Pumping Breast Milk in the NICU: Coping Mechanisms and Challenges Shape the Complex Experience of Closeness and Separation

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Abstract

**Background:** Breast milk has multiple benefits for human health, however rates of infants receiving breast milk at discharge in Canadian neonatal intensive care units (NICU) are far below recommendations of the Baby Friendly Hospital Initiative supported by the Canadian Pediatric Association. Mothers of infants requiring NICU care usually need to pump their milk, especially mothers of premature infants, since for some time their infant is unable to feed directly at the breast. Pumping human milk for an extended period can be challenging for mothers.

**Purpose:** To document maternal experiences pumping human milk for their infant in the NICU as a closeness or separation experience, and to discover what factors gave rise to these perceptions.

**Methods:** In this descriptive qualitative cross-sectional study, 15 mothers whose infants were hospitalized in a level III NICU; and who were pumping human milk audio recorded their thoughts and feelings with a smartphone application for 48 hours while they were pumping. A thematic content analysis was used to analyze data.

**Findings:** Pumping human milk for their hospitalized infant was a difficult experience for all mothers, and most described both closeness and separation feelings while pumping. Their feelings fluctuated depending on their coping mechanisms, perceived challenges; as well as their location and environment. Mothers were all pursuing their goal of continued milk expression with various levels of motivation.

**Implications for practice:** NICUs should adopt a family-centered approach to care whereby mothers’ care needs related to milk expression are addressed. Nurses can ask open-ended questions to explore how mothers are coping and nurses can assist mothers to find effective
coping strategies to minimize the challenges related to pumping to promote mother-infant closeness.

**Implications for research:** The impact of environment and location on mothers with hospitalized infants should be explored as unit designs could be altered to foster closeness.

**Key words:** human milk, milk expression, mothers, premature infants, NICU

**What this study adds:**

- Mothers of NICU infants who are pumping human milk experience both closeness with their infant and a feeling of separation; and this can fluctuate in the short-term over time.

- How mothers cope with the challenges of pumping plays a role in their ability to view pumping in a positive light, and feel close to their infant.

- The environment in which mothers pump can have an impact on whether they feel closer or more separated from their infant.
Background

Human milk has been shown to have protective properties for health problems such as respiratory and gastrointestinal infections, sudden infant death syndrome, obesity, and type I diabetes.¹ For preterm infants, human milk consumption can also reduce the risk of necrotizing enterocolitis, sepsis, retinopathy of prematurity, and lead to better neurodevelopmental outcomes.¹ In 2014 there were 15,045 babies hospitalized in neonatal intensive care units (NICUs) in 31 hospitals across Canada. Only 35.4% of these babies exclusively received human milk, and 38.5% received both human milk and formula at discharge.² This is below the 75% exclusive human milk goal of the Baby Friendly Hospital Initiative³ supported by the Canadian Pediatric Society.⁴ As the World Health Organization recommends exclusive human milk in the first six months of life, many NICU babies may not receive optimal nutrition for their development.⁵

One factor that may play a role in low rates of exclusive human milk feeding for NICU infants is the challenges mothers confront in manually expressing their milk. Mothers who choose to give human milk to their infant usually must pump their milk since for a time the infant is unable to effectively suck and feed directly at the breast.⁶ They typically use a hospital-grade electric pump to initiate lactation,⁷ then store the milk until it is given to the infant by enteral or bottle feeds.⁸ To attain and maintain adequate milk production, mothers need to start pumping within the first hour after childbirth,⁹,¹⁰ and continue to do so every two or three hours.¹¹,¹² In the first few days milk flows slowly and in small quantities, which can be frustrating for mothers.⁶,¹³ Milk production can be difficult to maintain as many mothers find expression exhausting,¹⁴,¹⁵ and time consuming.¹⁵ There is some evidence that women with lower socio-economic status, those with lower levels of education, and teenage mothers are less
likely to persist with breastfeeding until NICU discharge.\textsuperscript{16-19}

Although studies of the overall breastfeeding experience of mothers of NICU infants provide some knowledge of their perceptions of pumping, very few studies have focused explicitly on pumping during a NICU hospitalization. The few existing studies suggest that there is a wide spectrum of possible experiences. Some studies describe positive aspects of providing human milk as it was a way for mothers to bond, care and feel close to their child.\textsuperscript{20, 21} Some mothers find it provides structure in a time of uncertainty and a routine that included the infant, despite the separation engendered by hospitalization.\textsuperscript{21} Some mothers feel connected to their infant while pumping and this gives them motivation to persevere.\textsuperscript{22} It is also seen by some as an opportunity to relax.\textsuperscript{22}

In contrast, evidence suggests that some women find pumping to be unpleasant, or troublesome.\textsuperscript{20, 21, 23} The process is considered tedious and women find ways to distract themselves while pumping so they continue to do so frequently and maintain production.\textsuperscript{22} The pressure of meeting expectations about quantities of milk produced can cause distress.\textsuperscript{12} Pumping can also become a burden because of a sense of obligation, or failure if they feel unable to continue.\textsuperscript{12}

There is also recent evidence that some mothers experience mixed feelings. In a study by Hurst, Engebretson, and Mahoney\textsuperscript{24}, mothers describe providing human milk as a paradoxical experience. The breast pump represents detachment from their child, but also is an important way to provide for the child and feel connected.\textsuperscript{24} The authors highlight the need for further research to understand the complex paradoxical nature of pumping to enable the development of appropriate interventions to support mothers.

Studies of NICU mothers indicate they need to be close to their hospitalized infant and to
feel like a caring mother, not a visitor. Closeness can be emotional and physical, and these are not necessarily interrelated. Physical closeness refers to being spatially close, while emotional closeness refers to parental feelings of being emotionally connected to the infant. Emotional and physical closeness have physiological and psychological benefits. A review by Flacking et al. shows that closeness between NICU infants and their parents can improve child brain development and later cognitive development. Moreover, when closeness is promoted, mothers report better mental health. Treherne (2017) explored parents’ experience of closeness with their infants in the NICU, and pumping human milk was found to engender both closeness and separation for mothers. More research is needed to develop a deeper understanding of the closeness and separation experience of mothers pumping human milk.

Data from studies on mothers’ overall breastfeeding experience provide some knowledge about possible factors that can influence when and where women express milk. Dowling, Blatz & Graham report that mothers are most comfortable pumping in their home for privacy, comfort, control of the environment, and absence of interruptions. The second preferred place is the infant’s bedside, since it allows them to be close to their infant; and the last choice is the NICU’s pumping room.

Clinicians need to understand how to optimize the pumping experience of NICU mothers so they continue to provide human milk. A better understanding of mothers’ experience and the factors that shape whether they feel close or separate from their infant could lead to nursing practices to promote closeness. Thus, the purpose of this study was to explore whether mothers perceived pumping human milk for their infant in the NICU to be a closeness or separation experience and what factors gave rise to these perceptions.
Methods

A qualitative descriptive design was chosen to document maternal experiences pumping human milk for their infant in the NICU as a closeness or separation experience. A qualitative descriptive study is useful to capture a rich understanding of the experience of the participants and to develop nursing practices adapted to people’s needs in a specific circumstance.30

The study was conducted in a level III urban Canadian NICU which is a combination of 6-bed pods and single-family rooms, and approved by the hospital’s Research Ethics Committee. At the study site, all nurses receive twenty hours of basic mandatory breastfeeding training, and seven members of the nursing staff are lactation consultants. Women can pump in one of the two designated pumping rooms in the NICU and at the infant’s bedside behind a privacy screen. In each pod of six infants, there are two to three pumps per pod, each single-family room has a pump, and there is one pump in each of the two pumping rooms. Thus, there are a total of 24 pumps for this 34-bed unit. There is no milk bank. While at the hospital, mothers typically use these hospital-grade pumps. To pump elsewhere, women can choose to purchase or rent a hospital-grade pump similar to the one at the hospital; or choose a portable, more compact and travel-friendly electric pump.

Convenience sampling was used to recruit mothers who were pumping while their infant was hospitalized. Mothers were eligible if their infant: had been in the NICU for more than 48 hours regardless of gestational age, birth weight or reason for admission; was in stable condition and expected to be hospitalized at least one more week. Exclusion criteria were an infant diagnosis of grade 4 intraventricular hemorrhage, trisomy 21 and being in palliative care or foster care, as these are situations with major challenges beyond the NICU hospitalization that could affect mothers’ pumping experience.
Research phones with the HAPPY (Handy Application to Promote Preterm infant happY-life) application were loaned to participants. This smartphone application allows participants to describe their thoughts and feelings via voice recording. It has been used in studies with NICU parents and nurses; and was acceptable, and provided rich qualitative data.\textsuperscript{28, 31, 32} Verbal and written instructions for the application were provided. Mothers were asked to use the application while pumping or soon after, at the location where they pumped, for 48 hours. They first choose the “closeness” or “separation” button to describe if they felt close or separated from the infant while pumping. No definition of these concepts was provided to encourage them to use their own interpretation. After selecting the word representing their current feeling, they verbally described their pumping experience. Confidentiality of data was protected as audio data could only be decoded on the research computer. Mothers completed a demographic questionnaire with a subject number, and the infant’s medical chart was reviewed to retrieve data for sample description.

A thematic content analysis process was used to analyze the data, which is consistent with the descriptive qualitative design.\textsuperscript{33} Data analysis was an iterative process as codes were continuously compared to data gathered in subsequent recordings. Data collection continued until saturation was achieved and this was evident after 13 participants were enrolled. Audio files were transcribed and data read several times to acquire a general overview of the participants’ perspectives. Qualitative data analysis software (NVivo) was used to manage data. Our analysis was structured around the topic of this inquiry: closeness and separation, so these were the major categories. Our findings describe the sub-categories that emerged within each of these major categories. Salient segments of text were identified and coded according to the main idea expressed. Coded segments were regrouped into subcategories based on similarities and
differences. These were corroborated with new information from subsequent recordings.

Credibility was ensured by peer debriefing: the team met weekly to discuss the data and acquire different perspectives. Confirmability was addressed by initiating an audit trail documenting decisions, analysis products, and reflexive notes.\(^\text{33}\) Dependability, the stability of data over time and conditions, was ensured by coding checks: that is coding data and then recoding two weeks later to compare.\(^\text{34}\) Using a team of researchers with some members familiar with qualitative methods as well as the study field ensured confirmability.\(^\text{35}\) Adequate description of participants and setting allows readers to determine transferability or extent to which findings can be applied in other settings.\(^\text{33}\) Francophone participants’ quotes included as examples in this report were translated into English.

**Findings**

The 15 participants all had preterm infants born at an average of 29 gestational weeks (range = 23-32), who were on average 37 days of life (range = 5-94) on the first day of data collection. They weighed an average of 1171 grams at birth (range = 590-1730). Mothers’ mean age was 32 years (range = 26-44). Ten of the 15 were first-time mothers. They had been pumping for an average of 38 days (range = 5-93). Additional sociodemographic characteristics are presented in Table 1.

Pumping human milk was a difficult experience for all, and all experienced varying degrees of closeness and separation while pumping. Most mothers described both positive and negative feelings, and feelings fluctuated over time (See Figure 1). Fluctuation in feelings were influenced by three factors; namely coping mechanisms, perceived challenges, as well as mothers’ location and environment while pumping. Some women described mostly positive feelings and closeness experiences as they seemed to have found effective coping mechanisms.
In contrast, other mothers felt overwhelmed by challenges, had difficulty coping and felt separated. Some mothers who had previously found ways to cope encountered new challenges that provoked negative feelings and separation.

**Closeness and Positive Feelings**

Thirteen out of fifteen mothers (87%) reported closeness experiences at some point during data collection, and nine of those mothers (60%) reported more episodes of closeness than separation. Closeness was associated with positive thoughts, feeling relaxed and feeling a special connection with the infant. Several reported being more motivated to pump when they felt close to their child. “When I’m with my baby, … it’s very motivating to have your baby close, and sometimes I even have him on me while expressing my milk…” (P05). Nonetheless, physical proximity was not necessary to feel close. Using the pumping room after having held the infant was typically described as a closeness experience. Merely thinking about being with the infant, either before or after a visit, made some mothers feel close. “I still feel close to my baby because I went to see him this morning… When I think of him… pleasant thoughts come to me. I know he’s okay… that he’ll have good milk.” (P06).

**Finding Ways to Cope with Pumping Helps Mothers Feel Close**

Mothers utilized a variety of strategies to help them cope with the challenges of pumping. Usually, by utilizing these strategies, they could achieve closeness.

**Considering pumping as a way to feel useful as a mother.** Mothers could cope, felt more positive about pumping, and emotionally close when they considered pumping made them feel useful in their infant’s care. It gave them purpose. One mother explained:

I think it’s so important to give him his milk …, this is the only way you can feel like you are close to the child because he is sick and he is away in the NICU and pumping and
giving him milk is like a way to feel like you are important for your child. You feel you’re a mother. (P09)

They considered pumping as something they owed the infant. They wanted to give human milk to their vulnerable babies because of its benefits; they believed that providing milk formed a privileged bond. “Expressing milk brings me closer to my baby, because it’s like a privileged bond we have. Instead of breastfeeding him, I’m giving … him the best possible start” (P05).

Using self-talk. Mothers described how they talked to or encouraged themselves, reminding themselves of their motivation, the need to persevere and not get discouraged. They reflected on the need to persist towards their goal of breastfeeding, to be resilient and determined to continue pumping human milk despite the numerous challenges confronted over time. For example, one mother noted: “It’s motivating to remind myself that I’m doing this for her, when I see her and I know she’s going to drink this milk” (P08).

Thinking about their infant. Most mothers purposefully thought about their infant while pumping, whether at home or at the bedside. As one woman explained: “I like to think about my baby, it brings positive thoughts. I know … he will get good milk.” (P06). If they were with the infant while pumping, they would look at her/him or hold her/his hand to feel close. If they were not physically close, they would look at the infant’s picture or grasp an object that belonged to their infant such as a blanket with the infant’s smell. Thinking about the infant could stimulate milk production, and observing their milk production increase was a source of motivation.

Reframing pumping as a part of the breastfeeding process. Mothers described being able to cope with pumping and feeling close to their infant when they considered pumping as a stepping stone to their goal of breastfeeding. “Pumping my milk, well it is part of the breastfeeding process. We’ve now started to feed him at the breast, it’s very motivating for me, it
definitely makes me feel closer to my child” (P01). Most were more motivated to pump when they started feeding at the breast and when their infant’s feedings progressed, as they perceived they were closer to their breastfeeding goals and their efforts were successful.

**Integrating pumping into daily life.** Women also coped with pumping by doing so while addressing other demands. As one stated: “I sit at home and I can help my other children while telling myself that I’m helping the one who isn’t present at that moment” (P06). Pumping with the infant’s siblings present gave some women a sense integrating the hospitalized infant into the family. Mothers felt more positive about pumping when they found ways to integrate it into their daily routine and simultaneously meet their own personal needs (e.g., by spacing nighttime pumping sessions to enable them to get rest). Finding a pump that allowed them to pump anywhere, and made it easier to integrate pumping into their daily life, was important.

**Using distractions to pass the time.** While some mothers preferred to think about their infant while pumping, others relied on distractions to pass the time and help them cope. While pumping, they would watch television, play on their phone, listen to music, or talk to someone. For example, one participant described what she was doing while pumping in a designated pumping room in the unit: “I’m alone in a small room so I check my phone, check social media, or play games… findings ways to pass time because I need to pump for 15 minutes. But I will go back to my baby right after” (P01).

**Seeking and using support.** Mothers sought and received support from several sources, including nurses, lactation specialists, their partner, friends or family; and this helped them cope. The bedside nurse was identified as a key support to foster closeness. Mothers were motivated to pump when they perceived that pumping was equally important to their infant’s nurse. One mother described how she appreciated being encouraged to pump by the nurse and felt less guilty putting her infant back into the incubator to pump when nurses reminded her to do so. Mothers
also appreciated receiving support from the lactation specialists who taught them pumping methods, and gave them tips to make pumping less painful, easier, and more efficient; such as to massage their nipple to elicit a milk ejection reflex, or to apply warm compresses to the breasts prior to pumping.

Mothers also recognized the importance of sharing their experience with other women in the same situation. Observing another mother pumping was encouraging. They experienced increasing motivation to persist when their partners provided encouragement and support. “He [husband] is encouraging me a lot. He supports and understands and appreciates what I’m doing for our child. This is for me the power to continue pumping” (P09). Women could feel isolated when pumping, and finding someone to be with them while doing so could diminish isolation.

**Separation and Negative Feelings**

Fourteen of fifteen mothers (93%) reported separation experiences at some point during data collection, and six of those (40%) reported more episodes of separation than closeness. Physical separation was typically linked to emotional separation and negative feelings such as sadness, loneliness, frustration, and a longing for their infant. In these moments, they felt demotivated and perceived pumping as an obligation. Mothers felt emotional separation when they had to leave their infant’s side to pump. Discomfort and pain led to feelings of separation.

**Being Overwhelmed by the Challenges and Feeling Separated**

While all mothers had to deal with challenges related to pumping, some perceived the challenges as overwhelming. When mothers were unable to find effective coping mechanisms to overcome the inherent challenges, they experienced pumping as an emotional separation.

**Having a negative perception of milk production.** Some mothers felt pressure about the quantity of milk they could pump. They worried about their milk supply and were fearful of not having enough to feed their infant. “I’m not feeling very close, just feeling stressed out that
I’m not producing enough milk” (P13). In contrast, other mothers were producing too much milk, exceeded their infant’s needs. Due to limited storage space for milk, they experienced feelings of separation and decreased motivation while pumping because they knew the infant would probably not be given that milk and it might be thrown out.

**Considering that pumping is not breastfeeding.** Mothers had difficulty coping with the demands of pumping when they compared it to feeding at the breast. Pumping was a reminder that they were separated from their child and could not feed directly at the breast. They were less motivated to wake at night to pump compared to if they had to wake to breastfeed their child. “Of course, I’ve never experienced it, so it’s hard to say, but it’s less appealing to pump your milk at night than to wake up to breastfeed your baby” (P01).

Mothers described feeling frustrated when comparing pumping to breastfeeding their previous children as they did not experience the same closeness. For some mothers who had started feeding their infant at the breast, they felt more separated when pumping compared to when they were not feeding at the breast:

These days, I’m not feeling emotionally connected. In the beginning, I remember really feeling like I had a mission and I was doing this [pumping] for my infant and it was one of the only things that I could really … do for him…(P11).

**An exhausting schedule.** Mothers explained how difficult it was to feel close to their child while pumping when they had to rush and juggle competing demands with pumping. It was difficult to plan their day around their pumping schedule. It was also time-consuming to set up equipment, pump, store the milk, and then wash and sterilize equipment. Mothers experienced fatigue when pumping disturbed their sleep. They reported more separation and less motivation in evenings and at night due to fatigue. One mother explained:
That’s really when I feel the most alone, the furthest away. I don’t think there’s really anything to help at that hour. You need willpower to get up, express your milk. Then you tell yourself, I’m tired, why am I doing this?” (P06)

**Lacking adequate support.** When mothers perceived that support from their partner, family, or staff was inadequate; they felt less able to cope and separated. For some, even if their partners were supportive, they felt lonely and isolated as the person going through this tedious process. They sometimes wished they would have more communication with nurses while they were pumping, to reduce isolation and to have someone answer questions. However, it was confusing when they received different advice from different nurses. Some considered that nurses were often not proactive in providing teaching or not sufficiently trained to provide needed help. For example, one mother described:

“I’m at home pumping… I feel isolated from our infant because we’re not there. He’s over at the hospital and we’re here and it feels strange to be doing...” (P07).

**Location and Environment**

Mothers’ location and environment were factors that could affect closeness and separation while pumping, but these could also affect coping mechanisms and resources that were available. Mothers pumped in four locations: at home (n = 14), at the home of friends or family (n = 2), the infant’s bedside (n = 13) and in the NICU pumping rooms (n = 6). Mothers identified more pumping episodes as separation when they were pumping at home (n = 10).

For some, being physically separated from their infant at home contributed to feeling an emotional separation. As one explained: “I’m at home pumping… I feel isolated from our infant because we’re not there. He’s over at the hospital and we’re here and it feels strange to be doing...”
something for him when he’s not in our home” (P13). For some, they felt more separated while pumping at home without the infant when they had just visited in hospital, and felt sad picturing their infant alone in the hospital. In contrast, other mothers found home to be a more comfortable environment, where they could relax and pump. One mother recreated the environment she had when breastfeeding her previous children at home: she chose a quiet and comfortable place to pump to create the same positive and calm mindset she would have if she was with the infant.

Physical closeness was often associated with emotional closeness. For example, being able to pump at the bedside while looking at or holding the infant’s hand. “I pump my milk next to my baby’s isolette. I’m able to look at my baby. It’s a nice moment for me, I feel very close to him” (P01). Paradoxically, the desire for physical closeness could prevent mothers from pumping. One mother explained that at the hospital, she felt guilty when she had to pump instead of holding her infant. She would prefer not to pump, choosing physical closeness over pumping.

The environment also played a role, particularly privacy. In the hospital, it was possible for women whose infant was in a multi-bed pod to erect a screen to provide more privacy. Nonetheless, a few mothers still felt a lack of privacy due to comings and goings of health professionals. If they desired greater privacy, they would go to a dedicated pumping rooms away from the bedside. They also pumped in these rooms if they wished to let the nurse provide the infant’s care, take a break and relax, eat while pumping, listen to music, or talk on the phone.

Discussion

This study found that while pumping their human milk mothers did not experience only closeness with their infant or separation, but they experienced both; and for most their feelings fluctuated over the 48 hours of their participation. We observed fluctuations as participants were asked to describe each pumping session as either “closeness” or “separation”. Hurst²⁴ found that
pumping was a paradoxical experience for American mothers: the pump was both a wedge between them and their infant, as well as a link. Our study extends knowledge by revealing the dynamic nature of closeness and separation for NICU mothers. It is important to note that in our study procedures participants were asked to choose either the closeness or the separation button on the application to describe their experience at the time they made each of their recordings. However, there were some events where mothers chose one of this options but went on to describe both feelings of closeness and separation. Thus, although it seems that mothers can experience both at the same moment, our method of data collection did not allow us to fully capture this.

The current study also revealed that mothers’ experience of closeness or separation was shaped by their perceptions or cognitions about pumping, rather than the actual challenges they faced. Moreover, how mothers coped with challenges played a key role in their ability to view pumping in a positive light, and feel close to their infant. Hallowell noted that while lactation consultant availability is limited, bedside nurses are available at all times, giving them a critical role in lactation support. Furthermore, nursing support is associated with higher rates of NICU infants receiving human milk at discharge. Thus, if NICUs aim to help mothers reach their goal of breastfeeding; it is imperative that nurses help mothers find and employ ways of coping that help them manage challenges and feel close to their infant.

Previous studies have found, as we did, that some mothers consider pumping as a way to feel useful as a mother and an important step in the breastfeeding process. In contrast, other mothers deem that pumping was not like breastfeeding. As with previous studies, mothers in the present study thought that milk expression was exhausting and time consuming, and used distractions to pass the time. Relaxation techniques and listening to music
may not only help mothers cope, but can also increase the quantity of expressed milk.\textsuperscript{44, 45}

Using positive self-talk, thinking about their infant, and perceiving pumping as a way to provide for their infant were ways of coping that cast a positive light on and emphasized the importance of their efforts (Figure 2). Reframing pumping as a necessary step towards breastfeeding, integrating pumping into their life, using distractions, and seeking support made them feel that they could manage the demands of pumping. All these ways of coping boosted their motivation, and helped them feel close to their child.

Nurses can encourage mothers to surround themselves with supportive individuals as studies find that social support is associated with continued milk expression.\textsuperscript{46} Peer support has also been associated with maintaining lactation: a program of trained peer counsellors who are former NICU mothers has been shown to also foster hope and coping, and increase knowledge.\textsuperscript{47}

It is interesting that while some coping strategies described by participants supported closeness, the opposing coping behavior was associated with separation (Figure 2). For example, reframing pumping as a step towards breastfeeding was associated with coping effectively with challenges and closeness; while considering pumping as not like breast feeding was linked to feeling overwhelmed and separated. Similarly, integrating pumping into daily life was linked to coping effectively and closeness; and perceiving the demands as exhausting was linked to feeling overwhelmed and separation. Nurses are well placed to help mothers use ways of coping that help them manage the demands of pumping, and feel close. In contrast, when mothers in the current study had predominately negative perceptions of pumping and were overwhelmed by challenges, they felt separated. Many challenges encountered were related to their perceptions of pumping or internal discourse, such as having a negative perception of their milk production or considering that pumping is not breastfeeding. Hill\textsuperscript{48} found that mothers of preterm infants report
greater psychological distress and negative mood than mothers of term infants. The challenges of pumping and feeling separated might contribute to mothers’ mood and distress.

Consistent with previous studies\textsuperscript{6, 20, 38, 41, 42, 49} we found that some mothers had negative perceptions of their milk supply. These could arise due to lack of knowledge of lactogenesis and the quantity of milk that their newborn requires,\textsuperscript{20} and could be addressed by nurses with teaching. Nurses can normalize these feelings and reassure mothers that pumping is a difficult experience for most mothers. Ikonen et al.\textsuperscript{50} suggest avoiding collective-use refrigerators and using opaque milk containers so that mothers cannot compare their production to that of others. Several mothers in our study perceived they were producing too much milk, and worried excess milk might be thrown away. The possibility of donating to a milk bank could be raised.

In the current study, most mothers preferred to pump at the bedside concealed by a privacy screen as they enjoyed being physically close to the infant as this sustained their motivation, while other studies have found that they preferred to do so at home.\textsuperscript{29, 41} In other studies,\textsuperscript{6, 13, 20, 22, 41} lack of privacy was a barrier to pumping at the bedside. Unit design may account for differences in preferences across studies. Nurses need to ensure mothers’ privacy while pumping at the bedside. Acuña-Muga et al.\textsuperscript{51} found that mothers who pumped during or immediately after skin-to-skin contact produced more milk than those who pumped at the bedside or home. They also produced more if they pumped at the bedside compared to another hospital room. Thus, nurses can educate mothers about how physical proximity is beneficial for milk production. In our study, some mothers described choosing to remain in skin-to-skin contact and consequently forgoing pumping sessions. In these cases, supporting mothers to pump during skin-to-skin contact might be convenient, as well as beneficial for milk production.

\textbf{Conclusion}
Mothers often experienced both closeness and separation while pumping, and their feelings fluctuated over 48-hours. Their perception of the challenges or their cognitions concerning pumping, the coping mechanisms utilized, as well as their location and environment, played a role in whether they experienced pumping as making them feel close to or separated from their infant. Nurses can help mothers find effective coping mechanisms to feel close to their infant. They can motivate mothers to continue pumping by finding ways to integrate pumping into daily life and to find support. Being aware of the challenges related to pumping, nurses can assist mothers to manage difficulties to promote closeness with their infant.

As mothers with lower socio-economic status, lower levels of education and teenage mothers are less likely to persist with breastfeeding until NICU discharge, they may benefit most from additional support and education from nurses to persist with pumping. Lactation support from nurses can take many other forms as well, including checking bottles for proper labeling and expiration, thawing milk, gathering pumping equipment and supplies, and providing education related to breast pumping, human milk or direct breastfeeding. Providing nurses with adequate education on how to support pumping mothers can have benefits such as improving their knowledge, standardizing care, increasing their advocacy for the provision of human milk, and augment the lactation support they provide; which ultimately improves NICU care. Implications for practice are summarized in Table 2.

Our study has limitations that should be considered. Coincidently, all our participants had given birth prematurely, and most were first-time parents, which may affect transferability of our findings. There was a broad range in infant postpartum age at the time of data collection, and mothers’ pumping experiences may be significantly different at postpartum day 5 compared to day 94. Infant health differences may also have played a role, and this was not explored. We did
not collect data on mothers’ actual milk production, so do not know how these shaped their pumping experience. Moreover, we did not examine maternal depressive symptoms, anxiety, and PTSD symptoms; and pumping challenges may contribute to maternal mood and vice versa.\textsuperscript{55}

This study did not explore whether mothers’ pumping experience in relation to closeness or separation varied based on their socio-demographic characteristics (i.e., educational level, ethnicity), or previous feeding experience. This would be an important avenue for future research. There is a physiological difference in hormone production between breastfeeding and pumping.\textsuperscript{56} As current evidence suggests that the hormone oxytocin is implicated in maternal stress, mood and mother-infant bonding,\textsuperscript{57} the effect of pumping on oxytocin and feelings of closeness and separation requires further investigation. In future studies, the effect of environment and location on feelings of closeness and separation during pumping should be examined more closely. This knowledge could help units make design and environment decisions to promote infant-mother closeness.


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Summary of Recommendations

What we know:

- The rates of infants in Canadian NICUs receiving breast milk are far below recommendations.
- Mothers of NICU babies who are pumping breast milk face multiple challenges while pumping for an extended period.
- Mothers use a variety of coping mechanisms to deal with the challenges of pumping breast milk.

What needs to be studied:

- Studies should examine how the environment and location affect mothers who are pumping their milk and what could be done to promote infant-mother closeness.
- Studies should examine whether the coping mechanisms described in this study significantly decrease separation and increase closeness.
- Studies need to determine whether hormone production differs between pumping and breastfeeding and how this could affect infant-mother closeness.

What we can do today:

- Assess mothers’ milk production and provide positive reinforcement.
- Help mothers identify and use ways of coping with pumping that promote mother-infant closeness.
- Offer peer support groups for NICU mothers who are pumping their milk.
- Ensure privacy at the bedside to foster closeness in mothers who are pumping their milk.

Figure titles

Figure 1. Concept Map of Closeness, Separation and Influencing Factors

Figure 2: Contrasting ways of coping
Table 1. Sociodemographic characteristics and feeding (n = 15)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mother living with partner</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>87</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td><strong>Mother Canadian citizen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td><strong>Mother’s highest level of education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Technical college</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>University</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td><strong>Mother currently working</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>86</td>
</tr>
<tr>
<td><strong>Mother visiting baby everyday</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>14</td>
<td>93</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td><strong>Time of the day when mothers visited NICU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day shift (7 a.m. to 3 p.m.)</td>
<td>11</td>
<td>73</td>
</tr>
<tr>
<td>Evening shift (3 p.m. to 11 p.m.)</td>
<td>13</td>
<td>87</td>
</tr>
<tr>
<td>Night shift (11 p.m. to 7 a.m.)</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Room type where infant currently located</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Single patient</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Multiple patients (2 - 6 infants per room)</td>
<td>10</td>
<td>67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maternal parity</th>
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<tbody>
<tr>
<td>Primiparous</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>Multiparous</td>
<td>5</td>
<td>33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pregnancy</th>
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</thead>
<tbody>
<tr>
<td>Single birth</td>
<td>13</td>
<td>87</td>
</tr>
<tr>
<td>Multiple</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Previous breastfeeding experience</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Yes</td>
<td>4</td>
<td>31</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
<td>69</td>
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</table>

<table>
<thead>
<tr>
<th>Breastfeeding attempted</th>
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<th></th>
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<tbody>
<tr>
<td>Yes</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>40</td>
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</table>

<table>
<thead>
<tr>
<th>Currently breastfeeding</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>8</td>
<td>53</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>47</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Planning to breastfeed</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>15</td>
<td>100</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Pumping method</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Hospital pump</td>
<td>14</td>
<td>93</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>53</td>
</tr>
<tr>
<td>Type of milk baby currently receiving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Breast milk</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>Formula(^2)</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Breast milk and formula</td>
<td>4</td>
<td>26</td>
</tr>
</tbody>
</table>

\(^1\) Total of percentages is more than 100 because participants could choose more than one response.

\(^2\) One infant was temporarily receiving strictly formula to rule out human milk as a contributing factor to a health issue. Mother stated that she could start giving human milk again soon.

\(^3\) Only one participant reported manually expressing at home.
Table 2. Implications for practice

<table>
<thead>
<tr>
<th>How to help mothers cope with milk expression</th>
<th>Strategies</th>
</tr>
</thead>
</table>
| Support and maintain mothers’ motivation     | • Remind mothers to keep their goal of breastfeeding in mind  
|                                               | • Encourage mothers to hold an object that belongs to the baby (blanket, clothes) while pumping  
|                                               | • Encourage mothers to look at pictures of their baby while pumping  
|                                               | • Teach mothers positive self-talk  
|                                               | • Provide encouragement and positive reinforcement related to pumping  
|                                               | • Explain realistic expectations for amounts of milk needed  
|                                               | • Suggest using a journal or smartphone application to track milk volumes and thoughts  
|                                               | • Inform mothers of the possibility to donate excess milk |
| Help mothers integrate milk expression into daily life | • Help mothers attain a comfortable environment in which to pump  
|                                               | • Encourage mothers to pump while they are in or right after skin-to-skin contact  
|                                               | • Find strategies to multitask while pumping (Altering a sports bra to pump hands-free)  
|                                               | • Encourage mothers to use distractions to pass the time (television, music, games, social media)  
|                                               | • Advise mothers to double pump to reduce time needed to pump |
| Help mothers obtain support for pumping       | • Organize weekly parent support groups  
|                                               | • Organize group pumping sessions  
|                                               | • Establish peer-to-peer mentoring programs |
- Encourage mothers to seek support from their nurse, partner, family, friends
- Encourage visiting family to offer pumping support to the mother

| Provide NICU facilities to meet mothers’ needs | Provide pumping rooms that can accommodate mothers alone or in groups
| Ensure privacy for mothers pumping at the bedside (Knocking, providing screens or curtains, limiting disruptions) |
Coping and feeling close

- Positive self-talk
- Think of baby
- Useful as mom
- Reframe step in BF
- Integrate daily life & use distractions
- Seek & use support
- Lack support
- Exhausting schedule
- Not like BF
- Negative perception milk production

Overwhelmed by challenges and feeling separated