 months ($n = 914$). For the analyses we used frequency and stepwise multiple logistic regression procedures.

RESULTS. Eighty-five percent of breastfeeding mothers of infants in the youngest age group had successfully expressed milk at some time since their infant was born. When asked only about the previous 2-week period, 68% of the breastfeeding mothers of infants in this youngest age group had expressed milk, with 43% having done so occasionally and 25% on a regular schedule. Approximately one quarter of breastfeeding mothers of infants in the 2 older infant age groups also expressed milk on a regular schedule. The percentage of mothers expressing milk decreased with increasing infant age. Mothers expressed milk for various reasons. The most frequently cited reason was to get breast milk for someone else to feed their infant. In all 3 age groups, reporting any breast milk expression, compared with none, was positively associated with maternal employment, higher income, lack of previous breastfeeding experience, and living in the Midwest versus the West. In all 3 age groups, expressing milk on a regular schedule, compared with occasionally, was positively associated with maternal employment and the use of an electric versus manual breast pump.

CONCLUSIONS. Breast milk expression is a very common practice. It is associated most strongly with maternal employment, a recognized barrier to breastfeeding. *Pediatrics* 2008;122:S63–S68

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Key Words

breastfeeding, breast milk, medical device

Abbreviation

IFPS—Infant Feeding Practices Study

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THE AMERICAN ACADEMY of Pediatrics recommends that infants receive only breast milk for their first 6 months of life, with continued breast milk throughout their first year.¹ Achieving this goal can require mothers to overcome logistic barriers such as separation from their infant and physical challenges such as mastitis. Milk expression, by hand or with a pump device, may help mothers to overcome some obstacles to successful breastfeeding and, therefore, increase breastfeeding duration.²

Expressing and feeding breast milk from a bottle is a qualitatively different experience from breastfeeding directly from the breast. Although feeding expressed milk mitigates a few advantages of the nutritional components of the milk, even from a bottle, human milk feeding is superior for infants compared with infant formula.^{3–5}

Little is known about the prevalence of milk expression and the reasons that mothers express milk for term singletons. In this article we estimate the prevalence of any, occasional, and regular milk expression according to mother and infant characteristics; describe the reasons that mothers say they express milk; and identify the maternal and infant characteristics associated with any breast milk expression (compared with none) and with breast milk expression on a regular schedule (compared with occasional breast milk expression) among breastfeeding mothers of infants in 3 successive age groups.

PARTICIPANTS AND METHODS

Data were obtained from the Infant Feeding Practices Study II (IFPS II), a longitudinal mail survey of mothers from pregnancy through their infant's first birthday. The data were collected from year 2005 to 2007. The sample was drawn from a national consumer opinion panel and included only mothers aged ≥ 18 years who gave birth to healthy

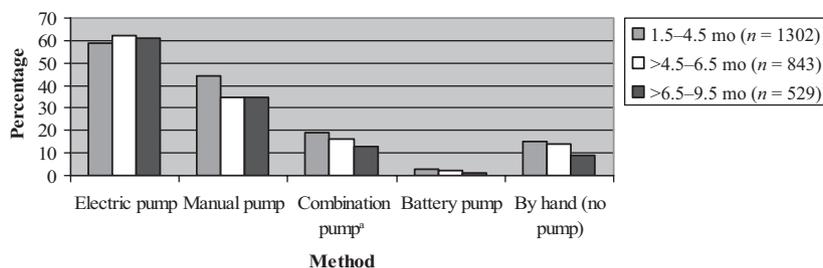


FIGURE 1

Percentage of breastfeeding mothers who had successfully expressed milk, according to method of milk expression and infant age group. The 1.5- to 4.5-month sample is based on breastfeeding mothers who responded about methods used to successfully express milk since their infant was born; the >4.5- to 6.5-month sample is based on mothers who responded about methods used in the previous 3 months; and the >6.5- to 9.5-month sample is based on mothers reporting about methods used in the previous 2 months. Samples are smaller than the total of those who had successfully expressed milk during a given period (1315, 845, and 653, respectively, for the successive age groups) as a result of question nonresponse. Respondents could mark all answers that applied; therefore, percentages in each age group do not sum to 100%. ^a Combination pumps were defined as both electric and battery operated.

near-term or term singleton infants. The research was approved by the Food and Drug Administration Research Involving Human Subjects Committee. The study methodology and characteristics of the sample are described in detail elsewhere in this supplement.⁶

Detailed questions about breast milk expression were asked on 3 questionnaires, sent to mothers at approximately 2, 5, and 7 months postpartum. On the month 2 questionnaire, mothers who had ever breastfed were asked certain questions about milk expression since their infant was born. Questions included whether she ever expressed milk and, if so, the method used to express milk since the infant was born; how many breast pumps she used since the infant was born; and what type of breast pump she used most often. On the month 5 and 7 questionnaires, these same questions were asked only of mothers who had breastfed in the previous 3 or 2 months, respectively, and for each question the reference period “since your infant was born” was replaced with “in the past 3 months” or “in the past 2 months,” respectively. On all 3 questionnaires, these mothers were asked how old their infant was the first time they expressed milk successfully or tried to do so; how many times they expressed milk in the previous 2 weeks; for what reasons they expressed milk in the previous 2 weeks; and whether they were now expressing milk on a regular schedule and, if so, how old the infant was when they first began doing so. The analysis cohort was limited to mothers who indicated that they had not stopped breastfeeding at the time they answered a questionnaire. Questions that asked about a limited time, such as the “past 2 weeks” or “now” do not capture all practices since the previous questionnaire.

Questionnaires were mailed out twice each month, ~2 weeks apart. Therefore, mothers could have received a questionnaire ~1 week earlier or later than the infant’s target age. Regardless of when the mothers received a questionnaire, they may have completed it at varying times afterward.

Using the actual age of the infant at the time the mother completed the questionnaire, we defined age cutoffs for the data from each of the 3 questionnaires. The cutoffs omitted outliers and allowed for the analysis of behaviors when the infants were in 3 mutually exclusive age groups: 1.5 to 4.5 months, >4.5 to 6.5

months, and >6.5 to 9.5 months. In the youngest age group, 1564 mothers were breastfeeding, 1315 had successfully expressed milk since their infant was born, and 1071 had expressed milk within 2 weeks of answering the month 2 questionnaire. In the middle age group, 1128 mothers were breastfeeding, 845 had successfully expressed milk in the previous 3 months, and 653 had expressed milk within 2 weeks of answering the month 5 questionnaire. In the oldest age group, 914 mothers were breastfeeding, 530 had successfully expressed milk in the previous 2 months, and 443 had expressed milk within 2 weeks of answering the month 7 questionnaire.

We used frequency and logistic regression procedures for the analyses. For the comparison of continuous variables, we used *t* and nonparametric tests of statistical significance. For the comparison of categorical variables, we used χ^2 and Fisher’s exact tests of statistical significance. Stepwise multiple logistic regression was used to identify factors associated with any milk expression among those mothers who were breastfeeding their infants in each of the infant age groups. Variables considered included mother and infant demography (mother’s age, race, education, income, employment status, geographic region, and infant gender); characteristics of the infant’s birth and health (near-term or term gestation, type of delivery, and whether the infant had an infection in the previous 2 weeks); mother’s prenatal intent to

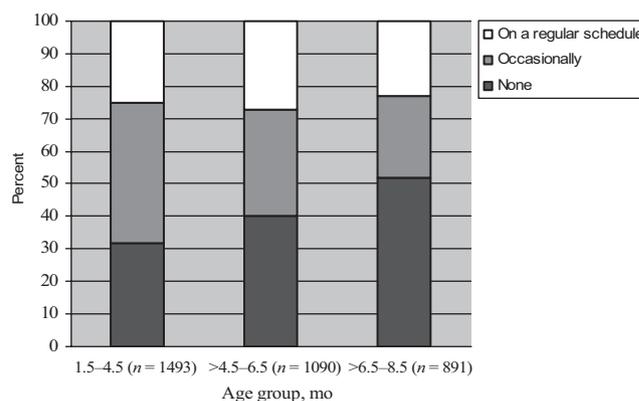


FIGURE 2

Breastfeeding mothers’ prevalence of breast milk expression in the previous 2 weeks, according to infant age group.

TABLE 1 Percentage of Breastfeeding Mothers of Infants 1.5 to 4.5 Months Who Did not Express Milk, Expressed Milk Occasionally, and Expressed Milk Regularly in the Previous 2 Weeks, According to Mother and Infant Characteristics

Characteristic	n ^a (N = 1493) ^b	Expressed Milk in Previous 2 wk, 1.5–4.5 mo, %			P
		None	Occasionally	Regularly	
Mother's education					
High school or less	188	42.0	37.2	20.7	
Some college	547	36.6	45.2	18.3	
College graduate	695	25.8	43.0	31.1	<.001
Household income					
<185% of poverty level	521	40.7	43.8	15.6	
185–350% of poverty level	578	32.2	44.8	23.0	
>350% of poverty level	394	20.3	40.1	39.6	<.001
Postnatal WIC participation, infant or mother					
No	1089	29.1	43.3	27.6	
Yes	397	40.1	42.8	17.1	<.001
Region					
Northeast	257	34.2	42.9	23.0	
Midwest	416	25.5	46.2	28.4	
South	447	30.2	40.7	29.1	
West	373	40.0	43.2	16.9	<.001
Employed in previous 4 wk					
No	1038	35.0	47.2	17.8	
Yes	391	20.0	34.0	46.0	<.001
Embarrassed to breastfeed in public					
No	690	35.8	44.9	19.3	
Yes	781	28.6	42.0	29.5	<.001
Breastfed other infant					
No ^c	431	18.6	44.3	37.4	
Yes	1026	37.5	43.1	19.4	<.001
Prenatal intent for any breastfeeding					
<12 mo	1141	29.6	42.6	27.9	
≥12 mo	254	39.0	43.7	17.3	<.001
Infant gestation					
35 to <37 wk	51	23.5	33.3	43.1	
≥37 wk	1440	32.3	43.5	24.2	.006
Infant delivery					
Vaginal birth without pain medication	276	43.1	39.5	17.4	
Vaginal birth with pain medication	826	30.3	43.7	26.0	
Cesarean section	384	27.9	44.8	27.3	<.001

Includes only significant characteristics. Characteristics that we analyzed but that were not significantly associated with differences in not expressing milk, expressing occasionally, and expressing regularly were mothers' age, race, and prenatal intent for exclusive breastfeeding, whether the infant had an infection in the previous 2 weeks, and the infant's gender. WIC indicates Supplemental Nutrition Program for Women, Infants, and Children.

^a Sample sizes for some characteristics are <1493 as a result of missing data.

^b Of the 1564 mothers in the sample who were breastfeeding, this analysis includes only those who responded to questions on whether she had expressed milk.

^c Includes mothers with no other children and mothers with other children whom they did not breastfeed.

breastfeed; embarrassment over breastfeeding in public; and previous breastfeeding experience. Stepwise multiple logistic regression was also used to identify factors associated with the mothers' regular breast milk expression, compared with occasional expression, in each infant age group. For this analysis, in addition to the variables listed above, we also considered the type of pump device used most often and infant age at first breast pump use. A variance inflation factor was used to identify collinearity between variables, and the potential interaction effects (demography and mothers' breastfeeding and milk-expression behavior) were explored with the likelihood ratio test by fitting the interaction term into the model one by one. The

final models were chosen to include all the variables that were significant for at least 1 infant age group. The analyses were conducted by using SAS 9.1 (SAS Institute, Inc, Cary, NC) and Stata 8.0 (Stata Corp, College Station, TX).

RESULTS

Most mothers who breastfed their infant also expressed milk. Of the 1564 mothers who breastfed their infant in the 1.5- to 4.5-month age group, 85% had successfully expressed milk since their infant was born, and 2% tried but failed to express any milk. Of these 1315 mothers who had successfully expressed milk, more than half of

TABLE 2 Percentage of Breastfeeding Mothers Who Expressed Milk in the Previous 2 Weeks and Indicated Doing so During That Period for Each Reason, According to Infant Age Group

	1.5 to 4.5 mo (N = 1022) ^a	>4.5 to 6.5 mo (N = 652) ^a	>6.5 to 9.5 mo (N = 422) ^a
For someone else to feed infant	69	70	63
For an emergency supply	43	35	37
To relieve engorgement	42	32	34
To increase milk supply	33	27	23
When mother does not want to breastfeed	31	24	18
To keep up milk supply when infant could not nurse	27	33	33
To mix with cereal or other food	4	35	39
Nipples too sore to nurse	4	1	2
To donate	<1	1	<1

Respondents marked all reasons that applied; therefore, percentages in each age group do not sum to 100%.

^aSamples are smaller than the total of those who had expressed milk during the previous 2 weeks (1071, 653, and 443, respectively, for the successive age groups) as a result of question nonresponse.

them first expressed milk when their infant was <1 week old. Among the 820 mothers who were continuing to breastfeed on the 2-, 5-, and 7-month postpartum questionnaires, 92% had expressed breast milk at some time. Electric pumps were the most widely used method for expressing milk in all of the age groups, followed by manual pumps (Fig 1).

Prevalence of Any, Occasional, and Regular Breast Milk Expression

Of the 1493 breastfeeding mothers of infants in the 1.5- to 4.5-month age group with complete data on the relevant questions, only 32% had not expressed milk in the previous 2-week period, whereas 43% had expressed milk occasionally, and 25% had expressed milk on a regular schedule. As the infants aged, a similar percentage of breastfeeding mothers expressed milk on a regular schedule, and a greater percentage did not express milk at all (Fig 2).

The percentages of mothers not expressing milk, expressing milk occasionally, and doing so on a regular schedule in the previous 2 weeks differed significantly depending on several maternal characteristics. Table 1 lists these characteristics for mothers of infants in the 1.5- to 4.5-month age group. Many of the same maternal characteristics were associated with the prevalence of breast milk expression among mothers of infants in the older age groups (data not shown). The exceptions among mothers of infants in the >4.5- to 6.5-month age group (*n* = 1090) were that there were no significant differences based on mothers' embarrassment of breastfeeding in public and infants' length of gestation. Among mothers of infants in the >6.5- to 9.5-month age group (*n* = 891), there were 2 additional characteristics that were no longer significantly associated with the prevalence of milk expression: region of residence and how the infant was delivered.

Reasons for Pumping

The mothers who expressed milk in the previous 2-week reference period for each questionnaire were asked to

TABLE 3 Logistic Model Factors and Adjusted Odds Ratios (95% Confidence Intervals) Associated With Any Milk Expression (Compared With None) Among Breastfeeding Mothers, According to Infant Age Group

Characteristic	1.5–4.5 mo (N = 1264)	>4.5–6.5 mo (N = 942)	>6.5–9.5 mo (N = 740)
Mother's education			
Some college vs high school or less	1.01 (0.68–1.50)	1.24 (0.77–1.98)	1.26 (0.70–2.28)
College graduate vs high school or less	1.36 (0.89–2.06)	1.40 (0.87–2.27)	1.68 (0.94–3.02)
Household income			
185%–350% vs <185% poverty level	1.24 (0.92–1.67)	1.10 (0.78–1.55)	1.50 (1.01–2.22) ^a
>350% vs <185% poverty level	1.62 (1.10–2.39) ^a	1.60 (1.03–2.51) ^a	1.72 (1.05–2.81) ^a
Region			
Northeast vs West	1.00 (0.68–1.48)	1.15 (0.73–1.80)	1.03 (0.62–1.71)
Midwest vs West	1.83 (1.29–2.59) ^a	1.45 (0.98–2.15) ^a	1.49 (0.95–2.31) ^a
South vs West	1.34 (0.96–1.88) ^a	1.46 (0.99–2.17) ^a	1.30 (0.83–2.04)
Infant delivery			
Vaginal birth with pain medication vs without pain medication	1.43 (1.03–1.98) ^a	1.49 (1.03–2.16) ^a	0.96 (0.63–1.47)
Cesarean section vs vaginal birth without pain medication	1.57 (1.08–2.30) ^a	1.61 (1.04–2.47) ^a	1.12 (0.69–1.82)
Infant gender, girl vs boy	0.88 (0.69–1.14)	0.72 (0.54–0.97) ^a	0.81 (0.59–1.13)
Infant gestation, ≥37 vs 35 to <37 wk	0.68 (0.31–1.48)	0.98 (0.40–2.40)	0.79 (0.30–2.09)
Breastfed other infant, yes vs no ^b	0.42 (0.30–0.58) ^a	0.55 (0.38–0.81) ^a	0.38 (0.25–0.58) ^a
Prenatal intent to breastfeed, ≥12 vs <12 mo	0.80 (0.58–1.12)	0.88 (0.63–1.26)	1.21 (0.82–1.77)
Prenatal intent to exclusively breastfeed, ≥5 vs <5 mo	1.13 (0.83–1.54)	1.44 (0.96–2.15) ^a	1.04 (0.67–1.61)
Employed in previous 4 wk, yes vs no	2.09 (1.52–2.87) ^a	4.60 (3.34–6.31) ^a	4.33 (3.09–6.06) ^a
Embarrassed breastfeeding in public, yes vs no	1.17 (0.90–1.52)	0.80 (0.60–1.09)	1.10 (0.78–1.53)

Analysis was limited to those with complete data on the relevant questions.

^aIndicates statistical difference at the .05 level.

^bIncludes mothers with no other children and mothers with other children whom they did not breastfeed.

TABLE 4 Logistic Model Factors and Adjusted Odds Ratios (95% Confidence Intervals) Associated With Regular Milk Expression, Compared With Occasional Milk Expression, Among Breastfeeding Mothers Who Expressed Milk in the Previous 2 Weeks, According to Infant Age Group

Characteristic	1.5 to 4.5 mo (N = 853)	>4.5 to 6.5 mo (N = 558)	>6.5 to 9.5 mo (N = 362)
Mother's education			
Some college vs high school or less	0.53 (0.30–0.92) ^a	1.43 (0.64–3.21)	0.95 (0.32–2.78)
College graduate vs high school or less	0.76 (0.44–1.32)	2.07 (0.93–4.57) ^a	1.37 (0.48–3.09)
Household income			
185%–350% vs <185% poverty level	1.23 (0.82–1.84)	1.52 (0.91–2.52)	2.10 (1.04–4.22) ^a
>350% vs <185% poverty level	1.82 (1.15–2.87) ^a	1.50 (0.84–2.67)	2.48 (1.16–5.27)
Region			
Northwest vs West	1.24 (0.75–2.09)	1.30 (0.70–2.41)	0.78 (0.35–1.70)
Midwest vs West	1.36 (0.88–2.11)	1.22 (0.72–2.06)	0.64 (0.32–1.25)
South vs West	1.73 (1.12–2.66) ^a	1.49 (0.87–2.55)	1.05 (0.53–2.10)
Infant delivery			
Vaginal birth with pain medication vs without pain medication	0.95 (0.60–1.50)	0.97 (0.56–1.69)	0.69 (0.35–1.35)
Cesarean section vs vaginal birth without pain medication	1.10 (0.67–1.82)	0.72 (0.39–1.32)	0.52 (0.25–1.11)
Infant gestation, ≥37 vs 35 to <37 wk	0.37 (0.16–0.81) ^a	1.58 (0.56–4.52)	0.55 (0.14–2.17)
Breastfed other infant, yes vs no ^b	0.64 (0.45–0.90) ^a	0.49 (0.31–0.76) ^a	0.71 (0.40–1.27)
Prenatal intent to breastfeed, ≥12 vs <12 mo	0.72 (0.45–1.14)	0.49 (0.30–0.81) ^a	0.58 (0.32–1.06) ^a
Employed in previous 4 wk, yes vs no	3.99 (2.86–5.56) ^a	4.02 (2.68–6.04) ^a	5.94 (3.47–10.17) ^a
Embarrassed to breastfeed in public, yes vs no	1.34 (0.97–1.85) ^a	0.87 (0.59–1.09)	1.11 (0.66–1.87)
Type of breast pump device used most often ^c			
Combination of electric/battery vs electric pump	0.66 (0.43–1.02)	0.55 (0.33–0.92) ^a	0.87 (0.42–1.82)
Manual pump vs electric pump	0.51 (0.35–0.75) ^a	0.39 (0.23–0.65) ^a	0.31 (0.16–0.59) ^a
Age of first breast pump use (wk)	0.91 (0.84–0.98) ^a	1.02 (0.96–1.09)	1.02 (0.96–1.09)

Analysis was limited to those with complete data on the relevant questions.

^a Indicates statistical significance at the .05 level.

^b Includes mothers with no other children and mothers with other children whom they did not breastfeed.

^c Hand expression was not a response option on the question that asked about the type of pump device used most often.

mark all reasons that applied to their decision. Mothers expressed milk for various reasons. In all 3 age groups, the most frequently cited reason for expressing milk was to allow someone else to feed the infant expressed breast milk. Another prominent reason in all 3 age groups was to have an emergency supply of breast milk. In the 2 older age groups, milk expression was used by more than one third of the mothers to get milk to mix with cereal or other foods (Table 2).

Factors Associated With Any and Regular Breast Milk Expression in 3 Infant Age Categories

In multivariate logistics regression analyses, the factors independently associated with a greater likelihood of any breast milk expression, compared with no milk expression, among mothers of infants in all 3 age categories included a household income of >350% of poverty level compared with <185% of poverty level, living in the Midwest compared with the West, having no previous breastfeeding experience, and maternal employment. Additional factors were significantly associated with the likelihood of any milk expression in 1 or 2 infant age groups (Table 3).

In multivariate logistic regression analyses, factors independently associated with a greater likelihood of expressing milk on a regular schedule, compared with occasional expression, among mothers of infants in all 3 age categories included maternal employment and use of an electric pump versus a manual pump. Additional factors were sig-

nificantly associated with expressing milk on a regular schedule in 1 or 2 infant age groups (Table 4).

DISCUSSION

Milk-expression devices have been used for centuries to help mothers redress immediate challenges to breastfeeding, such as engorgement and inverted nipples. Significant recent advances in breast pump technologies have now made these devices able to more effectively redress long-term challenges such as regular, extended separations from the infant for work.^{7–9} These recent technical advances could contribute to increased rates of milk expression, as suggested in previous research.⁵

The overwhelming majority of breastfeeding mothers in the IFPS II expressed milk and initiated doing so when their infants were very young. This result suggests that milk expression is a normalized aspect of breastfeeding behavior and provides context for health professionals who counsel breastfeeding mothers. However, it is important to note that the IFPS II sample is not nationally representative. Compared with members of a nationally representative sample from the National Survey of Family Growth, IFPS II participants were older, more educated, had fewer children, were more likely to be white, employed, and middle income, and were less likely to smoke.^{6,10} Compared with women participating in the National Immunization Survey who gave birth in 2004, IFPS II mothers were more likely to breastfeed and to continue doing so longer.^{6,11}

Mothers in the IFPS II reported expressing milk for several different reasons associated with common logistic and physical barriers to breastfeeding. Maternal employment, a common reason a mother might be separated from her infant, was the characteristic most strongly associated with expressing milk. Employed mothers of infants in the 1.5- to 4.5-month age group were twice as likely to express milk as those who were not working. Employed mothers were 4 to 6 times more likely to express milk regularly than occasionally, compared with mothers who were not employed. A finding consistent with the strong effect of maternal employment is that the most frequently cited reason mothers expressed milk was to get breast milk for someone else to feed their infant, presumably, but not necessarily, in their absence. Half of the mothers in the United States with infants under 1 year old are employed, and one third are employed full-time.¹² Employment is negatively associated with breastfeeding duration.¹³ For mothers whose work separates them from their infants, milk expression can help them continue to provide their infant with their milk and maintain their breastfeeding relationship when they are not separated.

Another frequently reported reason for expressing milk was to have an emergency supply. Having a readily available extra supply of their milk on hand may help mothers achieve their breastfeeding goal or extend the duration of their breastfeeding. Such a supply is useful for situations such as unplanned separations from the infant, mothers' need to take medications contraindicated for breastfeeding, or to replace milk lost to accidental spillage or spoiling.

Having no previous breastfeeding experience increased the likelihood of milk expression. This result may reflect a lack of confidence in the ability to breastfeed successfully among mothers who are new to breastfeeding that manifests itself in milk expression to have an emergency supply. However, this association may be confounded by the relationship between primiparity and longer duration of labor, which is associated with increased risk of delayed lactation onset.¹⁴ Milk expression can be recommended to women experiencing delayed lactation onset as a strategy to expedite the process.¹⁵ Unplanned cesarean birth is another risk factor for delayed lactation onset.¹⁴ In this analysis, cesarean delivery and vaginal delivery with pain medication were associated with a greater likelihood of expressing milk among the mothers of infants in the younger age groups.

The increased likelihood of expressing milk regularly, compared with occasionally, when using an electric pump could be explained by the characteristics of these pumps, which are often designed for frequent and regular use. Electric pumps are considered to be the best choice for most situations for which mothers may need to pump. With a manual pump, only 1 breast can be expressed at a time and it may be hard for a mother to reach the suck frequency and pressure required for efficient emptying, which makes these pumps both time and labor intensive. Manual pumps may be an appropriate choice for occasional use but diffi-

cult for mothers who pump often. Battery-powered pumps may not offer enough suction pressure for mothers who need to collect a high volume of milk.¹⁶

CONCLUSIONS

The results from this analysis suggest that milk expression could be a strategy to help mothers continue to breastfeed and to provide their milk to their infant, but additional research is needed to understand whether milk expression helps mothers to achieve their breastfeeding goals.

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