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The Influence of Breastfeeding Educational Interventions on Breast Engorgement and Exclusive Breastfeeding: A Systematic Review and Meta-Analysis

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Abstract

Background: Breast engorgement and breast pain are the most common reasons for the early cessation of exclusive breastfeeding by mothers.
Research Aims: (1) To examine the influence of breastfeeding educational interventions on breast engorgement, breast pain, and exclusive breastfeeding; and (2) to identify effective components for implementing breastfeeding programs.
Methods: Randomized controlled trials of breastfeeding educational interventions were searched using five English and five Chinese databases. Eligible studies were independently evaluated for methodological quality, and data were extracted by two investigators. In total, 22 trials were identified, and 3,681 participants were included. A random-effects model was used to pool the results, and a subgroup analysis and meta-regression analysis were conducted.
Results: Breastfeeding education had a significant influence on reducing breast engorgement at postpartum 3 days (odds ratio [OR]: 0.27, 95% CI [0.15, 0.48] $p < .001$), 4 days (OR: 0.16, 95% CI [0.11, 0.22], $p < .001$), and 5–7 days (OR: 0.24, 95% CI [0.08, 0.74], $p = .013$) and breast pain (standardized mean difference: −1.33, 95% CI [−2.26, −0.40]) at postpartum 4–14 days. Participants who received interventions had higher odds of exclusive breastfeeding. Breastfeeding educational interventions provided through lecture combined with skills practical effectively reduced breast engorgement (OR: 0.21; 95% CI [0.15, 0.28]; $p = .001$) and improved exclusive breastfeeding at postpartum 1–6 weeks (OR: 2.16; 95% CI [1.65, 2.83]; $p = .001$).
Conclusions: Breastfeeding educational interventions have been effective in reducing breast engorgement, breast pain, and improved exclusive breastfeeding. A combination of knowledge and skill-based education has been beneficial for sustaining exclusive breastfeeding by mothers.

Keywords

breast pain, breastfeeding, breast engorgement, exclusive breastfeeding, lactation education, meta-analysis, randomized controlled trials, systematic reviews

Background

The health benefits of breastfeeding are well known, and breastfeeding is recommended as the sole nutritional source for infants in the first 6 months of life (World Health Organization [WHO], 2020). Nevertheless, only 26% of mothers stop practicing exclusive breastfeeding because of sore or crack nipples encountered in the early postpartum period (Morrison et al., 2019). Talbert et al. (2016) reported that 48% of the Kenyan mothers in their study experienced breast engorgement, and 56% experienced nipple pain in the

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early postpartum period. It is important for health professionals to develop effective interventions for breast engorgement and breast pain to assist mothers and their families to sustain optimal breastfeeding practices.

Various medical and nonmedical treatments for breast engorgement have been studied, but few interventions have been found to be effective. A recent meta-analysis indicated that cabbage leaves, acupuncture, acupressure, and scraping therapy may help reduce breast engorgement in breastfeeding mothers (Mangesi & Zakarija-Grkovic, 2016). Educational interventions, which were not included in a previous meta-analysis, are worthy of evaluation, considering that health education is a common and vital intervention used in postpartum care by health professionals. For example, breastfeeding education, including frequent breastfeeding with proper positioning, is often delivered by clinical staff in early postpartum wards to reduce breastfeeding issues faced by the mothers (Anderson et al., 2019). However, the best form that educational interventions for breast engorgement should take, and the effectiveness of interventions, remain unexplored.

Breast engorgement is a condition characterized by breast overfilling due to milk blockage, and it usually occurs within 1 week after delivery (Mangesi & Zakarija-Grkovic, 2016). Researchers have reported that 52% of mothers experience breast pain 3–7 days after giving birth (Leung, 2016), and 33.9% of mothers reported a high intensity of breast pain in the 2nd week after delivery (Fahey, 2017), which is often associated with the early introduction of supplemental feeding using a source other than human milk (Johansson et al., 2020). The 1st week after delivery is a critical period, as mothers are in the process of learning to breastfeed their newborn (Che et al., 2018). Evidence has indicated that 34.3% of mothers change their breastfeeding decision between initiation and 2 months after delivery and begin introducing complementary feeding (Ritchie-Ewing et al., 2019). Therefore, investigating breastfeeding outcomes during the early postpartum period should be prioritized to help mothers sustain optimal breastfeeding practices throughout the infant's 1st year.

Several breastfeeding educational interventions have been recently examined using randomized controlled trials (RCTs), which were suggested to provide high-quality evidence with clinicalimplications (Spieth et al., 2016). Further, pooling RCT studies together can achieve larger sample sizes with sufficient power to detect the effects of an intervention and improve the external validity of studies (Bangdiwala et al., 2016). Therefore, examining the most effective modality for delivering breastfeeding educational interventions to postpartum mothers using a systematic review and meta-analysis can help health professionals to develop useful educational interventions.

Mothers often experience a wide range of physical, emotional, and role changes during the early postpartum period (Marques et al., 2018). Tailoring educational interventions to address the mothers' health conditions and the provision of teaching materials, including simulated models, lifelike dolls, or handbooks, would be beneficial for breastfeeding mothers (Tseng et al., 2020). Educational interventions have indicated a mixed result on breast engorgement and nipple/breast pain. In a prospective study with mothers ($N = 42$) in the United States, educational interventions incorporating knowledge and skills education helped to significantly ameliorate breast engorgement and breast pain (Witt et al., 2016a, 2016b), whereas a randomized study in Brazil indicated no significant changes in breast engorgement among mothers receiving breastfeeding instructions (Souza et al., 2020). Potential factors influencing the results include the frequency of classes, varying from one to two or more contacts, and whether the class is offered individually or in a group (Brockway et al., 2017; Chipojola et al., 2020). Therefore, it is crucial to examine the most effective modalities for delivering breastfeeding educational interventions to postpartum mothers. Through this study, we aimed to (1) examine the influence of breastfeeding educational interventions on breast engorgement, breast pain, and exclusive breastfeeding; and (2) identify the key components of effective breastfeeding educational intervention programs.

Key Messages

- Breast engorgement, which commonly occurs in the early postpartum period, often leads to early cessation of exclusive breastfeeding in lactating mothers.
- Our meta-analysis found that breastfeeding educational interventions were effective in reducing breast engorgement and breast pain and improving exclusive breastfeeding during the early postpartum period.
- Our study highlights the need to promote frequent and individualized breastfeeding educational programs to impart knowledge and skills to mothers to ameliorate breastfeeding-related concerns and foster exclusive breastfeeding outcomes.

Methods

Design

This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines (Liberati et al., 2009). The focus was on the influence of breastfeeding educational interventions on selected breastfeeding outcomes.

Sample

We included all RCTs if they met the following criteria: (1) study participants were postpartum women; (2) the intervention was breastfeeding education; (3) the comparison group

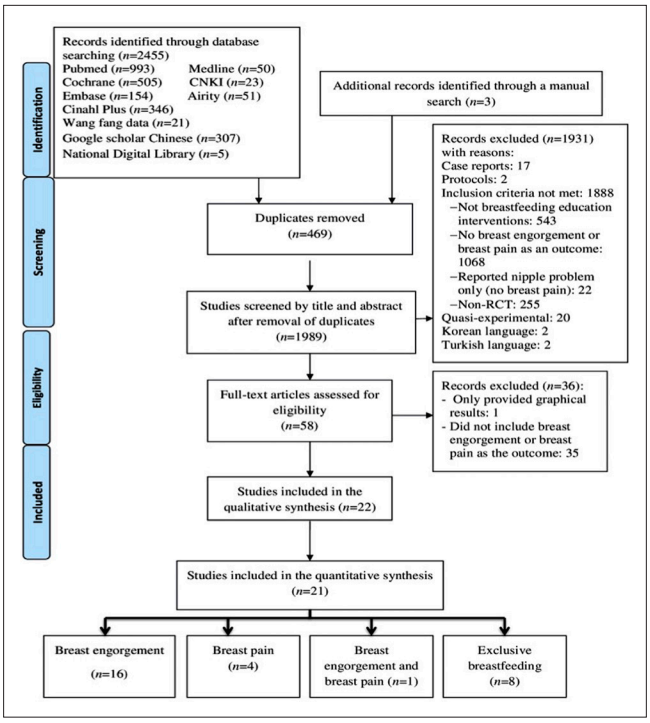

Figure 1. PRISMA Flow Diagram.

received usual care or some intervention; (4) studies were published in English or Chinese; and (5) the study outcomes included (a) breast engorgement (b) breast pain and (c) exclusive breastfeeding. Systematic reviews and studies lacking data regarding measurement time points were excluded.

In total, 2,455 articles were identified through the search strategy, and three additional articles were retrieved from reference lists. After removing duplicates, 1,989 articles remained. Of these, 1,931 articles were excluded, but 58 studies met the inclusion criteria after the titles and abstracts had been screened. Of these, 36 articles were excluded because they provided only graphical results (n = 1) or did not include breast engorgement or breast pain outcomes (n = 35). In all, 22 studies were included. One study was not pooled in the subsequent quantitative synthesis. Of the remaining 21 studies, 16 studies had a breast engorgement outcome, four had a breast pain outcome, one had both breast engorgement and breast pain outcomes, and eight had exclusive breastfeeding outcomes. In total, 18 articles from Chinese databases and three articles from English databases (de Oliveira et al., 2006; Labarere et al., 2005; Liu et al., 2018) were included. The entire process of study selection is illustrated in Figure 1.

Measurement

In this study, we adopted the following established definitions for ascertaining the study outcomes, as follows:

Breast engorgement is a condition characterized by overfilling of the breast owing to milk blockage, which usually occurs within 1 week of delivery (Mangesi & Zakarija-Grkovic, 2016). It was measured based on breast assessment by health professionals using a dichotomous variable (yes or no), with the inter-rater reliability of 0.90 (de Oliveira et al., 2006).

Breast pain is defined as an unpleasant physical sensation due to engorged breasts. A visual analog scale (VAS) with a score range of 0–10 was used to measure breast pain after delivery, with a test–retest reliability of 0.95 (Wewers & Lowe, 1990).

Exclusive breastfeeding is defined as the provision of only human milk to infants without any additional water, liquid, or foodstuff (WHO, 2019). This outcome was determined based on the WHO definition (n = 3), or operationally defined by the investigator using a dichotomous variable (yes or no; n = 5). This variable was reported on the basis of what the participants had fed their infant within the previous 24-hr period, from the self-report questionnaires completed by the participants.

The methodological quality of the included studies was assessed by two authors using the revised Cochrane Risk of Bias Tool for Randomized Controlled Trials (RoB 2.0) that included the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, selection of reported results, and overall bias. Each domain was evaluated as a low risk of bias, a high risk of bias, or some concern (Higgins et al., 2016). Specifically, a study with a low risk of bias was identified when it appeared to be free from potential sources of bias, and a study with a high risk of bias was identified when at least one major risk of bias was identified. "Some concern" was described as the presence of a risk of bias arising from either insufficient information regarding bias or insufficient reasoning (Higgins et al., 2016). Discrepant results among the researchers were resolved by discussion until a consensus was reached.

Data Collection

We searched English databases, including MEDLINE, PubMed, Cochrane, EMBASE, CINAHL Plus, and Chinese databases, including Wanfang data, Google Scholar Chinese, National Digital Library, China National Knowledge Infrastructure (CNKI), and Airity Library from 1984 to October 26, 2019, followed by a text review. Two investigators independently identified studies using the following keywords: "education program" OR "health education" OR "structure teaching" OR "teaching" OR "promotion" OR "counseling" AND "breast engorgement" OR "engorge" OR "blocked duct" OR "swelling" OR "breast problem" OR "breast tenderness" OR "breast pain" OR "breastfeeding problem" OR "breastfeeding" AND "prenatal" OR "postnatal" OR "postpartum." Bibliographies for additional potential trials were manually searched. There were no

limitations on the country category while searching the articles. After removing duplicates, two authors independently screened the titles and abstracts of potentially eligible articles. The full texts were then retrieved and reviewed. Any disagreement would have been resolved through discussion between the two authors until a consensus was reached. However, no such instances occurred.

Data were extracted by three investigators, two of whom were bilingual. The following information was extracted: Study characteristics (e.g., author and year), participant characteristics (e.g., country, sample size, parity, setting, the timing of education, type of delivery, and maternal age), characteristics of the intervention (e.g., type and content of health education, teaching materials used, duration of each contact, class format, class contact, and class frequency), and study outcomes, including measurement tools and time points for each outcome.

Data Analysis

Descriptive data, including frequencies and percentages for categorical variables and means and standard deviations for continuous variables, were entered into Excel. The meta-analysis was conducted using Comprehensive Meta-Analysis (CMA) Version 2 (Biostat, Englewood, NJ, USA). We calculated the OR with its 95% CI for dichotomous outcomes (i.e., breast engorgement and exclusive breastfeeding). For extracting continuous data (i.e., breast pain), the standardized mean difference (SMD) with 95% CI was calculated.

A random-effects model was adopted to summarize the treatment effects. To determine the influence of breastfeeding educational interventions on breast engorgement, breast pain, and exclusive breastfeeding during the early postpartum period, we pooled the included studies reporting outcomes at different time points to obtain estimates with sufficient power and validity (Bangdiwala et al., 2016). One study with the outcome estimates at 4 months postpartum (Labarere et al., 2003) was not included in the meta-analysis because most of the other included studies had outcomes ranging from postpartum Weeks 1–6. Heterogeneity between studies was assessed using the I^2 statistic. A significant I^2 value > 50% indicated the presence of heterogeneity (Riley et al., 2011).

A moderator analysis was performed to compare the estimates of the participants' characteristics, intervention details, and potential covariates on breast engorgement, breast pain, and exclusive breastfeeding rates to examine further the factors underlying the observed heterogeneity. A subgroup analysis was conducted by dividing the studies into groups and comparing the effects between the groups. Covariates were adopted based on prior evidence and pre-specified characteristics of the educational intervention, including the type of health education, class format, class contact, risk of bias, and region of the world (Chipojola et al., 2020). Further, a meta-regression model was used to examine the moderating effects of continuous variables—for instance, the effect of maternal age on breastfeeding outcomes.

To determine the presence of publication bias, we adopted the Begg and Mazumdar rank correlation test using Kendall's tau statistics with a continuity correction. The presence of publication bias was indicated by a p-value < .05 (Begg & Mazumdar, 1994). A sensitivity analysis was performed to assess the robustness of our findings.

Results

Study Characteristics

In total, 3,861 participants were included in the 22 studies included in this systematic review, and the sample size of each study ranged from 60–570 participants (Table 1). All participants received breastfeeding educational interventions in a hospital setting, and one study involved a home visit after discharge from the hospital at 1 month after giving birth. Investigators for two studies implemented the intervention in both the prenatal and postnatal periods, and for 18 studies the intervention was implemented during the postnatal period. The age of the participants ranged from 22 to 33 years. Among the 21 studies included in the meta-analysis, 19 studies were conducted in China (i.e., 18 studies were published in Chinese Mandarin, one study was published in English), one in France, and one in Brazil.

The investigators for four studies adopted a lecture-based method, whereas investigators for 18 studies adopted a combination of lectures and practical skills (Table 1). The content of the educational intervention included the anatomy and physiology of the breast; the importance of breastfeeding, latching-on, and positioning during breastfeeding; manual expression; management of breastfeeding-related problems; nutrition for breastfeeding mothers; newborn and infant care; and demonstration of positioning and breast massage. Most researchers demonstrated the procedure of warm compression and manual expression using a towel and storage bottle. The teaching materials adopted during the intervention were lifelike dolls (two studies), handouts (one study), handbooks (two studies), a combination of lifelike dolls and handbooks (one study), and a combination of handbooks and leaflets (one study).

In total, 20 studies had an individual class format. Half of the educational interventions were conducted for more than five contacts (11 studies). The duration of each educational intervention class ranged from 10 min to 2.5 hr. In seven studies, the class frequency was two contacts each day for 4 days (Table 1).

Influence of Breastfeeding Educational Interventions on Breast Engorgement

Among the 17 studies, participants who received breastfeeding educational interventions in a postpartum ward (within 1 week of delivery) were less likely to experience breast engorgement compared with participants in the usual-care group at 3 days, 4 days and 5–7 days postpartum. The I^2 statistic indicated a high level of heterogeneity among studies on breast engorgement on Day 3 or Days 5–7 postpartum.

Table 1. Characteristics of the Sample (*N* = 22).

Author (year) Country	Participants	Type of Education	Content of the Intervention	Teaching Method/tools	Intervention Characteristic	Outcome Measures	Measurement Tools
Cui et al. (2006) China	*N* = 120 Age & parity: NS between groups	- Lecture - skills	- Importance of BF - BM, manual expression & Infant care	Demonstration warm towel & storage bottle	Contacts: *n* = 8 BID x 4 Duration: 20 min, Format: Individual	- Breast engorgement at postpartum 4th day - EBF at 6 wks PP	- Assessment by nurse - Questionnaire
Deng et al. (2010) China	*N* = 100 *M* Age: 26 Primipara/multipara	- Lecture - Skill	- Importance of BF - Anatomy and physiology - Positioning - Latch on - BM & manual expression	Demonstration using warm towel and storage bottle	Contact: *n* = 8 BID/ x4 Duration: 20 min. Format: Individual	- Breast engorgement at postpartum 4th day	- Assessment by nurse
De Oliveira[a] (2005) Brazil	*N* = 210 Primipara/multipara	- Lecture based	- Positioning & Latch on - Manual expression	Picture, doll, breast model, skill checklist	Contact: *n* = 1 Duration: 30 min. Format: Group	- Breast engorgement at postpartum 7th day - EBF at 4 wks PP	- BF assessment tool - Questionnaire
Gao et al. (2016) China	*N* = 570 *M* Age: 25.6	- Lecture - Practical	- Importance of BF - Latch on, manual expression - Breast engorgement - Positioning - Psychological support	Handbook and doll	Contacts: *n* = 5 qd x 5 Duration: 30 minutes Format: Individual	- Breast pain at postpartum 6th day - Exclusive BF at 6 weeks at postpartum	- VAS - Self-reported questionnaire
Hu (2010) China	*N* = 100 *M* Age: 24 Primipara/multipara	- Lecture - Skill	- Importance of BF - Anatomy and physiology - Human milk production - Positioning & Latch on - Psychological support - BM & manual expression	Doll. Demonstration using warm towel and storage bottle	Contact: *n* = 8 BID x 4 Duration: - Format: Individual	- Breast engorgement at postpartum 4th day	- Palpation assessment by nurse
Huang (2008), China	*N* = 96 Age: - Parity: -	- Lecture - Skill	- Importance of breastfeeding - Latch on - BM & manual expression	Demonstration using warm towel and storage bottle	Contact: *n* = 8 BID x4 Duration: 20 minutes Format: Individual	- Breast engorgement at postpartum 4th day - EBF at 6 wks PP	- Assessment by nurse - Questionnaire
Jiang (2014) China	*N* = 114 *M* Age: 29 Parity: -	- Lecture - Skill	- Importance of breastfeeding - Nutrition - Psychological support - BM & manual expression	Demonstration using warm towel and storage bottle	Contact: 1x Duration: - Format: Individual	- Breast engorgement at postpartum 3rd day	- Assessment by nurse

(Continued)

Table 1. Continued

Author (year) Country	Participants	Type of Education	Content of the Intervention	Teaching Method/tools	Intervention Characteristic	Outcome Measures	Measurement Tools
Labarere et al. (2003) France	*N* = 190 *M* Age: 30.7 Primipara/multipara	- Lecture based	- Importance of breastfeeding - Positioning - Inhibition of formula and pacifier - Sore nipples & engorgement - Working mothers	Handbook and leaflet	Contact: 1x Duration: 30 minutes Format: Individual	- Breast engorgement at postpartum 4 months - EBF at 4 months at postpartum	- Self-reported questionnaire
Labarere et al. (2005) France	*N* = 231 *M* Age: 29.5 Primipara/multipara	- Lecture based	- General health assessment - Physiology of lactation - Positioning & Latch-on - BF related problems - Infants' health - Sources of support	Handouts	Contact: QD x 2 Duration: 2.5 hours Format: Individual	- Breast pain at postpartum 2 weeks - EBF at 4 weeks at postpartum	- Self-reported questionnaire
Li (2015) China	*N* = 400 *M* =Age: 20–38 Parity: Primipara/ multipara	- Lecture - Skill	- Importance of breastfeeding - Nutrition for breastfeeding - Newborn care & latch on - Psychological support - Breast engorgement - BM & manual expression	Handbook. Demonstration using warm towel and storage bottle	Contact: *n* = 4 qd x 4 Duration: - Format: Individual	- Breast engorgement at postpartum 5th day	- Assessment by nurse
Liao (2012) China	*N* = 216 *M* = Age: 24.5 Primipara	- Lecture - Skill	- Importance of breastfeeding - Latch on - Bm & manual expression	Demonstration warm towel and storage bottle	Contact: 3 QD X 3 Duration: 20 minutes Format: Individual	- Breast engorgement at postpartum 3rd day	- Assessment by nurse
Liang et al. (2009) China	*N* =266 Age & Parity: equivalent between groups	- Lecture - Skill	- Importance of breastfeeding - Positioning & Newborn care - Psychological support - BM & manual expression	Doll. Demonstration warm towel and storage bottle	Contact: *n* = 8 BID X 4 Duration: 30 minutes Format: Individual	- Breast engorgement at postpartum 4th day	- Assessment by nurse
Liu et al. (2018) China	*N* =260 Age: - Primipara/multipara	- Lecture - Skill	- Human milk expression - Psychological support expression	Handbook	Contact: 1x Duration: - Format: Group	- Breast engorgement at postpartum 3rd day - EBF at 6 wks PP	- Assessment by nurse - Questionnaire

(Continued)

Table 1. Continued

Author (year) Country	Participants	Type of Education	Content of the Intervention	Teaching Method/tools	Intervention Characteristic	Outcome Measures	Measurement Tools
Luo (2012) China	*N* = 92 *M* Age: 27.8 Primipara	- Lecture - Skills	- Importance of breastfeeding - BM & manual expression	Demonstration warm towel and storage bottle	Contact: *n* = 3 QD x 3 Duration: 20 minutes Format: Individual	- Breast engorgement at postpartum 3rd day	- Assessment by nurse
Ran[b] (2012) China	*N* = 200 Age & Parity: equivalent between groups	- Lecture - Skill	- Importance of breastfeeding - Positioning &Latch on - Rooming in - Nutrition - BM & manual expression	-Demonstration using warm towel and storage bottle	Contact: *n* = 6 BID x 3 Duration: 15 minutes Format: Individual	- Breast engorgement at postpartum 3rd day - Breast pain at postpartum 4th day	- Assessment by nurse - VAS
Tang et al. (2015) China	*N* =186 *M* Age: 32.5 Primipara	- Lecture	- Importance of breastfeeding - Nutrition for breastfeeding - Newborn care - Psychological support Exercise post pregnancy	-	Contact: *n* = 5 QD x 5 Duration: - Format: Individual	- Breast engorgement at postpartum 7th day - Exclusive breastfeeding at 7 days postpartum	- Palpation assessment by nurse - Self-reported questionnaire
Wang (2015) China	*N* = 70 *M* Age: 27.9 Primipara/multipara	- Lecture - Skill	- Importance of breastfeeding - Positioning & Latch on - Nutrition for breastfeeding - Psychological support BM & manual expression	Demonstration using warm towel and storage bottle	Contact: *n* = 5 QD x 5 Duration: - Format: Individual	- Breast engorgement at postpartum 5th day	- Assessment by nurse
Wei (2010) China	*N* = 100 Age & Parity: equivalent groups	- Lecture - Skill	- Importance of breastfeeding - Psychological support - BM & manual expression	Demonstration warm towel and storage bottle	Contact: *n* = 10 BID x5 Duration: 30 minutes Format: Individual	- Breast engorgement at postpartum 5th day	- Assessment by nurse
Yan (2013) China	*N* = 100 *M* Age: 24 Primipara/multipara	- Lecture - Skill	- Importance of breastfeeding - Anatomy and physiology - BM & manual expression	Demonstration warm towel and storage bottle	Contact: *n* = 8 BID x4 Duration: - Format: Individual	- Breast engorgement at postpartum 4th day	- Assessment by nurse
Zhao et al. (2004) China	Sample size: 100 Age & parity: equivalent groups	- Lecture - Skill	- Importance of breastfeeding - Psychological support - Newborn care - BM & manual expression	Demonstration warm towel and storage bottle	Contact: *n* = 8 BID x4 Duration: 10 minutes Format: Individual	- Breast engorgement at postpartum 4th day - EBF at 4 days postpartum	- Assessment by nurse - Questionnaire

(Continued)

Table 1. Continued

Author (year) Country	Participants	Type of Education	Content of the Intervention	Teaching Method/tools	Intervention Characteristic	Outcome Measures	Measurement Tools
Zhang[c] (2007) China	*N* = 60 *M* Age: 25.6 Parity: -	- Lecture - Skills	- Importance of breastfeeding - Positioning & Latch on - BM. & manual expression	-Demonstration warm towel and storage bottle	Contact: *n* = 10 BID x5 Duration: - Format: Individual	- Breast pain at postpartum 5th day	- VAS
Zhang (2013) China	*N* = 100 *M* Age: 29.4 Primipara/multipara	- Lecture - Skill	- Importance of breastfeeding - Positioning - Psychological support - BM & manual expression	Demonstration warm towel and storage bottle	Contact: *n* = 5 Duration: 10 minutes Format: Individual	- Breast pain at postpartum 4th day	- VAS

Note. BF = breastfeeding; BE = Breast engorgement; BP = Breast pain; EBF = Exclusive breastfeeding; NS = not significant; No Information; VAS = Visual analogue scale. All studies took place during the postnatal period.
[a]Data were also collected during a home visit using the same educational content. [b]The intervention was also carried out during the prenatal period with the following topics covered: Importance of breastfeeding, infant nutrition, physiology of newborn, nipple care during pregnancy, aromatherapy breast massage, and psychological support for mother. Class consisted of 10 sessions over 10 days. [c]The intervention was also carried out during the prenatal period with the following topics covered: Importance of breastfeeding, psychological support, and demonstration of positioning.

No heterogeneity was observed among studies that assessed breast engorgement on postpartum Day 4 (Table 2; Figure 2a).

Influence of Breastfeeding Educational Interventions on Breast Pain

In five studies, participants who received educational interventions reported less breast pain at 4–14 days postpartum than those who received usual care. Further, heterogeneity existed among these studies (Table 2 and Figure 2b).

Influence of Breastfeeding Educational Interventions on Exclusive Breastfeeding

The rate of exclusive breastfeeding at 1 week and 4–6 weeks postpartum was examined in two and six studies, respectively. Compared with the controls, participants who received breastfeeding educational interventions were more likely to practice exclusive breastfeeding within 1 week of giving birth without heterogeneity and at 4–6 weeks postpartum with 26% heterogeneity (Table 2; Figure 2c).

Moderator Analysis

We found that participants who received a breastfeeding educational intervention involving a combination of lectures and practical skills had decreased odds of breast engorgement (Table 3). Participants who received breastfeeding education using an individual class format also exhibited significantly reduced breast engorgement (Table 3). Participants who received breastfeeding educational intervention with more than five contacts had significantly lower odds of breast engorgement. Those who received breastfeeding educational intervention and were residing in an eastern country were less likely to experience breast engorgement (Table 3). The effect size for breast engorgement was smaller for studies with a low risk of bias than for those with some concern or high risk of bias (Table 3).

Participants who received an educational intervention involving a combination of lectures and practical skills reported less breast pain (Table 3). A similar result was also found for participants living in an eastern country (Table 3). The effect size for breast pain was larger for studies with some concern of bias than for those with low risk of bias (Table 3).

Subgroup analysis revealed that delivery of an educational intervention using a lecture-based format plus practical skills increased the odds of exclusive breastfeeding at 1–6 weeks postpartum (Table 3). An individual class format for interventions improved the odds of exclusive breastfeeding. Participants with more than one class contact had significantly increased odds of exclusive breastfeeding, and those living in an eastern country showed a significantly higher exclusive breastfeeding rate. The effect size of studies

Table 2. Influence of Breastfeeding Educational Interventions on Breast Engorgement, Breast Pain, and Exclusive Breastfeeding.

Outcome	*N*	OR [95% CI]	Heterogeneity	
			I^2	*p*
Breast Engorgement				
Postpartum day 3	5	0.27 [0.15, 0.48]***	55%	.06
Postpartum day 4	7	0.16 [0.11, 0.22]***	0%	.99
Postpartum day 5–7	5	0.24 [0.08, 0.74]*	84%	<.001
Exclusive breastfeeding				
Postpartum week 1	2	1.95 [1.07, 3.55]*	0%	.44
Postpartum week 4–6	6	1.94 [1.44, 2.62]***	26%	.24
Breast pain Postpartum day 4–14[a]	5	−1.33[a] [−2.26, −0.40]***	96%	<.001

Note. *$p < .05$; **$p < .01$; *** $p < .001$. I^2 = the percentage of variation across studies that is due to heterogeneity.
[a]SMD = standardized mean difference instead of OR.

with a low risk of bias on exclusive breastfeeding was larger than that of studies with some concern and high risk of bias. However, there was no significant difference between the effects of different levels of bias on exclusive breastfeeding (Table 3).

Publication Bias

Begg and Mazumdar's rank correlation test using Kendall's tau statistic with a continuity correction was used to assess the publication bias. Kendall's *s* statistic was −0.27, $z = 1.48$, $p = .13$ for breast engorgement. Similar results were found for breast pain and exclusive breastfeeding: Kendall's *s* −0.50, $z = 1.22$, $p = .22$ and −0.11, $z = 0.37$, $p = .71$, respectively, indicating that no significant publication bias was found.

Sensitivity Analysis

We found no outliers after excluding the study with the largest effect size on breast engorgement, breast pain, and exclusive breastfeeding outcomes. All effect sizes were located within two standard deviations of the point estimates. The results of breast engorgement (OR: 0.21; 95% CI [0.16, 0.29]), breast pain (SMD: −0.74; 95% CI [−1.27, −0.21]), and exclusive breastfeeding (OR: 2.16, 95% CI [1.70, 2.74]) remained statistically significant. These findings suggested that the results of this meta-analysis were robust.

Quality Assessment of Included Studies

Table 4 presents the risk-of-bias assessments for the included studies. Eighteen studies had some concern of bias due to the

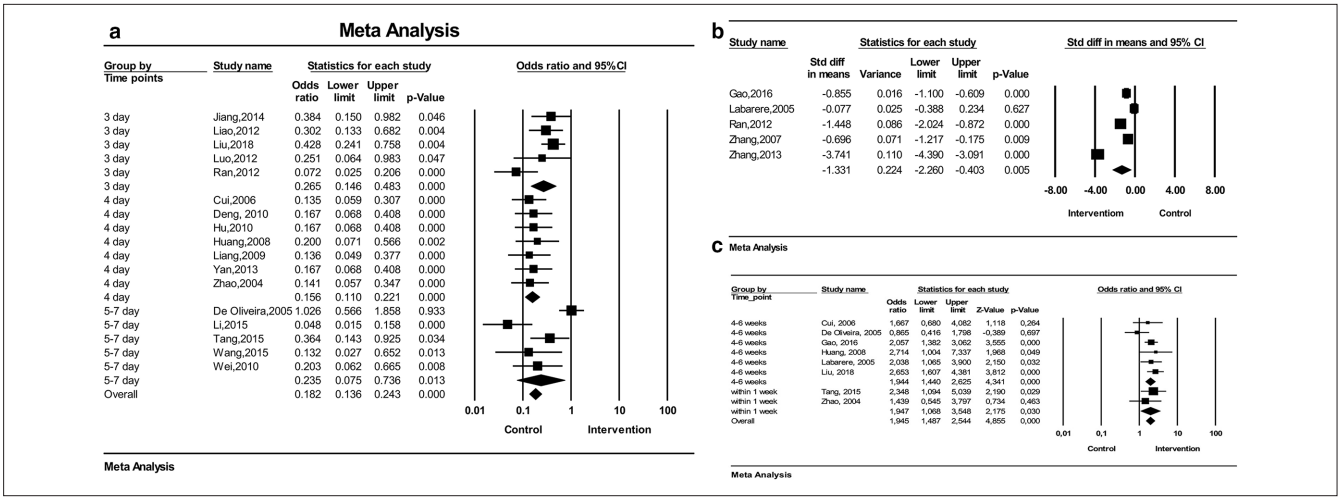

Figure 2. (a) Forest Plot of the Overall Influence of Breastfeeding Educational Interventions on Breast Engorgement. (b) Forest Plot of the Overall Influence of Breastfeeding Educational Interventions on Breast Pain. (c) Forest Plot of the Overall Influence of Breastfeeding Educational Interventions on Exclusive Breastfeeding.

Table 3. Subgroup Analysis and Meta-Regression of Educational Interventions on Breast Engorgement, Breast Pain, and Exclusive Breastfeeding.

	Breast Engorgement			Breast Pain			Exclusive Breastfeeding		
Variable	*n* (%)	OR [95% CI]	*p*	*n* (%)	SMD [95% CI]	*p*	*n* (%)	OR [95% CI]	*p*
Type of health education			.032			.008			.034
Lecture-based	2 (11.8)	0.65 [0.24, 1.79]		1 (20.0)	−0.77 [−0.39, 0.23]		3 (37.5)	1.61 [0.89, 2.93]	
Lecture + practical skill	15 (88.2)	0.21 [0.15, 0.28]		4 (80.0)	−1.66 [−2.80, −0.53]		5 (62.5)	2.16 [1.65, 2.83]	
Class format			.009		-				.668
Individual class	15 (88.2)	0.20 [0.15, 0.26]					5 (62.5)	2.03 [1.51, 2.74]	
Group class	2 (11.8)	0.66 [0.28, 1.56]					3 (37.5)	1.74 [0.93, 3.28]	
Class contact			.006			.580			.833
1 contact	3 (17.7)	0.58 [0.30, 1.10]		0 (0.0)			2 (25.0)	1.57 [0.52, 4.69]	
2–5 contacts	5 (29.4)	0.19 [0.09, 0.40]		3 (60.0)	−1.50 [−2.96, −0.07]		3 (37.5)	2.10 [1.54, 2.86]	
> 5 contacts	9 (52.9)	0.18 [0.13, 0.25]		2 (40.0)	−1.06 [−1.80, −0.33]		3 (37.5)	1.85 [1.07, 3.19]	
Region of the world			.001			.008			.286
Eastern	16 (94.1)	0.19 [0.14, 0.26]		4 (80.0)	−1.66 [−2,80, −0.53]		6 (75.0)	2.18 [1.69, 2.81]	
Western	1 (5.9)	1.03 [0.57, 1.86]		1 (10.0)	−0.77 [−0.39, 0.23]		2 (25.0)	1.35 [0.58, 3.13]	
Risk of Bias			.069			.008			.521
LR	1 (5.9)	0.43 [0.24, 0.76]		1 (20.0)	−0.77 [−0.39, 0.23]		2 (25.0)	2.40 [1.62, 3.58]	
SC	7 (41.2)	0.24 [0.11, 0.54]		4 (80.0)	−1.66 [−2.80, −0.53]		3 (37.5)	1.67 [0.96, 2.89]	
HR	9 (52.9)	0.20 [0.15, 0.27]		0 (0.0)			3 (37.5)	1.85 [1.07, 3.19]	
Maternal age	9 (52.9)	β =0.07	.18	3 (60.0)	B = −0.20	.62		-	

Note. SMD = standardized mean difference; LR = low risk; SC = some concern; HR = high risk; - = insufficient data.

randomization process. Twelve studies had a low risk of bias due to deviation from the intended intervention. All studies had a low risk of bias in missing outcome data. Sixteen studies had some concern due to the measurement of outcome data, and 20 studies had a low risk of bias in the selection of reported results. Regarding overall bias, 3 studies had a low risk of bias, 10 studies had some concern, and 9 studies had a high risk of bias (Table 4).

Discussion

To the best of our knowledge**,** this is the first systematic review and meta-analysis of RCTs in which the influence of breastfeeding educational interventions on breast engorgement, breast pain, and exclusive breastfeeding outcomes were examined using both English and Chinese language articles. We also assessed the critical components of educational interventions through moderator analysis.

Our meta-analysis indicated the influence of breastfeeding educational interventions in reducing the odds of breast engorgement. Our findings are consistent with those of a study conducted in Egypt, which revealed that educational programs could improve postpartum breast discomfort (Shabaan et al., 2018). Evidence has suggested that most mothers experience breast engorgement owing to insufficient knowledge and skills regarding proper breastfeeding techniques (Tiruye et al., 2018). Providing mothers with suitable instructions and necessary skills, for instance positioning and latching-on, may help them breastfeed their infants with correct techniques and increase their confidence to prevent breast engorgement (Tseng et al., 2020). Mothers with high breastfeeding self-efficacy were more likely to exclusively breastfeed (De Roza et al., 2019). Thus, a mother having more comfort and confidence in dealing with her breastfeeding problems (i.e., breast engorgement) is associated with superior postpartum adjustment and recovery (Feenstra et al., 2018), which was suggested as being an important factor for successful breastfeeding until 6 months postpartum. Educational interventions, including proper positioning and correct latching-on, reduce breastfeeding-related problems and are thus beneficial to mothers.

In line with a previous study (Labarere et al., 2005), educational interventions effectively reduced breast pain among breastfeeding mothers. During breastfeeding educational interventions, mothers were provided specific information regarding the procedure of pain relief massage and encouraged to practice such massage by themselves (Gao et al., 2016; Li, 2015). Frequent massaging of the breasts was associated with decreasing the levels of cytokine proteins related to inflammation. However, it is important to consider the health conditions of the mother when developing breastfeeding educational interventions.

Consistent with a prior systematic review and meta-analysis (Brockway et al., 2017), mothers who received educational interventions exhibited improvements in exclusive breastfeeding rates compared with the controls. Professional

Table 4. Risk of Bias Assessment.

Reference	Randomization Process	Deviation from Intended Interventions	Missing Outcome Data	Measurement of the Outcome	Selection of the Reported Result	Overall Bias
Cui et al. (2006)	SC	SC	L	SC	L	H
Deng et al. (2010)	SC	L	L	SC	SC	H
De Oliveira (2005)	SC	SC	L	L	L	SC
Gao et al. (2016)	SC	L	L	SC	L	SC
Hu (2010)	SC	L	L	SC	SC	H
Huang (2008)	SC	SC	L	SC	L	H
Jiang (2014)	SC	SC	L	SC	L	H
Labarere et al. (2003)	L	L	L	L	L	L
Labarere et al. (2005)	L	L	L	L	L	L
Li (2015)	SC	L	L	SC	L	SC
Liao (2012)	SC	L	L	SC	L	SC
Liang et al. (2009)	SC	SC	L	SC	L	H
Liu et al. (2018)	L	L	L	L	L	L
Luo et al. (2013)	SC	L	L	SC	L	SC
Ran and Wu (2012)	SC	L	L	SC	L	SC
Tang et al. (2015)	SC	SC	L	L	L	SC
Wang (2015)	SC	SC	L	SC	L	H
Wei (2010)	SC	SC	L	L	L	SC
Yan (2013)	SC	SC	L	SC	L	H
Zhao et al. (2004)	H	SC	L	SC	L	H
Zhang (2007)	SC	L	L	SC	L	SC
Zhang (2013)	SC	L	L	SC	L	SC

Note. Cochrane Risk of Bias Tool for Randomized Controlled Trials (RoB 2.0) was used. Scoring of L = Low risk; H = High risk; SC = Some concern was used by Higgins, Savović et al. (2016).

support was suggested as an important predictor of exclusive breastfeeding (van Dellen et al., 2019). Mothers who underwent breastfeeding classes received not only tailored education but also professional support. Specifically, the support and advice given by health professionals or significant others (i.e., spouses or family members) strengthened the mothers' breastfeeding knowledge and skills, which possibly had a positive influence on their attitudes and perceptions regarding breastfeeding (Senghore et al., 2018).

Several important aspects should be considered when developing and designing educational interventions aimed at improving breastfeeding. Consistent with previous research (Witt et al., 2016a, 2016b), a combination of lectures and skills education delivered using an individual format helped ameliorate breast engorgement and breast pain. Learning with hands-on practice positively affected breastfeeding behaviors (Tseng et al., 2020). Compared with cognitive learning in lecture only interventions, the addition of teaching mothers' skills allows them to acquire not only breastfeeding knowledge but also hands-on experience in aspects including correct positioning of the baby during breastfeeding, latching onto the breast, breast massage, and manual expression of human milk, which can help reduce breastfeeding-related problems (Witt et al., 2016a, 2016b). Observing a nurse's demonstration of breastfeeding during a skill class encourages mothers to adopt similar behaviors; thus, they assimilate and imitate that conduct, especially if their observational experiences are positive (Bandura, 1997). Therefore, breastfeeding education that combines cognitive and skills elements may be considered an effective strategy for reducing breastfeeding-related problems in postpartum women.

Subgroup analysis revealed that breastfeeding educational interventions delivered with more than five contacts reduced breast engorgement among the mothers. Apparently, frequent contact and an increased intensity of teaching during educational interventions provide mothers with repeated opportunities to apply their breastfeeding-related knowledge by practicing breastfeeding skills. A similar pattern was evident in a previous systematic review and meta-analysis (Brockway et al., 2017). The development of effective postpartum breastfeeding educational interventions should incorporate more than one session.

Our study findings provide novel evidence that breastfeeding educational interventions delivered in eastern countries fostered decreased breast engorgement, and breast pain, and higher exclusive breastfeeding rates compared with the interventions applied (or not) in western countries. Most interventions provided in eastern countries entailed the adoption of integrated complementary interventions (i.e., breast massage) with hospital-based practices (Liu et al., 2018), which may partially explain the positive findings in our study. Nonetheless, further studies are warranted to examine the effect of cultural context on breastfeeding.

We found that studies identified as having a high risk of bias had higher effect sizes than did studies with a low risk of bias on breast engorgement, and the larger effect on reducing breast pain was identified in studies with some concern. In addition, the randomization process and the measurement of outcomes were the main potential sources of bias in the included studies. Further investigations with improvements in randomization and in the adoption of standardized tools is warranted. For example, assessment of breast engorgement using a four-level scale based on criteria of Robson can be used to determine the influence of educational intervention (Alekseev et al., 2015). In addition, future researchers may want to continue post-discharge follow-up, which would be helpful to evaluate the breastfeeding status after the intervention. Recent evidence has demonstrated that the father's involvement during breastfeeding has beneficial effects on the mother's breastfeeding outcomes (Abbass-Dick et al., 2015). It is then worth investigating the influence of breastfeeding education on both mother and father in preventing breast engorgement and breast pain in future research.

Limitations

This study has several limitations that should be considered when interpreting its results. First, there was high heterogeneity among the included studies; however, a subgroup analysis and meta-regression were conducted to further examine the heterogeneity. Second, the included studies had either some concern or high risk of bias in the overall effect, including randomization concealment, blinding, or not using a validated outcome measurement. Future studies should provide detailed information about the validity and reliability of the measurement tools. Third, the exclusive breastfeeding outcome was based on self-reporting by the mothers, which may lead to a recall bias. However, this is a common strategy for collecting information on breastfeeding outcomes in most trials. Further, maternal recall of breastfeeding duration was proved to be accurate 6 years after childbirth (Amissah et al., 2017). Fourth, access to educational or professional support after hospital discharge may have influenced the mothers' breastfeeding practices. In particular, participants from the control group did not receive any intervention; they may have been more likely to seek professional support for the breastfeeding-related problems they experienced after being discharged. However, we did not extract information about this variable because of a lack of data. Fifth, the existence of selection bias resulting from mothers with higher motivation or those who had more time to attend the programs should be considered when interpreting our results. Finally, Chinese articles were retrieved and extracted by two bilingual authors to minimize potential translation issues. However, evidence indicated that most trials conducted in Chinese regions tended to report no negative findings (Tao et al., 2016).

Conclusions

Our meta-analysis suggested that breastfeeding educational interventions can effectively reduce breast engorgement and breast pain and increase the exclusive breastfeeding rate at 1–6 weeks after giving birth. Health professionals should consider frequent contacts (more than five sessions) and combine lectures and skills to alleviate breast engorgement and breast pain in order to sustain exclusive breastfeeding. The allocation of required resources and expenses should be considered when developing individualized class formats. Future studies are warranted to explore the effectiveness of educational interventions on long-term outcomes (e.g., exclusive breastfeeding for 6 months).

Disclosures and conflicts of interest

MHH was a PhD student, and SK was a supervisor for MHH's thesis at the time this article was written. The authors declared that no conflicts of interest exist with respect to this work.

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