DEVELOPMENT OF A TOOL TO MEASURE FACTORS

AFFECTING BREASTFEEDING IN THE NEONATAL

INTENSIVE CARE UNIT

By

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Abstract

Extensive research has been done investigating the benefits breastfeeding provides for both the baby and the mother and there is enough evidence to encourage mothers to breastfeed if possible for at least six months. Much less is known about the mother's experience with breastfeeding in general and in specific situations, like in the NICU. The studies previously completed on barriers to breastfeeding in the NICU have identified several barriers that mothers trying to breastfeed may face (Boucher, Brazal, Graham-Certosini, Carnaghan-Sherrard, & Feeley, 2011; Callen, Pinelli, Atkinson, & Saigal, 2005; Myers & Rubarth, 2013). There have also been several tools developed measuring the experience, self-confidence, and motivation of mothers trying to breastfeed (Cleveland & McCrone, 2005; Leff, Jefferis, & Gagne, 1994; Wheeler & Dennis, 2012). There has yet to be a tool developed to measure specific barriers faced by breastfeeding mothers in the NICU, which is what this study aims to accomplish.

This literature review is the first step in developing a tool that can measure the barriers to breastfeeding in mothers with an infant in the NICU. The tool was developed using a pilot study that included cognitive interviewing and will be followed by a larger study including 380 participants. The tool's psychometric properties will be analyzed and the predictive validity of the measure will be evaluated by the feeding method used at discharge. With success, this tool can be used widely to help eliminate barriers for mothers globally.

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Introduction

Breast milk is the best form of nutrition for infants in the first six months of life because it is easy to digest, helps fight against disease, decreases the likelihood of the infant developing allergies, improves cognitive function, and enhances the mother-child bond (U.S. Department of Health and Human Services [USDHHS], 2011). Formula-fed infants tend to have a higher risk of developing necrotizing enterocolitis, respiratory tract infections, obesity, asthma, type 1 and 2 diabetes, and childhood leukemia (USDHHS, 2011). Breastfeeding has also been associated with a lower risk of sudden infant death syndrome. The unique composition of breast milk is not entirely understood, but it is widely accepted that breast milk is the best nourishment for the newborn. For this reason, the World Health Organization and the United Children's Fund launched the Baby-Friendly Hospital Initiative (BFHI). This initiative is aimed at promoting breastfeeding by giving mothers necessary information and training to be successful (Baby Friendly USA, 2012).

Mothers can face many obstacles when trying to breastfeed, one of which is having an ill or preterm baby admitted to the neonatal intensive care unit (NICU) directly after birth. Mothers in these circumstances may face challenges that other mothers do not. These include the limited privacy of the unit, physical separation from the infant, and the strict feeding routine that is maintained in the hospital (Alves, Rodrigues, Fraga, Barros, & Silva, 2013). This study aims to develop a valid and reliable tool to measure barriers as well as facilitators that mothers are confronted with when trying to breastfeed their infant in the NICU. With a reliable tool to measure and identify factors that affect mothers trying to breastfeed, healthcare providers will be able to address some of these barriers,

while enhancing the facilitators, to improve breastfeeding outcomes. The specific clinical question being researched is: *Do mothers with babies in the NICU encounter additional barriers and facilitators to providing their infants with breast milk via breastfeeding or breast pump during their stay in the NICU compared to mothers with healthy infants who are discharged home within 48 hours of delivery?*

Theoretical Framework

The theoretical framework used as the foundation of this research is Nola Pender's Health Promotion Model (HPM) (Pender, 2011). This theory seeks to explain the process behind a person choosing to engage in health promoting behaviors. These behaviors may be aimed at preventing illness, such as getting a vaccine, or they may simply be intended to better a person's overall health, similar to someone who is a healthy weight but still exercises regularly to promote optimal health. Pender suggested that personal experiences and expectations shape your actions. This model assumes that people are actively seeking to regulate their own behaviors and that health professionals have an influence on people's perceptions and actions throughout their life (Pender, 2011, p. 5).

The HPM has three main focuses: individual characteristics and experiences, behavior-specific knowledge and affect, and behavioral outcomes (Pender, 2011, p. 4). While individual characteristics and experiences cannot be altered to change a person's perceptions about a behavior, the variables for behavior-specific knowledge and affect can be influenced by a nurse or other healthcare provider's actions. These variables have a significant influence on a person's motivation to complete an action. Reaching the

health promoting behavior requires commitment to a plan of action and no competing demands that may lead to deviation from that plan.

Theoretical and Operational Definitions

There are several factors affecting a mother's breastfeeding experience with her baby in the NICU that align the HPM described above. Individual characteristics of the mother may include age, race, parity, marital status, socioeconomic status, and educational experience. Prior related behavior is defined as "frequency of the same or similar health behavior in the past" (Pender, 2011, p. 4). In the current study this is exemplified by a mother who has successfully breastfed a previous child. These women may have different perceptions and confidence regarding their breastfeeding ability than women who have never tried to breastfeed before.

Behavior-specific cognitions and affect include factors that are crucial to this study. Perceived benefits of action are defined as "perceptions of the positive or reinforcing consequences of undertaking a health behavior" (Pender, 2011, p. 4). Women who have been educated on the benefits of breastfeeding for their babies as well as for themselves can see the positive outcomes of this action, and this is often the basis for their motivation to breastfeed. Breastfeeding is also a much cheaper option than buying formula. Perceived barriers to action are "perceptions of the blocks, hurdles, and personal costs of undertaking a health behavior" (Pender, p. 4). Women may have different ideas about what could inhibit or make breastfeeding more difficult, including inadequate milk supply and the inability of their baby to latch on to the breast. They may fear breastfeeding will be painful or they may be embarrassed to breastfeed in public or even around friends or family.

An important variable that has been studied extensively in regards to breastfeeding is self-efficacy (Dodt, 2008; Gregory, Penrose, Morrison, Dennis, & MacArthur, 2008; Karen, William, & Dennis, 2013; McCarter-Spaulding & Dennis, 2010; Wheeler & Dennis, 2012). Perceived self-efficacy is defined as "judgment of personal capability to organize and execute a particular health behavior; self-confidence in performing the health behavior successfully" (Pender, 2011, p. 4). Past experiences with breastfeeding influence success, such as friends who were able to breastfeed successfully. If the woman has not been exposed to people that have been able to breastfeed, then she may doubt her own abilities. This factor in particular has been shown to have a significant influence on whether a woman is still breastfeeding six months after discharge.

Activity-related affect is defined as "subjective feeling states or emotions occurring prior to, during, and following a specific health behavior" (Pender, 2011, p. 4). This is often times related to the emotional connection a mother feels when she is breastfeeding her infant. Breastfeeding is a bonding experience and a form of care that only the mother can provide. Interpersonal influences are "norms, social support, role models—perceptions concerning the behaviors, beliefs, or attitudes of relevant others in regard to engaging in a specific health behavior" (Pender, p. 4). This concept includes the health care providers who can be very influential on a person's course of action. If the people surrounding them are supportive, informative, and motivational, the mothers will be more likely to take action. Situational influences are defined as "perceptions of the compatibility of life context or the environment with engaging in a specific health behavior" (Pender, p. 4). In this study, the greatest situational influence in question is the

NICU. Having a baby admitted to the NICU versus one who is discharged after a couple days is a situational change that may have a huge influence on breastfeeding.

Reaching a health promoting behavior requires commitment to a plan of action, which is "intention to carry out a particular health behavior including the identification of specific strategies to do so successfully" (Pender, 2011, p. 4). In order to breastfeed in an environment like the NICU, it is important to be committed to the action. The baby needs to be breastfed roughly every three hours so the mother needs to plan her schedule around being available to feed the infant or pump enough milk to supply the baby when she cannot be present. The last factor that can affect completing an action is the presence of immediate competing demands or preferences, which are "alternative behaviors that intrude into consciousness as possible courses of action just prior to the intended occurrence of a planned health behavior" (Pender, p. 4). These could be several different things and cannot usually be predicted. Some examples could be the woman's husband got laid off at work and she needs to go back to work to support the family or another child gets sick and the mother cannot be at the hospital to breastfeed as often as she needs.

There are several variables outlined in the Health Promotion Model that will affect a woman's decision to breastfeed, all of which can pose barriers to breastfeeding in the NICU. The literature reviewed for this study highlights several of these variables discussed previously.

Review of Literature

The Benefits of Breastfeeding

Breastfeeding has become widely accepted as the paramount form of nutrition for newborns in their first six years of life (USDHHS, 2011). A myriad of research studies have been conducted to support this claim. A search of CINAHL Complete, MEDLINE, ProQuest Nursing & Allied Health Source, and EMBASE was conducted in order to find research supporting the beneficial aspects of breastfeeding. Search terms included "breastfeeding" AND "benefits".

An article published in *The American Journal of Clinical Nutrition* provided a detailed look at the proteins present in human milk and their beneficial functions for the infant (Lönnerdal, 2003). Several proteins assist with the digestion, absorption, and utilization of micronutrients and macronutrients found in the milk. For instance, the protein lactoferrin binds to iron and accounts for much of the infant's iron uptake and utilization. Several other proteins facilitate vital nutrients' absorption in similar ways. Immunoglobulins, as well as other proteins, provide antimicrobial activity for the infant by inhibiting the growth of several pathogens. Breast milk also provides protection from pathogens by acting as a probiotic and increasing the growth of beneficial bacteria, thus lowering the pH, in the infant's gut. Proteins such as cytokines and lactoferrin also stimulate the infant's defense against disease indirectly through their anti-inflammatory effects on the body. Lastly, many of the proteins found in human milk stimulate the growth and maturation of the digestive system. The wide range of proteins found in breast milk serve many vital functions in the newborn, including aiding in digestion,

defending against pathogenic bacteria and viruses, and enhancing the development of the gut.

Necrotizing enterocolitis (NEC) is a condition where areas of the intestines die, causing significant morbidity and mortality, in 3-10% of very low birth weight (VLBW) infants (Sisk, Lovelady, Dillard, Gruber, & O'Shea, 2007). The claim that breast milk is associated with lower rates of NEC has been widely researched and supported (Lucas & Cole, 1990; McGuire & Anthony, 2003; Schanler, Lau, Hurst, & O'Brian Smith, 2005; Schanler, Shulman, & Lau, 1999). Sisk et al. (2007) wanted to determine whether high proportions (50% or greater) of human milk in the infant's diet in the first 14 days of life are protective against NEC. The study consisted of 202 infants who were born at Forsyth Medical Center between May 2001 and August 2003. These infants weighed between 700 and 1500 grams at birth, putting them in the VLBW category. Of these infants, 46 received enteral feedings in the first 14 days of life containing less than 50% human milk, while 156 received 50% or greater of human milk in these feedings. The results indicated that infants who received at least 50% human milk in their feedings in the first 14 days of life experienced a six-fold decrease in the instances of NEC compared with the group receiving less than 50% human milk, indicating breast milk's protective factor against the condition.

Breastfeeding has been linked to lower obesity rates in children and adolescents. Moss and Yeaton (2014) conducted a study to look at the relationship between breastfeeding, the introduction of solid foods, and obesity at ages two and four. A sample size of 7,000 children was obtained from the Early Childhood Longitudinal Study-Birth Cohort, which represented the generalized U.S. population of children born in 2001. Each

child's height and weight measurements were taken at the two and four year mark, and then their body mass percentile was calculated. Children with percentiles below 85 were considered to be a healthy weight, while those between 85 and 94 were considered overweight, and those above 94 were considered obese. At nine months and then at two years, mothers were asked about their breastfeeding status and if they had ever breastfed their child. This split the sample into two groups: those who had breastfed and those who had not. The last groups provided the opportunity to measure the timing of the introduction of solid foods to the infant's diet: less than four months, between four and five months, and six months or greater. This distinction was made based on the American Academy of Pediatrics' recommendation that solid foods should be introduced no earlier than four months and ideally after six months (Moss & Yeaton, 2014). The study found a significant positive influence of breastfeeding and delayed introduction of solid foods (later than four months of life) on the child's healthy weight status at two and four years old. Children who were not breastfed had a higher instance of obesity at two and four years compared to those who were breastfed.

In addition to providing numerous benefits for the infant, breastfeeding also has maternal benefits that can't be overlooked. An article published by Godfrey and Lawrence (2010) outlines many of the researched benefits that breastfeeding provides for the mother. There is some evidence suggesting that the benefits for mothers who breastfeed for at least one year include decreased rates of postpartum depression, breast cancer and other reproductive cancers, type 2 diabetes, cardiovascular disease, and rheumatoid arthritis (Godfrey & Lawrence, 2010). With these benefits for both the

mother and infant in mind, there has been an effort to increase breastfeeding rates in the United States and around the world.

One of the efforts towards increasing breastfeeding rates among newborns was the international Baby-Friendly Hospital Initiative (BFHI) created by the World Health Organization. This initiative's goal was to equip hospital personnel with the necessary knowledge and skills to improve breastfeeding rates among their patients (Baby Friendly USA, 2012). The BFHI was originally designed for healthy infants. With this in mind, Diane Spatz created the *Ten Steps for Promoting and Protecting Breastfeeding for Vulnerable Infants* using the principles of the BFHI. The Ten Steps were then implemented by a group of researchers over a three-year period in an urban Level III NICU (Fugate, Hernandez, Ashmeade, Miladinovic, & Spatz, 2015). A Level III NICU is capable of taking care of the sickest neonates. The results of this implementation program were highly successful, as there was "significant improvement in the percentage of mothers expressing their milk within six hours of delivery, infants receiving MOM [mother's own milk] at initiation of feeds, and the percentage of mothers with hospital-grade pumps at discharge" (Fugate et al., 2015, p. 434). The researchers assessed parents' satisfaction with the nurses' support of the mother's efforts to breastfeed with the Press Ganey satisfaction survey. These results indicated that satisfaction also improved with the implementation of the Ten Steps (Fugate et al., 2015). This study creates a template, which other organizations can follow to further assess the success of the Ten Steps model.

Barriers to Breastfeeding

  A search of CINAHL Complete, MEDLINE, ProQuest Nursing & Allied Health Source, and EMBASE was also conducted in order to find studies reporting barriers encountered by mothers when initiating and continuing breastfeeding in the NICU setting. Search terms included "breastfeeding" AND "barriers" AND "neonatal intensive care". One systematic review that evaluated seven articles and three additional qualitative studies are discussed.

  One qualitative descriptive study was aimed at taking the extensive research compiled on the benefits of breastfeeding and trying to analyze the real world experiences by mothers who are breastfeeding babies admitted to the NICU (Boucher, Brazal, Graham-Certosini, Carnaghan-Sherrard, & Feeley, 2011). The researchers recruited a convenience sample of 10 mothers with babies in a Level III NICU. Only breastfeeding mothers who spoke English or French with babies in the NICU for at least five days were included. Data were collected through semi-structured audiotaped interviews, utilizing main guiding and open-ended questions to allow for the mother to express in detail her experience with breastfeeding. Following each interview, nonverbal behaviors were recorded by the interviewer as well. Ideas from the interviews were grouped together in categories that were reviewed for validity and repetition.

  The categories describing the maternal experience in terms of barriers faced were maintaining milk production and the regimen of the NICU. Mothers were constantly worried that their milk production would not be able to keep up with their baby's needs. They also felt that the NICU was not conducive to successful breastfeeding because of the strict feeding schedule that didn't reflect the infant's nutritional needs and hunger

cues. Infants were being woken up to feed when they weren't necessarily hungry. This interruption in their sleep led to unsuccessful breastfeeding because the infant was too tired. These findings are clinically important as they provide insight into the maternal experience in the NICU and can help nurses better provide care for both the patients and their mothers.

Several limitations to this study include the heterogeneity of gestational age at birth of the infants in the study, the exclusion of ethnic minorities who didn't speak English or French, and the one-time nature of the interview that excluded any evolution of experiences throughout their stay.

An additional study utilizing surveys given to mothers and healthcare workers in the NICU identified several barriers to breastfeeding (Myers & Rubarth, 2013). Mothers (n=15) and staff members (n=45) responded to the survey. While the mothers reported finding many benefits to breastfeeding their infant, the NICU still presented many barriers. Some of the barriers included not enough time with the lactation consultant, insufficient availability of breast pumps in the unit, too much time consumed by pumping, having premature or ill infants, the long length of the infant's hospital stay, separation from their infant, and the challenges of returning to work. The staff's perspective barriers included several similarities, such as not enough lactation help, having preterm or ill infants, the low availability of breast pumps, the time required for pumping, separation of the mother and infant, and the long length of hospital stay. Additional barriers reported by the staff included a lack of consistent information on helping mothers to breastfeed, inadequate education for the nurses, unavailability of the mother, maternal stress, nurse discomfort, maternal discomfort, the assigned feeding

volumes, and the use of formula supplementation. Using these findings, the researchers made some recommendations for practice that would eliminate a few of these barriers. These included providing an earlier emphasis on breastfeeding, providing skilled lactation support, ensuring an adequate availability of breast pumps, increasing educational opportunities for NICU staff, and providing more support systems of breastfeeding mothers. The small sample size of this study provokes a need for further research.

A study examining barriers to establishing and maintaining breastfeeding in very-low-birthweight (VLBW) infants found that the primary barriers change over time (Callen, Pinelli, Atkinson, & Saigal, 2005). This quantitative study was a secondary analysis of a previously completed randomized control trial and it examined the barriers to breastfeeding that mothers of infants weighing less than 1500 grams at birth faced both in the hospital and after being discharged home. The secondary data analysis found that the biggest barrier to successful breastfeeding at the time of discharge from the NICU was low milk volume, followed by the mother's emotional stress. Following discharge, poor breastfeeding technique was the greatest barrier at one month post discharge followed by compromised physical status of the infant assessed at three months post discharge. The results of this secondary data analysis indicate the need for tailored supportive care for the mother and the infant based on the needs at the time of discharge and following discharge to home.

A systematic review was conducted to integrate what has been found regarding factors that help or hinder breast milk supply in neonatal intensive care units (Alves, Rodrigues, Fraga, Barros, & Silva, 2013). The biggest barriers to breastfeeding were

unique to the NICU environment, namely the stressful nature of the NICU, the lack of privacy, the physical separation from the infant, and the structured feeding routine. A lack of consistent encouragement from healthcare workers was also seen as a barrier. Lastly, although social background did not play a significant role in the parents' experiences with breastfeeding, a lack of role models and/or social support and competing demands served as minimal barriers to breastfeeding.

The researchers identified several limitations in this systematic review. First, only one article defined breastfeeding, which may have allowed different interpretations of the word to make comparisons between articles difficult. Heterogeneity regarding the number of participants, the timing of data collection, and the eligibility criteria also made comparison between studies challenging. Finally, the lack of quantitative research on this particular subject should be addressed by future studies to develop a wider knowledge base. The strengths identified included the use of extensive search efforts, three investigators, and two methods of analysis, which all helped reassure triangulation and validation.

To supplement the research that has been collected evaluating the mother's perception of her breastfeeding experience in the NICU, one study looked at the implementation of the Baby-Friendly Hospital Initiative (BFHI) from healthcare professionals' point of view (Benoit & Semenic, 2014). This qualitative, descriptive study utilized interviews of 10 medical and nursing managers, nurse educators, lactation consultants, and neonatal nurse practitioners employed at two Level III NICUs in Canada. Staff reported similar barriers to assisting mothers in breastfeeding as the mothers reported. These barriers included the infant's health status and the mother's

physical separation from the infant. Staff also reported large workloads and varying work patterns, gaps in their knowledge and skills regarding breastfeeding, and an inconsistency in breastfeeding support among different members of the healthcare team. Despite these barriers, the staff valued the BFHI and identified several recommendations to increase its success, including better staff education, increased access to lactation consultants, and creating a team of NICU employees that are dedicated to implementing the BFHI.

Despite the many barriers to breastfeeding in the NICU, there are facilitators to the successful breastfeeding of mothers of ill infants in the NICU. The following section of the literature review examines the facilitators of breastfeeding in the NICU.

Facilitators of Breastfeeding

Boucher et al. (2011) explored the breastfeeding experiences of 10 mothers of infants in a Level III NICU using individual interviews. In addition to the barriers they identified, they also found many facilitators to breastfeeding in this environment. These factors were the mother as learner, personal motivation, and forming attachments. The women felt that the nurses were very helpful in providing information about breastfeeding techniques and encouraging them to continue trying. The women reported a high level of personal motivation due to their knowledge about the benefits of breastfeeding and the health status of their baby. Lastly, they viewed breastfeeding as one of their only opportunities to bond with their infant because of the limited physical contact they had with their baby in the NICU. These findings indicate that it is crucial to provide consistent and continuous support to new mothers as they try to overcome the many barriers that breastfeeding in the NICU presents.

Alves et al. (2013) identified factors that encourage breastfeeding. Several of these facilitators were related to the parents' perception of their breastfeeding experience and included the contribution to the infant's growth and wellbeing, the sense of "normality" associated with breastfeeding, the opportunity it provided to hold and connect with the infant, the chance to learn about the techniques of breastfeeding, and the infant's feeding cues. Positive, consistent, and continuous feedback from healthcare professionals was found to be another important facilitator to breastfeeding in the NICU. The clinical significance of these findings is the role that healthcare workers should play in the initiation and maintenance of breastfeeding in the NICU. The relationship between the parents and the health workers is vital in fostering a positive environment in order for breastfeeding to be successful. The parents need adequate teaching, motivation, and support throughout their time in the NICU.

Dweck et al. (2008) evaluated how the presence of a lactation consultant in the NICU affects the percentage of babies who receive human milk during their hospital stay and at discharge. Their study was a retrospective chart review of three time periods identified by their relation to the hire of a certified lactation consultant (LC). The first three-month period (T1) was prior to the LC's hire, the second three-month period (T2) was immediately following the LC's hire, and the third three-month period (T3). The infants that showed a significant increase in receiving human milk was identified as the outborn group because who were born another hospital and were transferred to the NICU in the study. Overall, the percentage of infants receiving human milk during their stay in the NICU increased from 55% in T1 to 69% in T3. Additionally, the percentage of babies discharged on a diet including human milk increased from 47% in T1 to 59% in T2. The

most significant increase was noted in T3, likely because this period began three months after the hire of the LC, which allowed for her services to be utilized and her education programs to be implemented. The use of LCs in NICUs seems to be a significant facilitator for mothers trying to provide their infants with breast milk.

In order to effectively measure the barriers and facilitators to breastfeeding in the NICU tool development is warranted; however, there are no tools specifically measuring this construct. The next section in the review of the literature is focused on those tools, which do exist to measure breastfeeding experiences in the NICU.

Breastfeeding Tools

The same databases were used to search and synthesize the literature as above using the terms "measure" OR "tool" AND "breastfeeding". Several studies describing a single tool development were identified as well as a systematic review. A comprehensive look at the breastfeeding tools can be found in Appendix A, Table 1.

The Breastfeeding Self-Efficacy Scale (BSES) was developed to assess a mother's confidence in her ability to breastfeed (Wheeler & Dennis, 2012). The tool contained 33 items that were measured on a five-point Likert-type scale ranging from not at all confident to always confident. Following a pilot test with 130 breastfeeding women in Canada, psychometric testing was done and a Cronbach's alpha coefficient of 0.96 for reliability was reported. Investigators also found that 73% of all corrected item-total correlations ranged from 0.30 to 0.70. Support for predictive validity was shown through a positive correlation between BSES scores and the infant's feeding method at six-weeks postpartum.

One of the most widely researched tools related to breastfeeding is the Breastfeeding Self-Efficacy Scale-Short Form (BSES-SF) (Dennis, Heaman, & Mossman, 2011; Dodt, 2008; Gerhardsson, et al., 2014; Gregory, et al., 2008; Karen, William, & Dennis, 2013; McCarter-Spaulding & Dennis, 2010; Wheeler & Dennis, 2012). The BSES-SF was developed after finding that the original BSES had noted redundancy in several items. Eighteen items were removed using explicit reduction criteria and the new 14-item BSES-SF has been used in several maternal populations including mothers of ill or preterm infants (Wheeler & Dennis, 2012). In mothers of ill or preterm infants the scale had a Cronbach's alpha coefficient of 0.88. The majority (87%) of the item-total correlations fell between the recommended range of 0.3 to 0.7. Predictive validity was supported by the finding of significant differences in BSES-SF scores at one-week post-discharge among mothers who were still providing breast milk at six-weeks post-discharge ($M = 83.44$, $SD = 8.23$) and those who discontinued breastfeeding and breast pumping at six-weeks post-discharge ($M = 75.51$, $SD = 10.08$, $p < 0.001$).

A tool similar to the BSES-SF was developed: the Breastfeeding Personal Efficacy Beliefs Inventory (BPEBI) (Cleveland & McCrone, 2005). The researchers who developed the BPEBI remarked on the differences between their tool and the BSES-SF. The BPEBI assesses a woman's confidence in her ability to breastfeed for three months, six months, and one year, and her capability to breastfeed in different environments. In contrast, the BSES-SF is measuring a woman's confidence in her ability to breastfeed for up to sixteen weeks post-discharge. The Cronbach's alpha coefficient of 0.89 was established. A principal components analysis (PCA) with varimax rotation identified five

factors that explained 53% of the variance. These five factors were the following: the confidence to manage duration, the confidence to manage technique with social support, the confidence to manage motivation, the confidence to manage different environments, and the confidence to manage possible challenges.

The Breast-Feeding Attrition Prediction Tool (BAPT) is a measure that was developed to predict breastfeeding cessation in mothers (Janke, 1994). The instrument's Cronbach's alpha was 0.80. PCA with varimax rotation identified a four-factor solution was that explained 35.1% of the variance. These factors were as follows: negative breastfeeding sentiment, social and professional support, breastfeeding control, and positive breastfeeding sentiment.

The Breast Milk Expression Experience Measure (BMEE) assesses three areas of a woman's experience: social support for milk expression; ease of learning how to express milk; and personal experiences of milk expression (Flaherman, et al., 2012). The Cronbach's alpha for the BMEE overall was 0.703. The measure showed good predictive validity; among the mothers who had a mean score less than three on the measure, which indicated a less than satisfactory experience, only 33.3% were expressing milk at one month compared to 80.4% of mothers with a mean score of at least three.

The Breastfeeding Motivational Measurement Scale (BMMS) was designed to measure motivational complexity and the difference between first time mothers and experienced mothers (Stockdale, Sinclair, Kernohan, McCrum-Gardner, & Keller, 2013). PCA with oblimin rotation identified three main factors with significant internal consistencies as shown by alpha values of 0.96, 0.85 and 0.84. These factors were total value of breastfeeding, perceived midwife support, and expectation of success.

The Maternal Breastfeeding Evaluation Scale (MBFES) was developed to measure certain aspects of breastfeeding that have been found to define successful breastfeeding (Leff, Jefferis, & Gagne, 1994). This tool was developed based on results from previous qualitative studies. Exploratory factor analysis identified three factors that accounted for 38.5% of the variance in the original 56-item tool. These factors were maternal enjoyment/role attainment, infant satisfaction/growth, and lifestyle/maternal body image. This measure was then reduced to 30 items based on the original factor analysis. The Cronbach's alpha for the revised scale was 0.93.

The Supportive Needs of Adolescents Breastfeeding Scale was created to measure ways that healthcare workers can encourage breastfeeding in this younger population (Grassley, Spencer, & Bryson, 2012). The content validity index was 0.82 and the alpha coefficient was 0.83. Principal components analysis resulted in a three-factor scale that explained 48% of the variance. The factors were the following: taking the time to help me breastfeed my baby, taking the time to talk with me about breastfeeding, and miscellaneous items about engaging the adolescents' support system and providing immediate skin-to-skin care.

A systematic review identified eight self-report instruments that have been developed to test the attitudes, satisfaction, experiences, and confidence toward breastfeeding (Ho & McGrath, 2010). They include the Gender-Role Attitudes toward Breastfeeding Scale (GRABS), the Iowa Infant Feeding Attitudes Scale (IIFAS), MBFES, BSES, BSES-SF, BPEBI, BAPT, and BAPT (refined). The researchers found the tools to be valid, reliable, and feasible measurements of different aspects of breastfeeding, including recognizing women who are at risk of early termination of

breastfeeding. One area for improvement that was identified was the need for a more diverse sample. Most of the studies describing the development of these tools were conducted in the United States with a fairly homogenous sample of white, educated, middle-class women. As a result, there is a lack of representation of the general population and may exclude important cultural diversity that could be relevant to the effectiveness of the tools. An important indication for further research identified in the review is in interventional measures that can be taken in healthcare settings once a woman is thought to be at risk for early cessation of breastfeeding is recognized.

There has been extensive research completed regarding the benefits of breastfeeding, the barriers and facilitators of breastfeeding in the NICU environment, and the development of tools to measure various aspects of breastfeeding. However, there is currently no tool that measures both the barriers and facilitators of breastfeeding in the NICU. Because previous studies have been mostly qualitative in nature, there is a plethora of literature on the facilitators and barriers facing women in the NICU. There is a large gap in this literature, which could be addressed by taking this information and developing a tool to quantitatively measure these barriers and facilitators. This tool should be consistent among large sample sizes so it can help healthcare workers identify the barriers and facilitators of breastfeeding in their facility. Once these have been discovered, further steps can be taken to help encourage mothers to breastfeed, provide them with the necessary knowledge and skills to do so, and eliminate those factors that are preventing or hindering their success.

The purpose of the current study is to develop a valid and reliable tool that measures both the barriers and facilitators in mothers of infants in the NICU.

Methods

Sample and Setting

Participants were recruited from the pool of mothers whose babies were admitted to the neonatal intensive care unit at Texas Health Harris Methodist Fort Worth (THHM-FW). Recruitment of mothers of infants in the NICU was done throughout the infant's hospital admission to elicit their input into the constructs representing barriers and facilitators to breastfeeding in the NICU. A brief information sheet was used to recruit participants. Because the purpose of this study is to develop a measurement instrument, our goal was to recruit sufficient participants to make factor analysis (FA) possible. General consensus is that at least 300 completed tools should be used for FA; therefore our intent was to achieve a total sample of 380. This number includes the first round of tool administration designed to obtain participants for cognitive interviewing, a second round of tool administration designed to obtain tools for reliability and validity analysis, and 10% waste tools.

Any mother age 18 years or older whose infant is in the NICU, regardless of birth weight and gestational age, was eligible for participation in this study. The tool has been developed in English first; therefore any mother who could read and comprehend English was eligible to participate. Mothers who were unable to read English were excluded.

Procedure

Through this psychometric study, the researchers developed an English instrument for measuring perceived barriers and facilitators to breastfeeding or pumping breasts in the NICU environment, which can be found in Appendix A. Institutional Review Board (IRB) approval for human subject research was obtained through THHM-

FW. IRB approval was also obtained from Texas Christian University for nursing honors student engagement in this project. To avoid coercion, each potential participant was informed that her participation in this study would not influence the care her baby received. Furthermore, potential participants were not paid. Mothers gave verbal consent for participation in this study after she was informed and demonstrated that she understood the procedures she was going to be involved in during the study. Cognitive interviews were conducted with a subset of participants to assess clarity and comprehension of the tool. It was then revised based on results of the cognitive interviews. The next step in the process will be to administer the tool to participants over a period of roughly 12 months, or the amount of time it takes to acquire 380 participants. This study is ongoing and currently data is still being collected.

No sensitive information was elicited on the questionnaire. Private health information (PHI) in the form of the medical record (MR) number of the participant's baby was collected and stored until the baby was discharged, but was then destroyed according to hospital policy. When the MR number was removed from the questionnaire, the only link between the identity of the mother and participation in the study was the consent form; therefore only verbal consent was obtained, using the study information sheet as an altered consent form. The research team complied with HIPAA regulations and protected confidentiality of the participants.

Psychometric analysis will be performed after all the data is collected. Internal consistency of the FaB-NICU questionnaire will be assessed by calculating Cronbach's alpha for the entire questionnaire. Internal structure of the questionnaire will be assessed by means of factor analysis. Associations between selected item scores and total scores

on the questionnaire and breastfeeding status at discharge will be assessed by multivariable analysis (selected item scores) and correlation (total score) and will be used to evaluate predictive validity of the questionnaire. A sample size of 193 achieves 80% power to detect a difference of 0.2 between the null hypothesis correlation of r = 0 and the alternative hypothesis correlation of r = 0.20 using a two-sided hypothesis test with a significance level of p = 0.05. However, to perform factor analysis we wish to enroll at least 380 participants. Power is not applicable for the internal consistency calculation.

Results of Cognitive Interviews

The purpose of conducting cognitive interviews in tool development is to ensure that the items in the tool are being comprehended by respondents the way the developers intended them to be (Izumi, Vandermause, & Benavides-Vaello, 2013). The interview questions are aimed at understanding the cognitive processes that readers undergo when they look at each tool. This ensures that when the tool is administered to the population in question in order to analyze its psychometric properties, the tool will be as clear as possible. The questions used in for cognitive interviewing purposes in this study can be found in Appendix B.

Cognitive interviews were conducted with eight mothers of infants in the NICU at THHM-FW. One of the components of the tool that was deemed important in the interview was the way mothers would respond to an item that they felt wasn't true for them. Investigators wanted to ensure that mothers were only using the scale measurements if the item was true for them. If the item was untrue for them, they should mark N/A rather than "0-Has no effect at all". Through cognitive interviewing,

investigators found that mothers understood this principle without the need for explanation.

Some of the items of the tool were revised to better align with the intended meaning. For instance, the item "In my circle of friends, there are women I admire who breastfeed their babies" was changed to "I admire women who breastfeed their babies". Investigators found that the addition of "In my circle of friends" didn't add anything to the statement and it was better comprehended if removed. Investigators also found some questions that were comprehended as very similar by the mothers and the investigative team was able to determine the better question and remove the other. This brought the tool from initially having 40 items to the revised 32-item version.

Discussion

As this study is ongoing and no results have been obtained currently, it is necessary to reflect on the learning experience this research project has provided. The student investigator was able to conduct a comprehensive literature review that provided insight into the benefits of breastfeeding, the barriers and facilitators to breastfeeding in the NICU, and current tools that have been developed to measure various aspects of the breastfeeding experience.

The benefits of breastfeeding have been widely researched and accepted. For this reason, the World Health Organization has launched the BFHI to encourage all mothers to breastfeed their infants. Breastfeeding provides many benefits for the infant, including improved digestive functioning, improved immunity, improved neurological functioning, and decreased risk of developing NEC. Breastmilk has also been linked to decreased obesity rates for the infants later in life. Additionally, breastfeeding has been shown to

have positive effects for the mother as well. These include lower rates of postpartum depression, breast cancer and other reproductive cancers, type 2 diabetes, cardiovascular disease, and rheumatoid arthritis. All of these effects for the infant and the mother have made it a priority in hospitals that care for these populations to increase the rates of breastfeeding through education and the provision of the proper resources.

The research exploring the barriers to breastfeeding in the NICU also provided important insight. One study identified two main barriers: the strict feeding schedule of the NICU and the mother's concern that she couldn't produce enough milk for her baby. Another study found the barriers to breastfeeding to be a lack of time with the lactation consultant, unavailability of breast pumps in the NICU, the time-consuming nature of pumping, having premature or ill infants, the length of the infant's hospital stay, physical separation from their infant, and the challenges of the mother returning to work. A systematic review discovered the biggest barriers to breastfeeding were the stressful nature of the NICU, the lack of privacy, the physical separation from the infant, the structured feeding routine, and a lack of consistent encouragement from healthcare workers. Additional barriers found in another study included the mother's low milk volume at the time of discharge, her emotional stress, poor breastfeeding technique, and the compromised physical status of the infant.

Several facilitators to breastfeeding in the NICU were also discovered in this literature review. These included the helpful information and encouragement provided by the nurses, the mother's personal motivation, and the chance that breastfeeding provided to bond with the infant. Additionally, the parents' perception of their breastfeeding experience was an important facilitator, including their knowledge of breast milk's

contribution to the infant's growth and wellbeing, the sense of "normality" associated with breastfeeding, the opportunity it provided to hold and bond with the infant, and recognizing the infant's feeding cues. One of the most important facilitators identified is the consistent and continuous teaching on breastfeeding provided by healthcare workers.

A myriad of valid and reliable tools were also presented in the literature review. However, no tool has been developed to identify barriers and facilitators to breastfeeding in the NICU. This is a very important gap in the literature that needs to be filled in order to effectively increase breastfeeding rates in the NICU. This is a unique environment that provides specific barriers to mothers trying to breastfeed. It is also an environment full of useful resources that have the potential to promote successful breastfeeding if they can be identified and utilized effectively. The tool being developed in the current research study will provide valuable insight into the mother's perception of her experience breastfeeding in the NICU and all of the factors that encourage or inhibit her from being successful.

Appendix A

Please read the following statements about activities that include behaviors, feelings, and thoughts. Consider how much each activity influences your own decision to breastfeed your baby.

Circle the number that shows how much each activity affects your decision to breastfeed. Circle 0 if the activity has no effect on your decision to breastfeed at all. Circle 1 if the activity has a weak effect on your decision to breastfeed, and so forth. Circle NA (not applicable) if the item does not apply to you at all. For instance, the first statement refers to your partner. If you have no partner, circle NA.

For this questionnaire, **you are breastfeeding if you put your baby to the breast or if you pump your breast and feed your breastmilk to your baby through a feeding tube or bottle**.

Factors Affecting Your Decision to Breastfeed	Does not Apply to Me	Has No Effect at All	Has a Weak Effect	Uncertain/Not Sure of the Effect	Moderately Strong Effect	Very Strong Effect
1. My partner wants me to breastfeed my baby	NA	0	1	2	3	4
2. My family members take care of the house and/or other children so I can breastfeed or pump	NA	0	1	2	3	4
3. I admire women who breastfeed their babies	NA	0	1	2	3	4
4. Most women in my family breastfeed their babies	NA	0	1	2	3	4
5. Breastfeeding is uncomfortable	NA	0	1	2	3	4

Factors Affecting Your Decision to Breastfeed	Does not Apply to Me	Has No Effect at All	Has a Weak Effect	Uncertain/Not Sure of the Effect	Moderately Strong Effect	Very Strong Effect
6. It embarrasses me for other people to see me breastfeed or pump my breasts.	NA	0	1	2	3	4
7. Taking care of my other children and family distracts me from breastfeeding	NA	0	1	2	3	4
8. My milk production is not enough to feed my baby	NA	0	1	2	3	4
9. Since giving birth, I have not felt well enough to breastfeed	NA	0	1	2	3	4
10. I have a breast pump that I can use when I am away from the NICU	NA	0	1	2	3	4
11. I take breaks at work to pump my breasts	NA	0	1	2	3	4
12. I want to breastfeed my baby even after my baby gets discharged from the NICU	NA	0	1	2	3	4

Factors Affecting Your Decision to Breastfeed	Does not Apply to Me	Has No Effect at All	Has a Weak Effect	Uncertain/Not Sure of the Effect	Moderately Strong Effect	Very Strong Effect
13. I believe giving my baby even a small amount of my breastmilk is better than giving him/her supplements alone	NA	0	1	2	3	4
14. I think babies who get their first feeding by mouth from a bottle will always prefer the bottle	NA	0	1	2	3	4
15. I know that if I continue to pump my breasts regularly, I will produce more breastmilk	NA	0	1	2	3	4
16. My baby likes my breastmilk	NA	0	1	2	3	4
17. My baby gains more weight on supplements than on my breastmilk	NA	0	1	2	3	4
18. Using formula is easier than breastfeeding	NA	0	1	2	3	4
19. In the NICU, it is easier to give breastmilk to my baby in a bottle than to put the baby to my breast.	NA	0	1	2	3	4

Factors Affecting Your Decision to Breastfeed	Does not Apply to Me	Has No Effect at All	Has a Weak Effect	Uncertain/Not Sure of the Effect	Moderately Strong Effect	Very Strong Effect
20. When I cuddle my baby skin-to-skin, my milk production increases	NA	0	1	2	3	4
21. The more I know about my baby's condition, the more I want to breastfeed	NA	0	1	2	3	4
22. The lactation consultant spends enough time with me to meet my needs	NA	0	1	2	3	4
23. I get differing advice about breastfeeding from the health care professionals (doctors, nurses, lactation consultants)	NA	0	1	2	3	4
24. Talking with other mothers in the NICU who breastfeed encourages me	NA	0	1	2	3	4
25. My baby's bedside nurse helps me with breastfeeding	NA	0	1	2	3	4
26. The NICU nurses seem knowledgeable about	NA	0	1	2	3	4

Factors Affecting Your Decision to Breastfeed	Does not Apply to Me	Has No Effect at All	Has a Weak Effect	Uncertain/Not Sure of the Effect	Moderately Strong Effect	Very Strong Effect
breastfeeding						
27. My NICU nurse prefers bottle feeding over breastfeeding	NA	0	1	2	3	4
28. Pumping breastmilk in the NICU is too time consuming	NA	0	1	2	3	4
29. There is adequate space for me to put my baby to the breast or pump my milk in the NICU.	NA	0	1	2	3	4
30. Staff interventions done to my baby interrupts my breastfeeding.	NA	0	1	2	3	4
31. The busyness in the NICU prevents me from breastfeeding	NA	0	1	2	3	4
32. Having to feed my baby on a fixed schedule makes it harder to breastfeed or pump my breast.	NA	0	1	2	3	4

Appendix B

Questions for Cognitive Interview

A. For each item the interviewer may ask any of the following questions, followed by spontaneous probes as needed.

    1. What does this (word, phrase, sentence) mean to you?

    2. What do you think of when you see this (word, phrase, sentence)?

    3. Can you think of another/better way to ask this question?

    4. As you read this question, tell me what you are thinking about.

B. Conditional probe: If the subject spends more than 60 seconds reading a question, ask the following:

    1. I noticed you paused a long time on this question; can you tell me what you were thinking?

C. After administering the entire tool or the entire target section of the tool, the interviewer may ask any of the following with spontaneous probes as needed:

    1. Is there any question on the survey that bothers you?

    2. Is there anything else we should ask about on this survey?

Table 1: *Barriers & Facilitators*

Who Reported	Barriers	Facilitators
Mothers	Low milk volume	Nurses who teach breastfeeding techniques
	Strict feeding schedule of NICU	Consistent feedback and encouragement from staff
	Stressful nature of NICU	Personal motivation due to knowledge about breastfeeding benefits
	Lack of consistent encouragement from healthcare workers	Health status of baby
	Not enough time with lactation consultant	Breastfeeding as opportunity to bond with infant
	Insufficient availability of breast pumps	Contribution of breastfeeding to infant's growth and wellbeing
	Pumping is too time-consuming	Sense of "normality"
	Having an ill or premature infant	Infant's feeding cues
	Long length of infant's hospital stay	Presence of lactation consultant
	Physical separation from infant	
	Challenges of returning to work	
	Mother's emotional stress	
	Lack of role models or social support	
Healthcare Staff	Lack of consistent information on helping mothers breastfeed	
	Inadequate education for the nurses	
	Unavailability of mother	
	Maternal stress	
	Nurse discomfort	
	Maternal discomfort	
	Assigned feeding volumes	
	Use of formula supplementation	
	Insufficient lactation assistance	
	Infant's health status	

	Low availability of breast pumps	
	Time consumption of pumping	
	Separation of mother and infant	
	Long length of hospital stay	
	Large workloads and varying work patterns of staff	
	Inconsistency in breastfeeding support among different staff members	

Table 2: *Breastfeeding Measurements*

Author and Tool	What it Measures	Sample	Reliability Score
Wheeler & Dennis (2012): Breastfeeding Self-Efficacy Scale	Measures a mother's confidence in her ability to breastfeed.	A sample of 130 breastfeeding women was used.	Cronbach's alpha was 0.96.
Wheeler & Dennis (2012): Breastfeeding Self-Efficacy Scale (Short Form)	Modified version of BSES; measures a mother's confidence in her ability to breastfeed.	Convenience sample of 144 mothers whose infants required care in a Level 2 or 3 NICU. Of the original sample, 112 provided follow-up data 6-weeks post-discharge.	Cronbach's alpha at 1-week post-hospital discharge was 0.88.
Cleveland & McCrone (2005): Breastfeeding Personal Efficacy Beliefs Inventory	Measures a woman's confidence in her ability to breastfeed for three months, six months, and one year, as well as her capability to breastfeed in different environments.	A sample of 479 women randomly selected from a University was used for the study.	Cronbach's alpha was 0.89.
Janke (1994): Breast-Feeding Attrition Prediction Tool	Developed to predicts breastfeeding cessation in mothers.	The sample consisted of 201 women who had just given birth.	Cronbach's alpha was 0.80.
Flaherman, Gay, Scott, Aby, Stewart, & Lee (2012): Breast Milk Expression Experience Measure	Measures three areas of a woman's breastfeeding experience: social support for milk expression, ease of learning how to express milk, and personal experiences of milk expression.	Sample of 68 mothers enrolled in a randomized controlled trial comparing breast pumping to manual milk expression. Of these mothers, 35 were assigned to the hand expression group, and 33 were assigned to the bilateral electric breast pump group.	Five items were removed because their item-total correlation was less than 0.3. The remaining 11 items had a Cronbach's alpha coefficient of 0.703.
Stockdale, Sinclair, Kernohan, McCrum-	Measures motivational complexity and the difference between first-	Sample of 182 women, with an additional 20 women from the pilot	Substantial internal consistency for three

Gardner, & Keller (2013): Breastfeeding Motivational Measurement Scale	time mothers and experienced mothers.	study, resulting in 202 women.	factors was found: total value of breastfeeding (alpha=0.96); perceived midwife support (alpha=0.85); expectancy to succeed (alpha=0.84)
Leff, Jefferis, & Gagne (1994): Maternal Breastfeeding Evaluation Scale	Measures certain aspects of breastfeeding that have been found to define successful breastfeeding.	Original sample of 442 woman 18 years or older who had given birth within the last year. The revised scale was given to a sample of 28 women.	Cronbach's alpha was 0.93.
Grassley, Spencer, & Bryson (2012): Supportive Needs of Adolescents Breastfeeding Scale	Measures ways healthcare workers can encourage breastfeeding in this younger population.	Convenience sample of 101 adolescents, aged 15-20 years old during their postpartum stay.	Cronbach's alpha was 0.83.

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