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Short Communication

Enhancing oxytocin and prolactin levels to address oligogalactia through emotional management and massage in working mothers

Dwi Astuti[1], Mohammad Z. Rahfiludin[2], Meidiana Dwidiyanti[3] and Hanifa M. Denny[4*]

[1]Doctoral Program in Public Health, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia; [2]Department of Nutrition, Faculty of Nutrition, Universitas Diponegoro, Semarang, Indonesia; [3]Department of Nursing, Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia; [4]Department of Occupational Safety and Health, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia

*Corresponding author: hanifadenny@live.undip.ac.id

Abstract

Emotional management, combined with oxytocin massage and breast care, offers a comprehensive approach to boost prolactin release, enhance milk production, and improve breastfeeding outcomes. The aim of this study was to evaluate the effectiveness of combining emotional management with oxytocin massage and breast care in increasing oxytocin and prolactin hormone levels to address oligogalactia in working postpartum mothers. A quasi-experimental study was conducted at Kudus Community Health Center, Kudus Regency, Central Java, Indonesia, from January to March 2024. A total of 93 postpartum mothers were randomly assigned to three groups: (1) emotional management with oxytocin massage; (2) emotional management with breast care; and (3) lactation education only. Blood samples were collected before and after the interventions to measure oxytocin and prolactin levels. The present study found that emotional management combined with oxytocin massage significantly increased oxytocin levels from 505.0±264.0 pg/mL to 600.0±231.3 pg/mL (mean difference: 103 pg/mL; p=0.002) and prolactin levels from 191.0±67.3 ng/mL to 233.0±86.8 ng/mL (mean difference: 27 ng/mL; p=0.001). The emotional management and breast care group showed a smaller increase in oxytocin (362.0±175.1 pg/mL to 418.0±185.1 pg/mL; mean difference: 23 pg/mL; p=0.048) and a significant increase in prolactin (195.0±48.8 ng/mL to 255.0±82.3 ng/mL; mean difference: 38 ng/mL; p=0.049). In contrast, the lactation education group showed no significant changes in oxytocin (p=0.756) or prolactin levels (p=0.341). In conclusion, emotional management combined with oxytocin massage significantly increased both oxytocin and prolactin levels, suggesting that integrating emotional management and oxytocin massage may be an effective strategy for postpartum lactation support.

Keywords: Emotional management, oligogalactia, oxytocin, prolactin, working mothers

Introduction

Oligogalactia, or insufficient breast milk production, affects an estimated 23–63% of mothers within the first four months postpartum and is often characterized by a perceived inadequate milk supply, leading to initiated supplementary feeding [1]. In Indonesia, the prevalence of oligogalactia is reported to be approximately 35% [2]. The introduction of breast milk substitutes

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increases the risk of infant morbidity and mortality, potentially delaying weight gain and causing deficiencies in essential nutrients, which can contribute to stunting [3-5].

Several factors contribute to reduced breastfeeding rates, including maternal psychological factors, employment status, limited knowledge, and socio-cultural influences [6]. Additionally, inadequate breast care may impair the stimulation of key hormones, such as prolactin and oxytocin, which are essential for milk production [7]. Early return to work postpartum can delay lactogenesis, often resulting in early supplementation with alternative fluids [4]. Furthermore, insufficient breast care may further compromise hormonal stimulation, exacerbating challenges in milk production [2].

In 2021, exclusive breastfeeding rates in Indonesia remained low at 66.1%, with Central Java Province at 66% in 2019 and Kudus Regency at 49.7%, below the 80% target [8], placing Central Java seventh out of 34 provinces and Kudus Regency 32nd out of 35 regencies within the Central Java Province [9]. High employment rates among women in Kudus Regency, particularly new mothers, are associated with emotional stress, anxiety, and reduced breastfeeding motivation, all of which can contribute to insufficient breast milk production [3,10,11]. Limited time for infant care and the need to express breast milk at work further exacerbate these challenges [12-13]. Additionally, neglect of breast care due to work demands can reduce milk production, with working mothers being 2.18 times more likely to discontinue breastfeeding compared to their non-working counterparts [14].

Emotional management has emerged as a promising intervention to enhance breast milk production by addressing both physiological and psychological factors, including anxiety and stress, which are often overlooked [15,16]. Integrating emotional management with established interventions, such as oxytocin massage and breast care, offers a comprehensive approach to improving breastfeeding outcomes and maternal well-being by stimulating prolactin release and enhancing milk production [17]. Emotional regulation is particularly critical for postpartum mothers in formal employment, as approximately 13–19% experience depression, which can impair emotional bonding with their infants and lead to irregular milk production, resulting in infant weight loss [15,18,19]. The aim of this study was to evaluate the effectiveness of combining emotional management with oxytocin massage and breast care in increasing oxytocin and prolactin hormone levels to address oligogalactia in working postpartum mothers.

Methods

Study design and setting

A quasi-experimental study was conducted at Kudus Community Health Center, Kudus Regency, Central Java, Indonesia, from January to March 2024. Ninety-three postpartum mothers were randomly assigned to three groups: (1) emotional management with oxytocin massage; (2) emotional management with breast care; and (3) lactation education only. Emotional management, delivered by midwives, lasted 30–45 minutes and was conducted twice daily for three days. Oxytocin massage, applied along the vertebral column, was performed by trained assistants for 15–20 minutes daily over three days. Breast care interventions followed a seven-step protocol and were administered similarly. Lactation education consisted of six face-to-face sessions, each lasting 20–30 minutes, focusing on breastfeeding techniques and benefits. Blood samples were collected before and after the interventions to measure oxytocin and prolactin levels, allowing comparison across the three groups.

Sampling strategy and criteria

The inclusion criteria included healthy mothers and infants, with infants birth weight ranging between 2500 and 3500 grams, postpartum days 1 to 3, having a normal sucking reflex, exclusive breastfeeding, and maternal employment in the formal sector both before and after childbirth. Mothers with conditions such as flat nipples, a history of breast surgery, or infants with labiodental clefts, infectious diseases, or an inability to breastfeed directly were excluded from the study. Deceased participants who declined to participate in blood sampling were considered dropouts.

The sample size was determined using analysis of variance (ANOVA) calculations. Expected differences in outcomes between the intervention groups were based on prior studies [20]. Statistical power was set at 80% to ensure a high probability of detecting significant differences, with a significance level of 0.05 to reduce the risk of Type I errors. Based on these calculations, a minimum of 93 postpartum mothers was required for the study. Consecutive sampling was used to recruit participants, and 93 eligible postpartum mothers were randomly assigned into three groups: (1) Emotional management with oxytocin massage; (2) Emotional management with breast care; and (3) Lactation education only. Each group consisted of 31 postpartum mothers.

Randomization was carried out using a simple random digit table to ensure unbiased allocation of participants across the study groups. Each eligible postpartum mother was assigned a unique number, which was randomly selected from the table. The randomization process was conducted using computer-generated random numbers to further enhance the precision and reliability of the group assignments. Additionally, the randomization procedure was monitored by an independent research assistant to maintain transparency and minimize any potential allocation bias.

Study procedures

Blood sampling

Participants meeting the inclusion criteria underwent a carefully executed blood sampling procedure before and after the intervention to assess oxytocin and prolactin hormone levels. A standardized 3 mL sample of venous blood was drawn at each time point, collected in tubes without anticoagulants, and allowed to clot for 1–2 hours at room temperature. The samples were then centrifuged at 3000 rpm to separate the serum, after which 1 mL of serum was transferred to microcaps and stored at either -20°C (for up to 2 months) or -80°C (for up to 6 months). Hormone analyses were performed using enzyme-linked immunosorbent assay (ELISA). For the oxytocin examination, the study used the Oxytocin (OT) ELISA kit (Elabscience Biotechnology Co., Ltd, Houston, USA), while the prolactin examination used Prolactin ELISA kit (Diagnostica Biochem Canada, Inc, Ontario, Canada).

Emotional management intervention

Emotional management intervention was delivered by a team of midwives who had been thoroughly briefed on the research protocol. It was structured into five key steps: (1) situation selection, where postpartum working mothers were guided to cultivate a strong determination and desire to breastfeed with full attention, awareness, and without coercion; (2) self-introspection, encouraged mothers to acknowledge any prior challenges or mistakes in breastfeeding and commit to optimizing future breastfeeding practices; (3) focus expansion, aimed at fostering a sense of acceptance and gratitude, viewing the dual role of working and breastfeeding as a meaningful act of worship; (4) cognitive restructuring, where mothers were encouraged to shift their mindset to view breastfeeding challenges as manageable and to actively seek solutions; and (5) relaxation and mindfulness, promoting regular mindfulness practices to alleviate discomfort associated with breastfeeding. Emotional management sessions lasted 30–45 minutes and were conducted twice daily over a three-day period.

Oxytocin massage

Oxytocin massage was administered by massaging along the vertebral column, from the spine to the fifth or sixth rib. The massage was performed using two fists, with the thumbs pointing forward, applying gentle pressure in small circular motions without causing bruises. The procedure was repeated 3–5 times along the spine up to the fifth or sixth costal bone. Trained research assistants conducted the massage for 15–20 minutes daily over three consecutive days.

Breast care intervention

Breast care intervention involved seven steps: initial positioning, circular massage, application of baby oil, support and circular motions, lubrication, knuckle massage, and repetition. The initial position involved placing both hands between the breasts, palms facing downward. A circular massage followed, starting from the middle of the palm and moving in a circular pattern from the

center of the breast to the sides and back to the top, then lifting the breast. The hands were then released forward to support the breasts. Baby oil was applied again to smooth the palms. In the fourth step, the left breast was supported by the left hand, while the right hand used two or three fingers to make circular motions from the base of the breast to the areola and nipple. This was followed by lubrication with baby oil and a knuckling massage, in which the right hand formed a fist, and the knuckles massaged the left breast from the base to the nipple. This process was repeated for both breasts. The breast care was conducted by trained research assistants for 15–20 minutes daily for three days.

Lactation education

Lactation education consisted of six sessions, each lasting 20–30 minutes. The sessions covered the importance of breast milk for infants, the benefits of breastfeeding, proper breastfeeding techniques, expressing breast milk, and breast care. The education was delivered face-to-face by the researchers to the participants. Details of all interventions can be found in the supplementary data.

Study variables

The primary outcomes were oxytocin and prolactin hormone levels, measured via blood sampling following the interventions. Prolactin levels were measured in nanograms per milliliter (ng/mL) and oxytocin levels in picograms per milliliter (pg/mL). Secondary variables included sleep duration, assessed through open-ended questions asking participants to report the total hours slept per day over the previous three days, with the average calculated. The work environment was assessed using a 17-item questionnaire, adapted and translated from a previous study [21], in which participants rated their perceptions of workplace facilities and infrastructure on a 4-point Likert scale (1=strongly disagree; 4=strongly agree). The total possible scores ranged from 17 to 68, and the questionnaire was validated and tested for reliability by the researchers (**Underlying data**) [21]. A higher score indicated a better work environment. Body mass index (BMI) was calculated by dividing the participant's weight (kg) by the square of their height (m). Carbohydrate intake was measured using a 24-hour dietary recall questionnaire [22], in which participants reported their food consumption over the previous 24 hours, and intake was analyzed using the Nutri Survey program.

Statistical analysis

SPSS version 25.0 software (IBM SPSS, Chicago, Illinois, USA) was employed for data analysis, with $p \leq 0.05$ considered statistically significant. Continuous data were presented as mean and standard deviation (for normally distributed data) and as median (minimum-maximum) for non-normally distributed data; categorical data were presented as frequency and percentages. The Shapiro-Wilk test was utilized to assess data normality. For normally distributed data, an analysis of variance (ANOVA) test was conducted, while the Kruskal-Wallis test was used for non-normally distributed data. Oxytocin and prolactin levels before and after each intervention were analyzed using paired t-tests to assess within-group changes. For the multivariate analysis, a general linear model (GLM) was employed, with the mean differences in oxytocin and prolactin levels serving as the dependent variables. These mean differences were calculated by subtracting pre-intervention hormone levels from post-intervention levels to evaluate the impact of the interventions on hormone regulation.

Results

Characteristics of the participants

The present study involved 93 postpartum women who were generally well-balanced in factors such as age, BMI, sleep duration, and carbohydrate intake, as presented in **Table 1**. However, there was a statistically significant difference in the work environment across the groups (p=0.022). The mean age of participants was similar across the groups, with the emotional management and oxytocin massage group having a mean age of 29.5±5.9 years, while the other two groups had mean ages of 28.8±5.4 years and 28.8±5.2 years, respectively (p=0.844). BMI showed slight variation, with median values of 20.8 (15.4–30.8) kg/m² in the oxytocin massage

group, 20.0 (16.0–29.5) kg/m² in the breast care group, and 21.7 (16.0–40.0) kg/m² in the lactation education group, though the difference was not statistically significant (p=0.762). Sleep duration was consistent across the groups, with a median of 10 hours in all three groups, ranging from 8 to 12 hours (p=0.122). However, there was a statistically significant difference in work environment scores, with the oxytocin massage group having a median score of 51.0 (33–58), the breast care group scoring 50.0 (31.0–59.0), and the lactation education group scoring 46.0 (30–58) (p=0.022). Carbohydrate intake showed no significant differences, with median values of 449.1 grams (172–600) in the oxytocin massage group, 439.0 grams (107–498) in the breast care group, and 445.1 grams (87–4744) in the lactation education group (p=0.199).

Table 1. Participants' characteristics

Characteristic	Emotional management and oxytocin massage	Emotional management and breast care	Lactation education	p-value
Age (years), mean±SD	29.5±5.9	28.8±5.4	28.8±5.2	0.844
BMI (kg/m²), median (min-max)	20.8 (15.4–30.8)	20.0 (16.0–29.5)	21.7 (16.0–40.0)	0.762
Sleep duration (hours), median (min-max)	10.0 (8–2)	10.0 (8–12)	10.0 (7–12)	0.122
Work environment, median (min-max)	51.0 (33–58)	50.0 (31.0–59.0)	46.0 (30–58)	0.022
Carbohydrate intake (gram), median (min-max)	449.1 (172–600)	439.0 (107–498)	445.1 (87–4744)	0.199

BMI: body mass index; SD: standard deviation

Effect of emotional management, oxytocin massage, breast care, and lactation education on oxytocin and prolactin hormone levels

Emotional management with oxytocin massage had the greatest impact on increasing oxytocin levels across groups, as detailed in **Table 2**. The emotional management and oxytocin massage group had an increase from 505.0±264.0 pg/mL to 600.0±231.3 pg/mL, with a mean difference of 103 pg/mL (p=0.002). The emotional management and breast care group had a smaller increase from 362.0±175.1 pg/mL to 418.0±185.1 pg/mL, with a mean difference of 23 pg/mL (p=0.048). The lactation education group showed no significant change, with a slight decrease from 335.0±135.7 pg/mL to 330.0±64.0 pg/mL (p=0.756).

Table 2. Effect of emotional management, oxytocin massage, breast care, and lactation education on oxytocin hormone levels before and after intervention.

Group	Oxytocin hormone level (pg/mL), mean±SD		Mean difference (95%CI)	p-value
	Before	After		
Emotional management and oxytocin massage	505.0±264.0	600.0±231.3	103 (-398–410)	0.002
Emotional management and breast care	362.0±175.1	418.0±185.1	23 (-421–336)	0.048
Lactation education	335.0±135.7	330.0±64.0	-4 (-141–(-219))	0.756

CI: confidence interval; SD: standard deviation

Both the emotional management combined with oxytocin massage and the emotional management combined with breast care groups exhibited statistically significant increases in prolactin levels, whereas the lactation education group did not show a significant effect on prolactin levels, as presented in **Table 3**. In the emotional management and oxytocin massage group, prolactin levels increased from 191.0±67.3 ng/mL before the intervention to 233.0±86.8 ng/mL after, with a mean difference of 27 ng/mL (95%CI: -28–146; p=0.001). The emotional management and breast care group also experienced an increase, with prolactin levels rising from 195.0±48.8 ng/mL before the intervention to 255.0±82.3 ng/mL after, showing a mean difference of 38 ng/mL (95%CI: -194–219; p=0.049). This increase was statistically significant, though the effect size was smaller compared to the oxytocin massage group. In contrast, the lactation education group showed no significant change in prolactin levels, with a decrease from

199.0±65.8 ng/mL before the intervention to 187.0±68.2 ng/mL after, resulting in a mean difference of -29 ng/mL (95%CI: -103–228; *p*=0.341).

Table 3. Effect of emotional management, oxytocin massage, breast care, and lactation education on prolactin hormone levels before and after intervention

Group	Prolactin hormone level (ng/mL), mean±SD		Mean differences (95%CI)	*p*-value
	Before	After		
Emotional management and oxytocin massage	191.0±67.3	233.0±86.8	27 (-28–146)	0.001
Emotional management and breast care	195.0±48.8	255.0±82.3	38 (-194–219)	0.049
Lactation education	199.0±65.8	187.0±68.2	-29 (-103–228)	0.341

CI: confidence interval; SD: standard deviation

Multivariate analysis, adjusted for age, nutritional status, sleep duration, and work environment, indicated that emotional management combined with oxytocin massage significantly increased both oxytocin (*p*=0.007) and prolactin levels (*p*=0.006), suggesting that this intervention effectively boosts these hormones, which are critical for lactation. Emotional management combined with breast care significantly increased prolactin levels (*p*=0.006), but the effect on oxytocin was less conclusive (*p*=0.059), showing a positive but less pronounced impact compared to the oxytocin massage group. Carbohydrate intake had a significant effect on prolactin levels, indicating that dietary carbohydrates may influence prolactin secretion (*p*=0.017). However, this effect was not significant for oxytocin levels (*p*=0.233) (**Table 4**).

Table 4. Multivariate analysis adjusted for age, nutritional status, sleep duration, and work environment to evaluate the effect of the interventions on hormone regulation

Variables	Group	B	95%CI	*p*-value
Oxytocin hormone	Emotional management and oxytocin massage	93.532	25.928–161.135	0.007
	Emotional management and breast care	64.752	-2.535–132.038	0.059
	Lactation education	0[a]		
	Carbohydrate intake	0.031	-0.020–0.083	0.233
Prolactin hormone	Emotional management and oxytocin massage	47.179	13.895–80.462	0.006
	Emotional management and breast care	46.919	13.792–80.046	0.006
	Lactation education	0[a]		
	Carbohydrate intake	0.031	0.006–0.056	0.017

CI: confidence interval
[a] Set to zero because this parameter is redundant

Discussion

The present study found that emotional management combined with oxytocin massage significantly increased oxytocin levels from 505.0±264.0 pg/mL to 600.0±231.3 pg/mL (mean difference: 103 pg/mL; *p*=0.002) and prolactin levels from 191.0±67.3 ng/mL to 233.0±86.8 ng/mL (mean difference: 27 ng/mL; *p*=0.001). The emotional management combined with breast care group showed a smaller increase in oxytocin (362.0±175.1 pg/mL to 418.0±185.1 pg/mL; mean difference: 23 pg/mL; *p*=0.048) and a significant increase in prolactin (195.0±48.8 ng/mL to 255.0±82.3 ng/mL; mean difference: 38 ng/mL; *p*=0.049). In contrast, the lactation education group showed no significant changes in oxytocin (*p*=0.756) or prolactin levels (*p*=0.341).

The present study confirmed that emotional management combined with oxytocin massage significantly increased oxytocin (*p*=0.002) and prolactin levels (*p*=0.001). Oxytocin massage, which targets the vertebral area up to the fifth or sixth rib, stimulates parasympathetic nerve activity and enhances hypothalamic oxytocin production [9]. This technique also provides comfort, stimulates breast muscles, improves cardiovascular function, and promotes breast firmness [23,24]. Emotional management helps mothers regulate negative emotions, fostering calmness and comfort [24,25], which is critical for optimizing lactation hormone secretion, as supported by previous studies [26]. Oxytocin massage further enhances relaxation and reduces

pain, facilitating smoother milk flow in postpartum mothers [24]. A relaxed, comfortable environment promotes positive emotions and increases endorphin secretion, which in turn enhances the let-down reflex and raises both prolactin and oxytocin levels [27-28]. Elevated prolactin levels following massage can alleviate psychological disorders such as postpartum blues [25,26,29]. Significant increases in oxytocin and prolactin were observed in mothers without psychological stress, anxiety, or depression, reducing the potential for data bias [30,31]. Psychological stress, anxiety, and depression are known to negatively impact breast milk production and lactation hormones, highlighting the importance of interventions to ensure adequate breastfeeding [19,26,29].

In the second intervention group, emotional management combined with breast care significantly increased both oxytocin (p=0.048) and prolactin levels (p=0.049); however, the increases were smaller compared to those observed in the first intervention group. These findings align with a previous study, which suggests that breast care, along with spiritual interventions such as Qur'anic Murottal, can reduce stress hormones and elevate prolactin levels in breastfeeding mothers [32]. Breast care stimulates both oxytocin and prolactin, the key hormones involved in lactation, ensuring adequate breast milk production to support optimal infant growth [33]. The massage involved in breast care provides regular stimulation to the breast muscles, enhancing blood circulation and improving the function of the lactiferous ducts, thus stimulating prolactin secretion [34]. Additionally, breast care offers numerous other benefits, including increased breast firmness, relaxation of the breast area, prevention of breast cancer and milk duct blockages, maintaining breast cleanliness—especially of the nipples—and promoting nipple prominence [32]. Breast care for postpartum mothers is typically initiated within 1–2 days after childbirth and is performed twice daily [32].

The key difference between oxytocin massage and breast care lies in the location and mechanism of stimulation [23]. Oxytocin massage is applied along the fifth or sixth costal bone, stimulating parasympathetic nerves originating from the medulla oblongata and sacral region of the spinal cord, which transmit signals to the hypothalamus, ultimately prompting the posterior pituitary to release oxytocin [23]. In contrast, breast care focuses on the breast area and does not directly stimulate hormone release; instead, it improves the function of the lactiferous ducts, which subsequently enhances the stimulation of lactation hormones such as prolactin [31].

In the control group, which received only lactation education, there were no significant changes in prolactin or oxytocin levels before and after the intervention. Lactation education for postpartum mothers is a process of providing guidance and support to help individuals achieve optimal development in breastfeeding practices [35]. Continuous breastfeeding education equips mothers with the necessary knowledge and skills, empowering them to make informed decisions based on their needs [35]. It also enables mothers to identify current challenges and implement appropriate solutions to overcome them [34]. Incorporating stress management counseling into breastfeeding education can further enhance maternal self-efficacy and promote continued breastfeeding [36].

Limitations of the present study include the inability to control for potential confounding variables, particularly parity and breastfeeding frequency. These factors could significantly influence the outcomes of interest, such as lactation hormone levels, and their uncontrolled variability may have introduced bias into the results. Furthermore, the quasi-experimental design, while allowing for practical implementation in real-world settings, may inherently introduce selection bias and limit the internal validity of the findings compared to a true experimental design, which would include randomization and stricter control over confounding variables. Consequently, the observed associations in this study should be interpreted with caution. Future studies employing more robust experimental methodologies are recommended to validate these findings.

Conclusion

Emotional management combined with oxytocin massage significantly increased both oxytocin and prolactin levels. In contrast, while emotional management combined with breast care also led to significant increases in these hormones, the magnitude of these changes was less pronounced compared to the oxytocin massage intervention. These findings highlight the

potential of integrating emotional management and oxytocin massage as an effective approach in postpartum care and lactation management, offering valuable benefits for both mothers and healthcare professionals supporting breastfeeding practices.

Ethics approval

The protocol of the present study was reviewed and approved by the Ethical Committee of Health Research, Universitas Diponegoro, Semarang, Indonesia (Approval number: 443/EA/KEPK-FKM/2022).

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Competing interests

All the authors declare that there are no conflicts of interest

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Underlying data

Derived data supporting the findings of the present study, along with the questionnaire and operational standards, are available at https://www.youtube.com/watch?v=2_XONJe6RHw and accessible through the provided link: https://doi.org/10.6084/m9.figshare.26334853.

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