# Evaluation of a Text Messaging Intervention for Breastfeeding Women Experiencing Breast and Nipple Symptoms

Rose Lisi
rose.lisi@uconn.edu

**Evaluation of a Text Messaging Intervention for Breastfeeding Women Experiencing**

**Breast and Nipple Symptoms**

Rose Lisi

Ruth Lucas, PhD, RNC, CLS

University of Connecticut School of Nursing

**Abstract**

Background: Nipple and breast pain while breastfeeding is a common reason why women stop breastfeeding earlier than they would have liked to. Texting is effective as a long-term intervention to support breastfeeding.

Objectives: To examine the effect of texting to support mothers to manage their breast and nipple symptoms and pain.

Method: A secondary analysis of a pilot randomized controlled trial testing the effectiveness of a breastfeeding self-management (BSM) intervention using texting to provide strategies for mothers to manage their breast and nipple pain. A three-group comparison, the intervention group with "barriers" and "non-barrier", and the control group, was conducted to determine how texting affects participant's report of breastfeeding symptoms or pain. An analysis in ANOVA and Chi-Square were conducted to determine which symptoms the intervention addressed.

Results: Women in the barrier group reported significantly increased occurrences of cracked or bleeding nipples compared to the other two groups $[F(2, 165)] = 5.685$, p = .004. Women in the non-barrier group reported significantly decreased occurrences of nipple pain compared to the women in the other groups $[F(2,165)] = 4.36$, p = .014. Both differences were significant at weeks 1, cracked/bleeding nipples $X^2$ (6, $N = 56$) = 18.375, $p > .005$; and nipple pain $X^2$ (6, $N = 56$) = 12.933, $p > .044$.

Discussion: Text messages significantly reduced nipple pain and provided strategies to significantly reduce the occurrence of cracked and bleeding nipples.

**Evaluation of a Text Messaging Intervention for Breastfeeding Women Experiencing**

**Breast and Nipple Symptoms**

Breastfeeding is one of the most effective ways to promote and ensure the healthy growth and development of an infant. It is the best source of nutrition for infants; it exclusively contains all the vitamins, nutrients, and antibodies infants need for up to 6 months (American Academy of Pediatrics, 2019). According to the Center for Disease Control (CDC), infants who are breastfed have reduced risks of asthma, obesity, type I diabetes, severe lower respiratory disease, acute otitis media, sudden infant death syndrome (SIDS), gastrointestinal infections, and necrotizing enterocolitis. Additionally, breastfeeding can lower a mother's risk of developing high blood pressure, type II diabetes, ovarian and breast cancer (CDC, 2019). However, only 1 in 4 infants are exclusively breastfed by the time they are 6 months old, as recommended by the CDC.

**Physiology of breastfeeding initiation**

Early breastfeeding is pivotal for establishing and maintaining milk so that mothers and infants receive short- and long-term health benefits from breastfeeding. Breastfeeding reduces the risk and incidence of short- and long-term diseases in infants and improves health outcomes. Breastfeeding protects against childhood infections, increases intelligence, and reduces childhood obesity and diabetes (Victoria et al., 2016). In the first few weeks postpartum, breastfeeding is extremely important and necessary for the mother's milk supply. Lactation is maintained by the emptying of milk from the breast and stimulation of the nipple, by either the infant or a pumping system. This stimulates the release of the hormones prolactin and oxytocin. These hormones work individually, however, their combined effect is necessary for milk production and ejection. The more the breast is stimulated, the more oxytocin and prolactin are released, and the more milk is produced. Once lactation has begun and is maintained, greater

volumes of milk in the woman's breast occur in response to the growing infant's feeding patterns. This is why it is so important to begin breastfeeding right after delivery; the earlier the breast is stimulated, the easier production and maintenance of milk will be (Pillay & Davis, 2019).

Why do mothers not breastfeed their infants, or why do they stop early? Based on data from the CDC, 60% of mothers stop breastfeeding sooner than they had hoped. Factors that influence how long babies breastfeed include hospital practices, breastfeeding education and support, policies in women's place of work, and access to support after discharge from the hospital (CDC, 2019).

**National and International Initiative to Support Breastfeeding**

In 1991, to provide support right after delivery, the World Health Organization (WHO) in collaboration with the United Nations Children's' Fund (UNICEF) developed the Baby-Friendly Hospital Initiative (BFHI) to address, promote, and encourage breastfeeding. The BFHI consists of 10 steps to support successful breastfeeding. This initiative aims to encourage the use of support groups and supportive outlets in the mother's life (UNICEF, 2005). The BFHI in the hospital can lead to long term breastfeeding success as well. One study collected data from 34 randomized trials comparing mothers receiving standard breastfeeding care to those receiving extra care for breastfeeding. This study reviewed different interventions to promote breastfeeding duration. The study found that mothers who had professional support breastfed longer than those mothers who did not have any support. The mothers who had BFHI support, that continued after discharge, had longer breastfeeding duration compared to those moms who did not have BFHI support (Britton et al., 2007).

**Barriers to Breastfeeding After Discharge**

After delivery, 30% of women stop breastfeeding within the first two weeks (CDC, 2019). Even with the BFHI, women experience barriers after they return home. In 2013, Odom et al. reported that women stop breastfeeding earlier than they had hoped due to three reasons. The three reasons for early cessation of breastfeeding was associated with difficulties with lactation (pain, lack of adequate milk volume) and processes associated with breastfeeding, such as milk-pumping issues. Because some of these issues were so general, the study concluded that continued professional support after discharge is necessary to address each mother's individual challenges with breastfeeding. These interventions would support mothers in meeting their breastfeeding duration goals (Odom et al., 2013).

Currently, there are many interventions to improve breastfeeding outcomes. Many studies have been done to determine the most effective interventions. A systematic review of 27 randomized controlled trials showed that the most effective interventions were multi-component and included the primary strategy as the BFHI in the hospital. Interventions should start in the prenatal period when mothers first become involved in their hospital community (Kim et al., 2018). Another meta-analysis showed a link between breastfeeding self-efficacy and breastfeeding outcomes. A positive link was identified, as mothers who were in the intervention group had higher breastfeeding self-efficacy than those who did not. Breastfeeding self-efficacy, such as encouragement and support, is a targetable factor that can be modified by healthcare workers (Brockway et al., 2017).

One form of support that would be easily accessible for mothers in their home is mobile health with the use of smartphones, specifically texting. According to the Pew Research Center, (2019), 96% of Americans own a cellphone. The percentage of Americans that own a

smartphone is now 81%, which is up from 35% in 2011. This is important because of the options

that are now available for providing mobile support for breastfeeding. Also, according to Pew,

75% of American adults now own desktop or laptop computers, half of Americans own tablet

computers and e-reader devices, and 1 in 5 Americans listen to audiobooks. This opens up many

options for providing support on-the-go, without needing mothers to go in and get support in

person. One study analyzed how the use of text messaging affects maternal and infant health. A

literature review of 48 randomized controlled trials was performed, looking at different antenatal

topics that used text messaging for education and support. The results show that each of the

topics was positively supported by texting. The text messages were more effective when they

were motivational, rather than informational. Overall, text messaging to support antenatal

education was shown to be effective, and should further be developed as a standard form of

mobile support (Poorman et al., 2014).

The use of "mobile Health" in breastfeeding specifically was evaluated by a few studies.

A meta-synthesis was performed analyzing peer and professional support through a qualitative

design. Thirty-one studies looked at different types of breastfeeding support, including different

types and durations of peer and professional support. The findings resulted in two kinds of

perceived support. The authentic presence was perceived as effective support, and the

disconnected presence was perceived as ineffective support. In general, mothers found "person-

centered" support the most effective. Women reported that personalized support from either peer

or professional support was helpful. This study emphasized the need for person-to-person

support and an authentic presence in the breastfeeding process (Schmied et al., 2010). A study

that utilized mobile health of "mHealth" was performed by conducting interviews of expecting

mothers in prenatal clinics. The study aimed to offer mHealth as a way to offer an accessible

platform to promote exclusive breastfeeding. From the interviews, the results indicated that

mothers found utilizing resources from social media and the internet was useful. This shows the

mHealth may have a positive effect on breastfeeding (Alnasser et al., 2018). A randomized

controlled trial was performed to test if a text messaging intervention, that sent one text per

week, could increase breastfeeding rates and improve breastfeeding self-efficacy. Women in the

intervention group received text messages, and women in control groups received standard

postpartum care, without text messages. The results of this study showed that text messaging had

a positive impact on breastfeeding behaviors. Women who received the text messages only

showed a 6% decrease in exclusive breastfeeding, compared to a 14% decrease in the control

group. Women in the control group were also less likely to display emotions-focused and more

likely to display active coping (Gallegos et al., 2014).

Together this literature reviews outline the work that has been done towards identifying

effective interventions for women experiencing pain with breastfeeding. In these studies, person-

to-person and individualized support has been identified as one of the most effective

interventions. Communication between breastfeeding mothers and healthcare professionals is

essential in providing care to patients dealing with breast and nipple pain. However, an issue

often encountered is the difficulty in maintaining long term support. Texting is an intervention

that must be considered now that most Americans own a cellphone. The purpose of this study is

to determine how effective texting as part of an intervention for reducing breast and nipple pain

supports breastfeeding and breastfeeding duration. This secondary analysis explored which

barriers mothers continued to experience beyond the support provided by the interventions text

messages. In addition, this secondary analysis explored what barriers mothers were reporting

using the Ongoing Breastfeeding Assessment (OBA) responses, and the association with the

symptoms reported in the text messages they sent. The outcome of the analysis was to find which symptoms reported in the OBA were not addressed by the text messaging.

## Methods

### Design

This study is a secondary analysis of a pilot randomized controlled trial testing the effectiveness of a breastfeeding self-management (BSM) intervention for breast and nipple pain in breastfeeding women, using texting. The secondary analysis compared the mothers' responses to bi-weekly text messages and the mothers' report of ongoing breastfeeding difficulties, using the OBA.

### Setting

Participants were recruited at two research-intensive regional tertiary medical centers in the northeast region of the United States.

### Sample

The study included 56 mothers, BSM intervention (n=26) and control (n=30), who were continuing to breastfeed at 6 weeks. The average age of mothers in the intervention group was 30, and the average age in the control group was 31. Inclusion and exclusion criteria are the samples from the larger study; "Eligibility criteria for women were (a) 18–45 years of age, (b) within 48 hours of having given birth, (c) antenatal intention to breastfeed, (d) access to texting, (e) access to a computer, (f ) fluency to read and write English, (g) singleton infant > 37 weeks gestational age admitted to the newborn nursery, and (h) evaluated by an International Board Certified Lactation Consultant (IBCLC) during their in-hospital stay. Exclusion criteria for women were (a) <18 years of age, (b) delivered infant with congenital anomalies, (c) history of mental health disorder (i.e., schizophrenia, bipolar disorder), (d) health condition that would alter

pain sensorium (i.e., sickle cell anemia, diabetes, and history of seizures), and (e) eczema, rash, or dermatographism on the nondominant forearm, which could interfere with experimental pain testing" (Lucas, Zhang, et al., 2019, p. 3-4).

**Measurements**

Demographic characteristics of parity, method of delivery, race, income, and education levels were collected. Participants filled out the OBA at week 1, week 2, and week 6. The OBA is a breastfeeding tool assessing symptoms with a Likert-type scale and multiple-choice questions assessing factors related to breastfeeding. These include breastfeeding pain and discomfort, specific breastfeeding factors (engorgement, breast infection), process factors related to breastfeeding related to knowledge and belief (perception of breastfeeding), self-regulation skills (frequency, duration, pain management), and social support with breastfeeding (lactation support) (Lucas, Zhang, et al., 2019). The research nurse contacted the participants bi-weekly to inquire how breastfeeding was going via texting, and the participants were provided five response descriptors: happy, average, sore, engorged, always feeding (Lucas, Bernier, et al., 2019).

**Data collection**

The BSM intervention was implemented from hospital discharge to 6 weeks postpartum, and included bi-weekly, nurse-led texting, online educational modules targeting knowledge and beliefs to self-manage breast and nipple pain, and a breastfeeding journal. Mothers in the intervention group also received bi-weekly cognitive therapy-based educational modules addressing challenges in breastfeeding and examples as to how to manage breast and nipple discomfort and hyperlinks to online resources for the first 2 weeks from discharge. The control group had access to usual care, including access to an outpatient lactation consultant. Both the

intervention and the control group received the texts at weeks 1, 2, and 6, with a link to complete

assessments for breast and nipple pain severity, breastfeeding support or challenging

breastfeeding symptoms (nipple pain, breast bruising, etc.) and feeding frequency.

The research nurse responded to bi-weekly text responses with an educational message

targeting the descriptor. For instance, if the participant texted "happy", the message provided

information about the infant's anticipated growth behavior. If the participant texted "sore", the

response provided problem-solving for the pain, links for resources, and a phone number for the

study in which the nurse would refer them to the hospital lactation consultant. At the end of

weeks 1, 2 and 6, participants in both groups reported breastfeeding symptoms with the OBA

(how the feeding was going, breast pain, breast bruising, nipple pain, cracked and bleeding

nipples, blanching nipples). Participants in the control group did not receive texts, and only

reported breastfeeding symptoms with the Ongoing Breastfeeding Assessment at week 1, week 2

and week 6 of the study.

**Data Analysis**

Maternal characteristics, text responses, and OBA responses were assessed to determine

whether the interventions were able to address breastfeeding barriers. Both texting and OBA

responses were coded into numerical values. The results of the OBA were coded into numerical

values. For the "please tell me how the feedings are going" prompt, responses were coded as

follows. "awful" = 1, "not so good" = 2, "well" = 3, "very well" = 4, and "excellent" = 5. For the

prompts asking about breastfeeding symptoms from the OBA, which were breast pain, breast

bruising, nipple pain, cracked and bleeding nipples, and blanching nipples, responses were coded

as follows. "rarely" = 1, "sometimes" = 2, "frequently" = 3, "usually" = 4.

The results of the OBA from the intervention group, who received texts, were compared to the results of the OBA from the control group, who did not receive texts, to assess symptoms reported at week 1, week 2, and week 6.

In addition, the participant's texting responses were evaluated to determine if the number of mothers reporting symptoms that indicated barriers (sore, engorged, always feeding) was decreasing, and if the number of mothers reporting non-barrier symptoms (happy, average) was increasing.

Texting responses from the intervention group were transformed into a bivariate variable. Responses were either coded to 2, for responses that indicated they were experiencing barriers (sore, engorged, always feeding = 2) or 1, for responses that indicated they were not experiencing barriers (happy, average = 1). The participants experiencing barriers were referred to as the "barrier group", and those who did not experience barriers were referred to as the "non-barrier group", based on their texting responses at week 1, week 2, and week 6 of the study. Each participant who reported a barrier (sore, engorged, always feeding) was placed into the barrier group for that week and each participant who reported not experiencing a barrier (happy, average) was placed into the non-barrier group for that week. The groups changed each week depending on each participant's response.

Descriptive statistics, Chi-squares, and ANOVA were used to determine relationships between responses to the text messages and responses to the OBA symptoms and assessment outcomes. Using ANOVA, the intervention group's responses regarding breastfeeding symptoms from the OBA were compared to their text-messaging responses in the barrier and non-barrier groups at week 1, week 2, and week 6. This was done to determine the difference in OBA symptoms between mothers who reported experiencing barriers and those who reported not

experiencing barriers in their text messages. Another analysis using ANOVA was done for each

of the breastfeeding symptoms responses reported in the OBA compared to the responses given

in text messages, to analyze which breastfeeding symptoms were not addressed by the texting

intervention.

## Results

There were no significant differences in maternal characteristics of parity, method of

delivery, race, income and education levels. The average age of mothers in the intervention

group was 30.04, and the average age of mothers in the control group was 30.67. See additional

demographic characteristics of the sample in Table 1.

**Table 1**

*Demographic Characteristics by Group*

| | Intervention | | Control | |
| --- | --- | --- | --- | --- |
| Characteristic | n | % | n | % |
| Race | | | | |
| White | 22 | 84.6 | 21 | 70.0 |
| Asian | 2 | 7.7 | 1 | 3.3 |
| Black or African American | 2 | 7.7 | 4 | 13.3 |
| Not reported | 0 | 0.0 | 4 | 13.3 |
| Ethnicity | | | | |
| Hispanic or Latino | 3 | 11.5 | 4 | 13.3 |
| Not Hispanic or Latino | 20 | 76.9 | 23 | 76.7 |
| Unknown or not reported | 3 | 11.5 | 3 | 10.0 |
| Education | | | | |
| High school or below | 6 | 23.1 | 6 | 20.2 |
| College | 10 | 38.5 | 15 | 50.0 |
| Graduate school | 10 | 38.5 | 9 | 30.0 |
| Family income | | | | |
| Less than $50,000 | 6 | 23.0 | 8 | 26.7 |
| $51,000 - $75,000 | 3 | 11.5 | 2 | 6.7 |
| $76,000 - $100,000 | 8 | 30.8 | 8 | 26.7 |
| Greater than $100,000 | 9 | 34.6 | 12 | 40.0 |
| Marital status | | | | |
| Single | 8 | 30.8 | 9 | 30.0 |
| Married | 17 | 65.4 | 20 | 66.7 |
| Not reported | 1 | 3.8 | 1 | 33.3 |
| Working (yes) | 20 | 76.9 | 26 | 86.7 |
| Primipara (yes) | 10 | 38.5 | 13 | 43.3 |
| Delivery (vaginal) | 20 | 76.9 | 25 | 83.3 |

*Note.* n=number of participants, %=percentage of each group, ns between groups.

For the BSM group, participants were texted bi-weekly, for 6 weeks, for 12 reports total. Participants responded to the text, and Figure 1 shows the number of each response given, each time the participants were texted. Overall, the number of "sore", "engorged" and "always feeding" responses decreased by the end of the study. There were 16 "barrier" responses at week 1, which decreased to 2 responses by week 6. Also, the number of "barrier" responses increased from 10 at week 1 to 24 "non-barrier" responses at week 6. By the end of the study, 24 mothers, 92% of the sample, reported either "average" or "happy", a "non-barrier" response. In our study, we found engorgement and soreness to be the most transient response, with 12 mothers reporting engorgement at week 1, and no mothers reporting engorgement by week 5 (Table 2).

**Figure 1**

*Number of Each Text Response Given Bi-Weekly Across 6 Weeks*
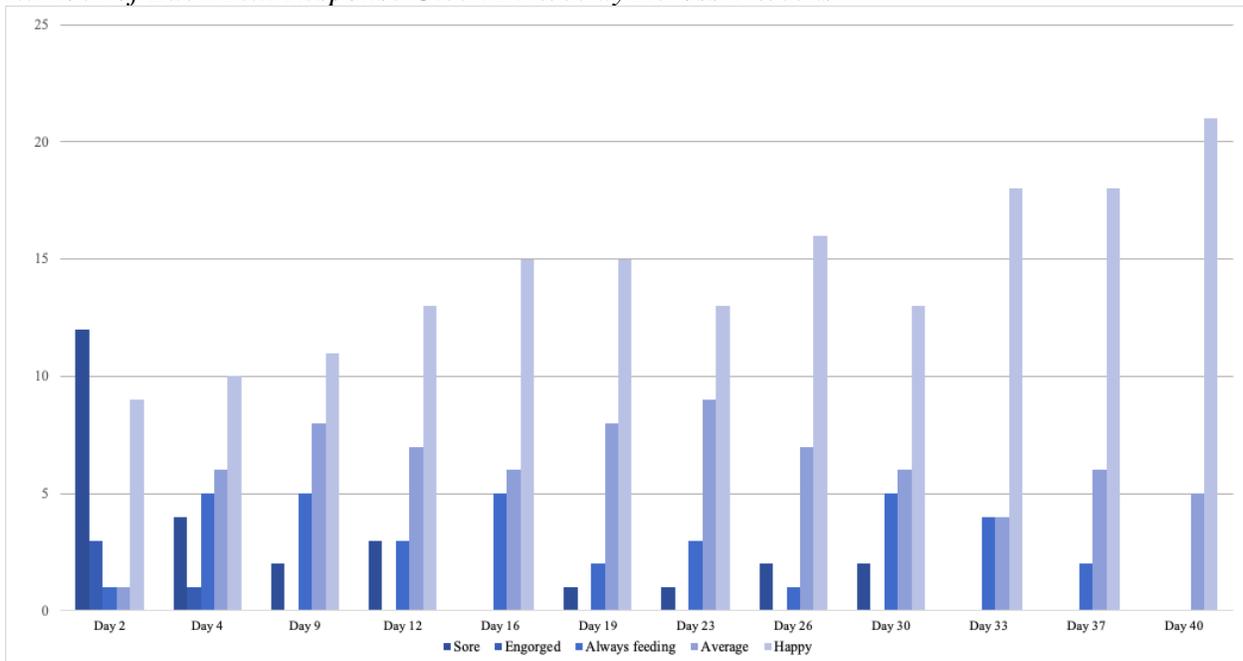
**Table 2**

*Responses to Text Messages with Each Symptom at Each Week*

| Texting Responses | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 |
|---|---|---|---|---|---|---|
| Sore | 4 | 3 | 1 | 2 | 0 | 0 |
| Engorged | 1 | 0 | 0 | 0 | 0 | 0 |
| Always feeding | 5 | 3 | 2 | 1 | 4 | 2 |
| Average | 6 | 7 | 8 | 7 | 4 | 4 |
| Happy | 10 | 13 | 15 | 16 | 18 | 20 |

Each week, the two groups responded to: "please tell me how the feedings are going". The results showed a slight difference between the intervention and control groups, but a similar trend. The intervention group had average coded responses of 3.46, 3.61 and 4.14 at week 1, week 2, and week 6, respectively, while the control group had average coded responses of 3.47, 3.53, and 4.06 at week 1, week 2, and week 6, respectively.

Each week, the intervention and control groups reported what symptoms they were experiencing on the OBA. The averages are present in Table 3, where all of the symptoms decreased over time.

**Table 3**

*Coded Averages of Symptoms Reported on OBA by Intervention and Control Groups Each Week*

| Breastfeeding Symptom | Week 1 | | Week 2 | | Week 6 | |
|---|---|---|---|---|---|---|
| | Intervention | Control | Intervention | Control | Intervention | Control |
| Breast pain | 2.11 | 2.16 | 1.71 | 1.87 | 1.54 | 1.52 |
| Bruised breast | 1.46 | 1.25 | 1.82 | 1.83 | 1.25 | 1.09 |
| Nipple pain | 2.96 | 2.69 | 2.43 | 2.59 | 1.71 | 1.59 |
| Cracked/bleeding nipples | 1.75 | 1.53 | 1.21 | 1.19 | 1.14 | 1.22 |
| Blanching nipples | 1.25 | 1.22 | 1.29 | 1.34 | 1.32 | 1.55 |

*Note.* OBA indicates Ongoing Breastfeeding Assessment.

More specifically, the participants' report of symptoms in the intervention group were clustered into two groups, barrier, and non-barriers. The report of occurrence for both groups are presented in Table 4.

**Table 4**

*Coded Averages of Symptoms Reported on OBA by Barrier and Non-Barrier Groups Each Week*

| Breastfeeding Symptom | Week 1 | | Week 2 | | Week 6 | |
|---|---|---|---|---|---|---|
| | Non-barrier | Barrier | Non-barrier | Barrier | Non-barrier | Barrier |
| Breast pain | 2.09 | 2.17 | 1.72 | 1.33 | 1.5 | 1 |
| Bruised breast | 1.41 | 1.67 | 1.81 | 1.67 | 1.27 | 1 |
| Nipple pain | 2.91 | 3.17 | 2.4 | 2.67 | 1.73 | 1.5 |
| Cracked/bleeding nipples | 1.5 | 3 | 1.32 | 1.33 | 1.15 | 1 |
| Blanching nipples | 1.14 | 1.67 | 1.4 | 1 | 1.27 | 1 |

*Note.* OBA indicates Ongoing Breastfeeding Assessment.

The two symptoms that were different between the intervention group were nipple pain and cracked nipples. The average occurrence of nipple pain and cracked/bleeding nipples are presented in Figure 2 and 3.

**Figure 2**
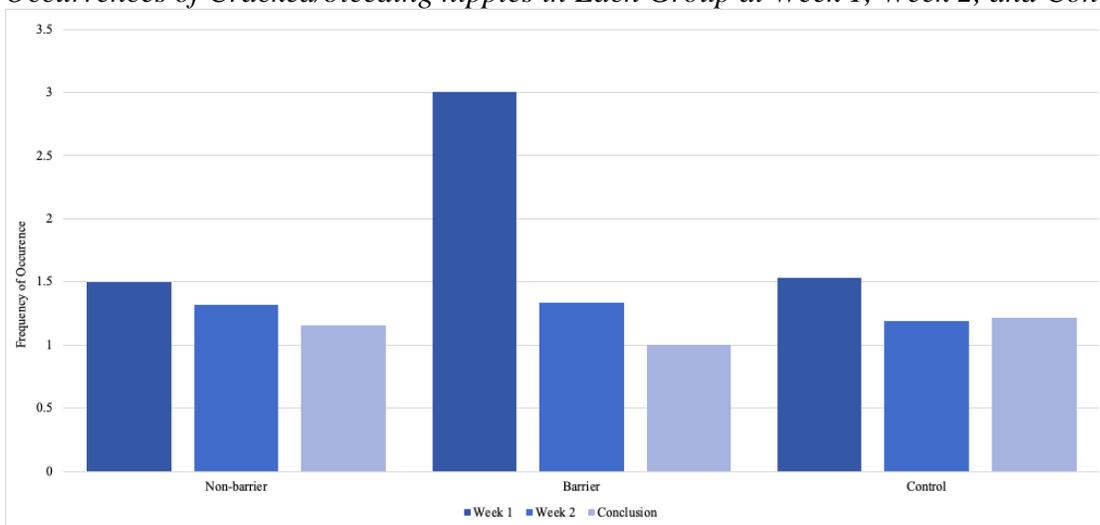
*Occurrences of Nipple Pain in Each Group at Week 1, Week 2, and Conclusion*
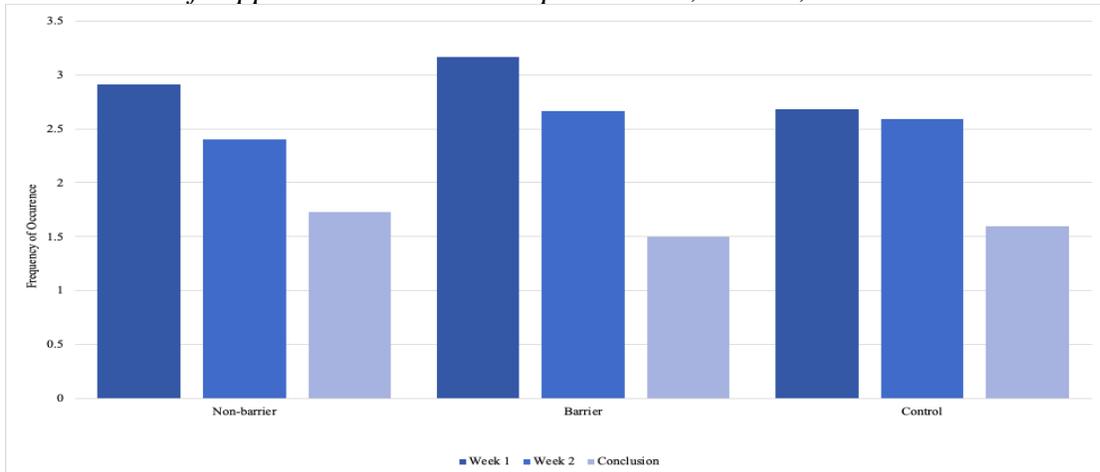


Note: Averages from each week. "Barriers" and "Non-barriers" are both from the BSM intervention group.

**Figure 3**

*Occurrences of Cracked/bleeding nipples in Each Group at Week 1, Week 2, and Conclusion*



Note: Averages from each week. "Non-barrier" and "Barrier" are both from the BSM intervention group.

Women in the intervention group who experienced barriers reported a significant increase in the occurrences of cracked or bleeding nipples compared to those women in the intervention group who did not experience barriers, $[F(2, 165)] = 5.685$, p = .004. Using a Bonferroni correction, women in the barriers group had significantly increased reports of cracked and bleeding nipples compared to the control group ($p = .024$) and no barriers ($p = .003$). Using Chi-square, time was significant at week 1, $X^2$ (6, $N = 56$) = 18.375, $p > .005$.

In addition, the women in the intervention group who experienced barriers also reported significantly increased occurrences of nipple pain compared to the women in the intervention group with no barriers and the control group $[F(2,165)] = 4.36$, p = .014. Using a Bonferroni correction, women in the non-barriers group had significantly decreased reports of nipple pain compared to the control group, ($p = .056$), and the non-barrier group, ($p = .059$). Using Chi-square, for nipple pain, time was significant at week 1, $X^2$ (6, $N = 56$) = 12.933, $p > .044$.

### Discussion

Overall, texting contributed to a decrease in breastfeeding symptoms between the intervention and control group, as shown by a slight decrease in the report of symptoms based on responses from the OBA. Overtime, the mothers in the intervention group reported less "barriers" in their text messages, and more "non-barriers". The significant findings were that, initially, those in the intervention group who reported barriers had significantly more occurrence of cracked and bleeding nipples at week 1, when compared to the non-barrier group and the control group. The non-barrier group reported almost significantly decreased nipple pain compared to the barrier and control group at week 1. , by the end of the study, there was no significant difference in reports of nipple pain and cracked/bleeding nipples across groups. These findings suggest that, by the end of the study, the mothers in the barrier group may not have seen

the symptoms on the OBA as a barrier, may have learned to cope with the discomfort, or were able to overcome their initial discomfort. This suggests that the critical time for intervening for nipple pain and cracked/bleeding nipples is by week 1 postpartum. An outcome of the study is finding that the intervention needs to provide additional strategies and support for women to self-manage nipple pain during the first weeks after delivery.

**Ongoing Breastfeeding Assessment Results and Efficacy of Texting in Pain-Management**

The results of the initial analysis between the control and intervention groups from their responses on the OBA showed that the texting slightly increased scores on the "please tell me how the feedings are going" prompt. By the conclusion of the study (week 6), the intervention group reported a more positive experience compared to the control group. Although not significant, the intervention shows that texting helped slightly increase the success of the feedings overall.

On the OBA, participants in the intervention group reported fewer symptoms related to breast and nipple discomfort compared to the control group. These differences were not significant. This initial analysis shows text messages alone were not adequate to address specific barriers to breastfeeding reported in the OBA, and additional interventions are required. However, mothers may have responded to having the extra support from the text messages, as shown in a slightly higher average for the "please tell me how the feedings are going" prompt.

**Effect of Texting on Report of Barriers in Text Messages by Intervention Group**

Although there was no significant difference in breastfeeding outcomes reported on the OBA between the control and intervention groups, the text messages showed different results within the intervention group. Based on our clustering of text responses, over time, mothers in the intervention group reported less "barrier" classified symptoms and more "non-barrier"

symptoms in their text messages. The texting drew attention to the challenges that mothers were experiencing and provided direction and affirmation for mothers to self-manage the issues they were experiencing. A definite conclusion cannot be drawn, as there were other interventions and factors influencing breastfeeding symptoms in this study. However, these findings suggest that there may be a link between the text message support provided in this study and a decrease in barriers to breastfeeding.

**Comparison of Barrier Group and Non-Barrier Group Trends to Determine Effectiveness of Texting Intervention on Specific Symptoms**

There was a significant decrease in symptoms reported on the OBA by the barrier group from week 1 to week 6 across all five symptoms. The two symptoms that were significantly decreased in the barrier group were nipple pain and cracked/bleeding nipples.

***Trend in Responses from the Barrier Group***

The averages of the symptoms reported by the non-barrier group on the OBA also showed a decrease in symptoms over time. An expected discomfort of breastfeeding is breast pain, as maternal breast tissue accommodates increasing milk volume to feed the infant, which creates more pain. However, as mentioned above, the barrier group reported this breast pain less than the non-barrier group. This meant that, by week 6, the barrier group may not have seen breast pain as a symptom of breastfeeding. In comparison, "nipple pain" and "cracked/bleeding nipples" had a significant decrease. This shows that the intervention was also able to drastically decrease or provide strategies for this symptom in mothers who reported it as a barrier after week 1. Lastly, for "blanching nipples", the barrier group's average coded responses of this symptom in the OBA also decreased from week 1 week 6. We wonder if those women who continued to report this symptom might have Raynaud's syndrome or some underlying condition such as

subclinical infections or vasospasms that contributes to the pain. Berens et al. (2016), and Lucas & McGrath (2017) identify additional interventions which should be considered for ongoing pain related to specific reports of breast and nipple pain that may be caused by underlying conditions. Like mentioned before, mothers in the participant sample may have experienced issues such as vasoconstriction that contributed to blanched nipples. Amir & Bearzatto (2016) state that other issues that contribute to breastfeeding barriers include vasospasm, dermatitis, mastitis, infection, blocked ducts, or abscess. These symptoms may be occurring in these, which may increase barriers for them.

### *Trend in Responses from the Barrier Compared to the Non-Barrier Group*

In order to accurately determine which barriers reported in the OBA were not addressed by the intervention, the non-barrier group must also be addressed. The mothers in the non-barrier group reported in their text messages that they did not experience barriers to breastfeeding. They also reported almost significantly less nipple pain and cracked/bleeding nipples than the barrier group at week 1. However, that did not necessarily always match the symptoms reported on their OBA for the whole study, especially at week 6. Some mothers reported experiencing symptoms on their OBA, but reported no barrier ("average" or "happy") instead of barriers ("sore", "engorged", or "always feeding") in their text messages for that same week. Conversely, some mothers reported not experiencing symptoms on their OBA but reported barriers instead of non-barriers in their text messages. This may mean that mothers who reported a barrier on one and not the other did not view that specific symptom as a reportable barrier, or, that this specific symptom was not addressed by the text messaging intervention. This could have a lot of different implications; perhaps the participant did not think it was worth attempting to fix, they did not think it could be addressed by the interventions, or they did not see it as a barrier to

breastfeeding. Or that the clustering of symptoms was not sensitive to the symptoms mothers experienced at 6 weeks. The cross-analysis here looked to find exactly which symptoms mothers were experiencing and reporting in their OBA that the texting did not address.

Specifically, the most relevant data will come from the "non-barrier" group. This part of the analysis looked at the participants that are reporting non-barriers (average, happy) in their texting, to see what they are reporting in their Ongoing Breastfeeding Assessment. If the non-barrier groups had significantly lower averages ("sometimes", "frequently" or "usually") more often, this would indicate that the texting was not able to address the symptoms that the mothers reported in the Ongoing Breastfeeding Assessment. Because the study lasted 6 weeks, the 6 weeks data reflects how effective the texting intervention was. At week 1, for all five symptoms on the OBA, the number of symptoms reported by the barrier and non-barrier groups correlated with their texts, where they reported barriers or non-barriers. The most significant responses were of nipple pain and cracked/bleeding nipples at week 1 by the barrier group. However, by week 6, their text responses did not correlate with their OBA responses for the barrier and non-barrier groups. This may indicate that the text message support reflected the lack of a significant difference in the number of symptoms between the two groups. This could also mean that the participants in the barrier group did not view these symptoms as a barrier to breastfeeding, or that they learned to cope with them. This may also indicate that in a future study, the data should be coded differently at different points in time or that the texting prompts might need to change across time.

**Clinical Implications**

Overall, the responses on the Ongoing Breastfeeding Assessment and the responses from the texting were not consistent for any breastfeeding symptoms. There was a discrepancy in

responses to the Ongoing Breastfeeding Assessment and responses for the texting in all 5 symptoms.

The original study analyzed how texting as an intervention, along with educational modules and journaling, would increase breastfeeding duration by providing support for mothers experiencing breast and nipple pain. Texting is an effective intervention because of how common and normalized cell phone use is in the world today. Providing support through text messaging is more effective than other forms of support because texting is easily accessible to mothers who are busy with their new infants. With texting, mothers are able to receive support and tips about decreasing breastfeeding pain and increasing breastfeeding duration. As more and more Americans begin to own cell phones, texting should be heavily considered as a way to provide long term, postpartum breastfeeding support. Gallegos et al. (2014) also found success with using "mHealth" to promote and support breastfeeding.

One thing this study did not consider was the effect of time and tissue healing. Based on the findings in the barrier group, those who reported symptoms of breastfeeding on the Ongoing Breastfeeding Assessment at the beginning of the study, specifically nipple pain and cracked/bleeding nipples, had a lower report of these symptoms by week 6. This may mean that as time went on, mothers were able to overcome the nipple pain or that the pain resolved as breastfeeding was established. Our findings show significant differences in nipple pain and cracked/bleeding nipples between the barrier and non-barrier groups at week 1, and by week 2, the difference between the two groups was insignificant. The larger study (Lucas, Zhang, et al., 2019) found that by week 2, the intervention group reported significantly less pain than the control group, meaning that the barrier group was able to decrease their physical trauma, resulting in less pain. Kent et al. (2015) found that 57% of cases of breastfeeding women

reporting pain resolved or was resolved by 18 days postpartum. These findings match our findings that the most significant report of nipple pain and cracked/bleeding nipples was at week 1. This means that the majority of issues that arise in breastfeeding should be solved before week 2 in order to promote long term breastfeeding (Odom et al, 2013).

In future studies, an adjustment to the study design needs to be made to account for why some mothers, specifically those in the barrier group, are not seeing certain symptoms of breastfeeding as a barrier by the end of the study. Qualitative data regarding what mothers are thinking should be collected to determine what they see as a barrier or a non-barrier of breastfeeding. Additionally, each of the five symptoms should be discussed with the women prior to the study. Topics such as normal and abnormal findings of breastfeeding and when to expect each symptom should be taught to the mothers at discharge. For example, breast pain may be common in women experiencing increased volumes of milk and increased instances of milk let down if their infants are drinking increased amounts of milk and how this changes over time. Mothers may be able to overcome breastfeeding pain and barriers as they progress through the postpartum period.

Our results showed that barriers to breastfeeding significantly decreased after week 1. A future study should include an intervention, like this one, that targets barriers to breastfeeding early. Receiving a more detailed explanation about the symptoms reported will also help the researcher to more accurately separate the data for analysis. This will lead to more accurate conclusions about how effective interventions, such as texting, are for those mothers experiencing barriers with breastfeeding.

**References**

Alnasser, Y., Almasoud, N., Aljohni, D., Almisned, R., Alsuwaine, B., Alohali, R., Alhezayen,

    R. (2018). Impact of attitude and knowledge on intention to breastfeed: Can mHealth

    based education influence decision to breastfeed exclusively? *Annals of Medicine and*

    *Surgery*, *35*, 6–12. doi: 10.1016/j.amsu.2018.09.007

Amir, L. H., & Bearzatto, A. (2016). Overcoming challenges faced by breastfeeding mothers.

    *Australian Family Physician*, *45*(8).

Berens, P., Eglash, A., Malloy, M., & Steube, A. M. (2016). ABM clinical protocol #26:

    persistent pain with breastfeeding. Breastfeeding Medicine, 11(2), 46–53.

    https://doi.org/10.1089/bfm.2016.29002.pjb

    Breastfeeding. (2019). Retrieved from https://www.aap.org/en-us/advocacy-and-

    policy/aap-health-initiatives/Breastfeeding/Pages/default.aspx

Brockway, M., Benzies, K., & Hayden, K. A. (2017). Interventions to Improve Breastfeeding

    Self-Efficacy and Resultant Breastfeeding Rates: A Systematic Review and Meta-

    Analysis. *Journal of Human Lactation*, *33*(3), 486–499. doi: 10.1177/0890334417707957

    Demographics of Mobile Device Ownership and Adoption in the United States. (2019).

    Retrieved from https://www.pewresearch.org/internet/fact-sheet/mobile/

Gallegos, D., Russell-Bennett, R., Previte, J., & Parkinson, J. (2014). Can a text message a week

    improve breastfeeding? *BMC Pregnancy and Childbirth*, *14*(1). doi: 10.1186/s12884-

    014-0374-2

Kim, S. K., Park, S., Oh, J., Kim, J., & Ahn, S. (2018). Interventions promoting exclusive

    breastfeeding up to six months after birth: A systematic review and meta-analysis of

    randomized controlled trials. *International Journal of Nursing Studies*, *80*, 94–105. doi:

    10.1016/j.ijnurstu.2018.01.004

Lucas, R. F., Bernier, K. M., Perry, M., Heather, E., Ramesh, D., Young, E., Walsh, S., &

    Starkweather, A. (2019). Promoting self-management of breast and nipple pain in

    breastfeeding women: Protocol of a randomized controlled trial. *Research in Nursing and*

    *Health*, *42*, 176–188. https://doi.org/10.1002/nur.21938

Lucas, R. F., & McGrath, J. M. (2016). Clinical assessment and management of breastfeeding

    pain. Topics in Clinical Nutrition, 32(3), 1–12.

Lucas, R. F., Zhang, Y., Walsh, S., Evans, H., Young, E., & Starkweather, A. R. (2019). Efficacy

    of a breastfeeding pain self-management intervention: A pilot randomized controlled trial

    (RCT). *Nursing Research*, *68*(2), 1–10.

Odom, E. C., Li, R., Scanlon, K. S., Perrine, C. G., & Grummer-Strawn, L. (2013). Reasons for

    Earlier Than Desired Cessation of Breastfeeding. *Pediatrics*, *131*(3). doi:

    10.1542/peds.2012-1295

Pillay, J., & Davis, T. (2020). *Physiology, Lactation*. Treasure Island, FL: StatPearls Publishing.

Poorman, E., Gazmararian, J., Parker, R. M., Yang, B., & Elon, L. (2014). Use of Text

    Messaging for Maternal and Infant Health: A Systematic Review of the Literature.

    *Maternal and Child Health Journal*, *19*(5), 969–989. doi: 10.1007/s10995-014-1595-8

Schmied, V., Beake, S., Sheehan, A., Mccourt, C., & Dykes, F. (2010). Women's Perceptions

    and Experiences of Breastfeeding Support: A Metasynthesis. *Birth*, *38*(1), 49–60. doi:

    10.1111/j.1523-536x.2010.00446.x

    Victora, C. G., Bahl, R., Barros, A. J. D., França, G. V. A., Horton, S., Krasevec, J., …

    Rollins, N. C. (2016). Breastfeeding in the 21st century: epidemiology, mechanisms, and

    lifelong effect. *The Lancet*, *387*(10017), 475–490. doi: 10.1016/s0140-6736(15)01024-7

Why It Matters. (2019, November 4). Retrieved from https://www.cdc.gov/breastfeeding/about-

    breastfeeding/why-it-matters.html