

Optimization of Breast Milk Production Through The Application of Oxytocin Massage Based on LLLT

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ABSTRACT

Breast milk (ASI) production in the early postpartum period often encounters difficulties, requiring effective non-pharmacological interventions. Oxytocin massage and Low Level Laser Therapy (LLLT) are believed to enhance oxytocin reflex and facilitate lactation. Objective: To evaluate the effectiveness of combined oxytocin massage and LLLT on breast milk production among postpartum mothers and to analyze influencing maternal characteristics. Methods: This study employed a pretest–posttest one group design with 40 postpartum mothers. Breast milk production was measured using the pumping method before and after intervention. Data were analyzed using descriptive statistics, paired t-test, and bivariate analysis based on age, parity, education, and delivery history. Results: Mean breast milk production increased significantly from 2.2 ml/day to 75.5 ml/day ($p < 0.001$). Bivariate analysis showed no significant differences by age, parity, or education ($p > 0.05$), but delivery history was significantly associated with milk production ($p = 0.04$). Conclusion: The combination of oxytocin massage and LLLT is clinically effective in enhancing breast milk production among postpartum mothers. Delivery history influences lactation outcomes, suggesting that this intervention has potential to be integrated into midwifery practice to support exclusive breastfeeding and stunting prevention.

Keywords: Breast milk production, Low Level Laser Therapy, Oxytocin massage, Postpartum, Stunting prevention

INTRODUCTION

Breastfeeding has a significant contribution to the growth and development of children because it is directly related to meeting optimal nutritional needs and enhancing the baby's immune system. Breast milk contains macro and micronutrients, antibodies, enzymes, as well as immunological factors that cannot be replaced by formula milk. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend exclusive breastfeeding for the first six months of an infant's life as one of the main strategies to reduce infant morbidity and mortality rates and prevent stunting from an early age.

Although the benefits of breast milk have been scientifically proven, the global coverage of exclusive breastfeeding has still not reached the set target. WHO and UNICEF report that global exclusive breastfeeding coverage has only reached around 41% and is targeted to increase to 70% by 2030. In Indonesia, exclusive breastfeeding coverage is also still fluctuating and faces various challenges, especially in the early postpartum period. One of the main obstacles is the issue of milk production experienced by mothers in the first week after giving birth, which often leads to anxiety, stress, and the decision to provide formula milk early.

Breast milk production is influenced by the hormones prolactin and oxytocin. Early breastfeeding on the first day after childbirth faces several challenges, one of which is that the low breast milk production can affect the mother's emotional condition, which is related to the oxytocin reflex that can influence breast milk production by around 80%-90%. Therefore, efforts to stimulate the hormones prolactin and oxytocin in postpartum mothers, besides expressing breast milk, include breast care, early initiation of breastfeeding (EIB), breastfeeding on demand, and oxytocin massage. Oxytocin massage functions to trigger the letdown reflex and provide comfort to the mother, reduce breast engorgement, reduce milk blockage, and stimulate the release of oxytocin. Oxytocin massage has been proven to enhance the letdown reflex, which is a very important milk ejection reflex in the process (Ardiyanti Hidayah, 2023). Research shows that postpartum mothers who receive oxytocin massage experience a significant increase in breast milk production compared to mothers who do not receive it (Vina Sutratal Putri, 2025). In addition to increasing milk production, oxytocin massage also provides a relaxation effect, reduces stress levels, and boosts mothers' confidence in breastfeeding (Fildzah Shella Afriyani, 2024). Outside of

Indonesia, the effectiveness of oxytocin massage is also supported by international studies showing that this technique is safe, easy to perform, and can be applied independently by mothers or family members. Family support, especially from husbands, in assisting with oxytocin massage has also been shown to improve the success of exclusive breastfeeding. On the other hand, Low Level Laser Therapy (LLLT) is a physiotherapy technology that can enhance microcirculation, muscle relaxation, and nerve stimulation related to the release of the hormone oxytocin.

Low breast milk production in postpartum mothers remains a significant issue because it can hinder the success of exclusive breastfeeding and impact the risk of stunting. One of the contributing factors is the lack of stimulation of the oxytocin hormone, which plays a role in the let-down reflex. Various studies have shown that oxytocin massage can stimulate breast milk production, while Low Level Laser Therapy (LLLT) has been proven to improve microcirculation and peripheral nerve stimulation.

The production and release of breast milk are greatly influenced by the balance of prolactin and oxytocin hormones. Prolactin plays a role in the formation of breast milk, while oxytocin is involved in the let-down reflex or milk ejection. A mother's psychological condition, such as stress, fatigue, and postpartum anxiety, can inhibit the oxytocin reflex by 80-90%, thereby affecting the production and release of breast milk. Therefore, interventions that can stimulate oxytocin both physiologically and psychologically are greatly needed to optimize lactation in postpartum mothers.

Various efforts have been recommended to increase breast milk production, including early initiation of breastfeeding (EIB), on-demand breastfeeding, breast care, breast milk expression, as well as non-pharmacological interventions such as oxytocin massage. Oxytocin massage is a stimulation technique applied along the back from the spine to the scapula aimed at stimulating the release of the hormone oxytocin. This intervention has been proven to enhance the let-down reflex, provide comfort and relaxation, reduce breast swelling (engorgement), and prevent milk blockage (Ardiyanti Hidayah, 2023).

Several studies in Indonesia have shown that postpartum mothers who receive oxytocin massage experience a significant increase in breast milk production compared to mothers who do not receive the intervention (Putri, 2025). In addition, oxytocin massage has also been proven to reduce stress levels and boost mothers' confidence in the breastfeeding process, which is an important factor in the success of exclusive breastfeeding (Afriany, 2024). Family support, especially the role of husbands in assisting with oxytocin massage, further strengthens the effectiveness of this intervention and enhances the success of sustainable breastfeeding.

On the other hand, the development of health technology opens up opportunities for the use of innovative approaches to support the lactation process. One technology that has begun to be widely studied is Low Level Laser Therapy (LLLT). LLLT is a non-invasive light-based therapy with low intensity that has been shown to improve blood microcirculation, accelerate tissue regeneration, stimulate the peripheral nervous system, and provide muscle relaxation effects. Physiological studies indicate that the increase in microcirculation and nerve stimulation from LLLT has the potential to indirectly influence the release of the hormone oxytocin.

Several international studies report that LLLT is effective in increasing tissue perfusion, reducing pain, and stimulating autonomic nerve activity, which is closely related to hormone regulation and the body's relaxation response. In the context of lactation, a relaxed condition and increased blood flow in the relevant areas are believed to support the oxytocin reflex and facilitate milk ejection. However, the use of LLLT in optimizing breast milk production is still relatively limited and has not been widely combined with touch-based midwifery interventions such as oxytocin massage.

Low breast milk production in postpartum mothers remains a public health issue as it can hinder the success of exclusive breastfeeding and have long-term impacts on child growth and development, including an increased risk of stunting. Therefore, an innovative, safe, and evidence-based approach is needed that can optimize breast milk production holistically, both from the physiological and psychological aspects of the mother. The combination of oxytocin massage with Low Level Laser Therapy (LLLT) is expected to provide a synergistic effect in stimulating oxytocin hormone, improving microcirculation, and creating optimal relaxation conditions for postpartum mothers.

State of The Art: Several previous studies have explored the benefits of massage stimulation and laser therapy in the health sector, but there has not been a study specifically examining the combination of oxytocin massage with LLLT in increasing breast milk production. Therefore, this study offers an innovative approach that has not been widely explored in Indonesia and has the potential to become a new breakthrough in technology-based midwifery services.

Novelty: This research proposal with a new approach can combine oxytocin massage with LLLT, which has never been explored in the context of increasing breast milk production, becoming an innovative method where LLLT provides non-invasive stimulation. This has implications for maternal and child health; if proven effective, this method can be integrated into midwifery services to support exclusive breastfeeding and reduce stunting rates. Furthermore, it offers efficiency and practical application in the field to reduce dependence on the skills of healthcare workers, as LLLT can be used with a simple protocol. The combination of oxytocin massage and LLLT

in a single intervention is believed to provide a more effective synergistic effect in naturally, safely, and minimally-risky stimulating breast milk production and release. This method is highly potential to be implemented as part of complementary midwifery services, especially in supporting exclusive breastfeeding programs and reducing the high rates of early formula feeding. This research is very relevant and strategic in addressing real issues in the community. In addition to contributing to the improvement of maternal and child health, the research results can serve as a basis for developing innovative technology-based services in midwifery practice. This aligns with the national priority of accelerating stunting reduction and improving the quality of Indonesia's golden generation by 2045.

Based on this background, this study aims to:

1. Evaluate the effectiveness of combining oxytocin massage with LLLT in increasing breast milk production in postpartum mothers.
2. Determine the differences in breast milk production before and after the LLLT-based oxytocin massage intervention.
3. Analyze the influence of maternal characteristics (age, parity, education, and delivery history) on the intervention outcomes.

METHODS

This study used a quasi-experimental design with a one-group pretest–posttest approach, aimed at evaluating the effectiveness of oxytocin massage intervention based on Low Level Laser Therapy (LLLT) in increasing breast milk production in postpartum mothers. This design was chosen because it allows researchers to measure changes in breast milk production objectively before and after the intervention within the same group, so each respondent serves as their own control. This approach is considered suitable for early clinical research examining the effectiveness of non-pharmacological interventions in a midwifery care setting.

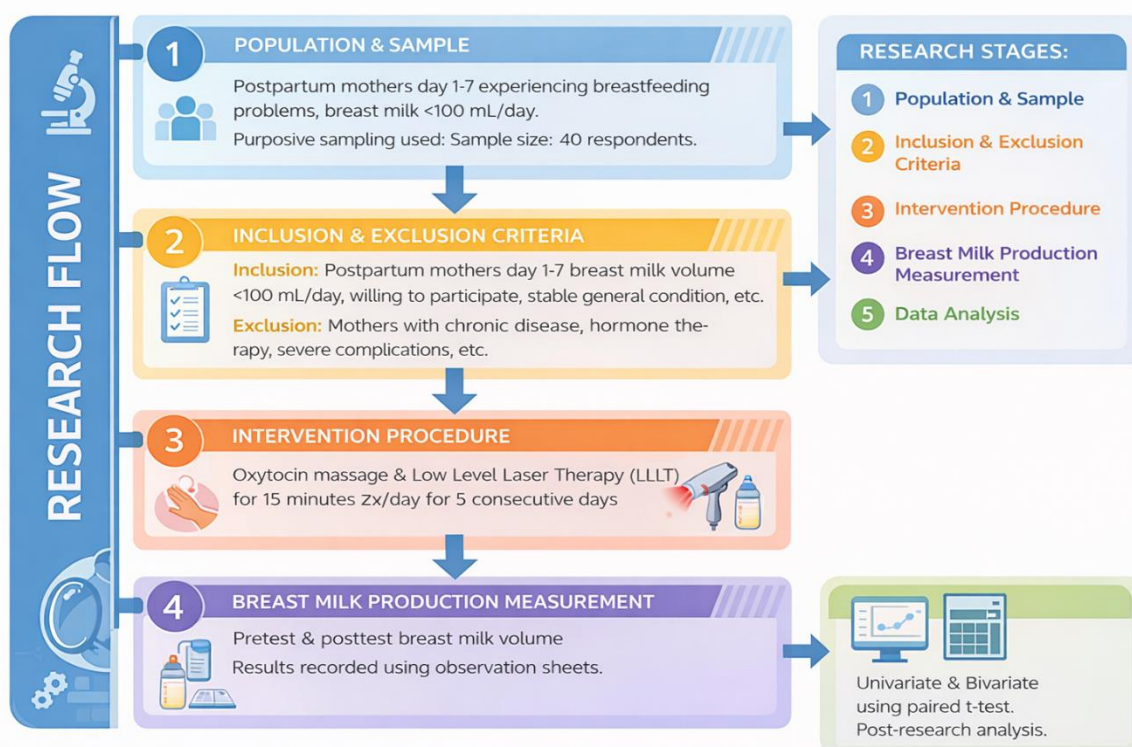


Figure 1. Research Stages Flowchart

Research Population and Sample

The population in this study consisted of all postpartum mothers from day 1 to day 7 who were in the research area and experienced breastfeeding problems, indicated by a breast milk volume of less than 100 ml per day. The early postpartum period was chosen because it is a critical period for lactation formation, during which the oxytocin and prolactin reflexes are still greatly influenced by the mother's physical and psychological conditions.

The sampling technique used purposive sampling, taking into account the predetermined inclusion and exclusion criteria. The sample consisted of 40 respondents, considered sufficient to meet the minimum sample requirements for paired difference statistical analysis, while also taking into account time constraints and research

resources. Respondents were purposively selected to ensure that all participants truly had characteristics relevant to the research objectives.

Inclusion and Exclusion Criteria

The inclusion criteria in this study include: postpartum mothers from day 1 to day 7, willing to participate as respondents by signing informed consent, experiencing breast milk production problems with a volume of less than 100 ml per day, having no contraindications to oxytocin massage or LLLT therapy, and being in a stable general condition.

The exclusion criteria include postpartum mothers with chronic diseases such as uncontrolled diabetes mellitus, endocrine disorders, or other systemic diseases that could affect the lactation process, as well as mothers undergoing hormonal therapy or taking medications known to affect breast milk production. Respondents who experience severe postpartum complications during the intervention period are also excluded from the study to maintain the validity and safety of the research.

Intervention Procedure

The main intervention in this study is oxytocin massage combined with Low Level Laser Therapy (LLLT). The oxytocin massage is performed by healthcare personnel who have received training, in accordance with midwifery technique standards. The massage technique is carried out along the spine (from the thoracic vertebrae to the upper lumbar region) up to the scapula area, aiming to stimulate the parasympathetic nerves involved in the release of the hormone oxytocin. The massage is done with gentle and rhythmic pressure, adjusted to the mother's comfort, to create a relaxation effect and stimulate the let-down reflex.

Low Level Laser Therapy (LLLT) is administered using a laser device with a wavelength of 650–850 nm, which falls into the low-intensity laser category and is safe for soft tissue therapy. LLLT is applied to the upper back area and around the breasts, with attention to the safety principles of device use. This therapy aims to improve microcirculation, stimulate peripheral nerves, and support the physiological release of oxytocin.

Each intervention session lasts for 15 minutes, with a frequency of twice a day, in the morning and afternoon, for five consecutive days. The combination of oxytocin massage and LLLT is carried out in an integrated manner in a single therapy session to achieve a synergistic effect between mechanical stimulation and photobiomodulation stimulation. During the intervention period, respondents are still encouraged to breastfeed their babies on demand and are not given additional pharmacological interventions that could affect milk production.

Measurement of Breast Milk Production

Breast milk production was measured before the intervention (pretest) and after the entire series of interventions was completed (posttest). The volume of breast milk was measured using a standard pumping method for 15–20 minutes on both breasts, using the same breast pump for all respondents to reduce equipment bias. In addition, to improve measurement accuracy, the test weighing method was also used, which involves weighing the baby before and after breastfeeding to estimate the volume of breast milk consumed.

Measurements were taken at relatively the same time each day to minimize physiological variations in breast milk production due to the circadian rhythm. All data were systematically recorded in observation sheets that had been tested for readability by the researchers.

Data Analysis

The collected data were analyzed using statistical software. Univariate analysis was conducted to describe the characteristics of the respondents, including age, parity, education level, and delivery history.

Furthermore, bivariate analysis was performed to determine the differences in breast milk production before and after the intervention using a paired t-test, as the data were normally distributed and came from two measurements within the same group. The level of statistical significance was set at $p < 0.05$. The analysis results showed a p-value of 0.001, indicating a statistically significant difference in breast milk production before and after the administration of oxytocin massage based on LLLT.

RESULTS

The characteristics of the respondents in this study are presented in Table 1. Based on age distribution, the majority of respondents were in the 25–30-year age group, totaling 17 individuals (42.5%), followed by the 20–24-year age group with 15 individuals (37.5%). These age groups fall within the healthy reproductive age range, which physiologically has optimal potential for the lactation process. Meanwhile, respondents over 30 years old each accounted for only 10%, indicating that most postpartum mothers in this study are still in their productive age and relatively at low risk of lactation disorders due to age factors.

Based on parity, most respondents were primipara, totaling 26 people (65.0%), while the multipara respondents were 14 people (35.0%). The high proportion of primipara indicates that most mothers still have limited breastfeeding experience, which can psychologically affect self-confidence, stress levels, and oxytocin reflex in the early postpartum period.

In terms of education level, the respondents are relatively evenly distributed across secondary to higher education. Respondents with high school, Diploma (D3), and Bachelor's degree (S1) education each numbered 12

people (30.0%), while those with junior high school education accounted for only 10.0%. This distribution indicates that most respondents have a fairly good educational background, which could potentially influence their understanding of breastfeeding education and acceptance of the interventions provided.

Based on the history of childbirth, the majority of respondents had normal deliveries, totaling 30 people (75.0%), while deliveries by cesarean section (C-section) amounted to 10 people (25.0%). This childbirth history is an important factor in further analysis because it is related to physical condition, postpartum pain, and the timing of breastfeeding initiation, which can affect breast milk production.

Table 1. Distribution of respondent characteristics

Num.	Category	Frequency (Patient)	Percentage (%)
1	Age		
	20–24 years	15	37,5
	25–30 years	17	42,5
	31–35 years	4	10
	36–40 years	4	10
2	Parity		
	Primipara	26	65
	Multipara	14	35
3	Education		
	Junior High School	4	10
	High School	12	30
	Associate Degree	12	30
	Bachelor Degree	12	30
4	Childbirth History		
	CS	10	25
	SVD	30	75

Based on the table above, there was a significant increase in the average breast milk production from an initial pumping average of 2.2 ml to 75.5 ml on the fifth day of pumping. Descriptive statistics of breast milk production before (pretest) and after the intervention (posttest) are presented in Table 2. The results indicate that before being given the combination intervention of oxytocin massage and LLLT, the average breast milk production of the respondents was very low, at 2.2 ml/day, with a standard deviation of 1.9 ml. The median value was 2.0 ml, with a minimum volume of 0 ml and a maximum of only 8 ml, illustrating that most mothers experienced serious problems with milk output in the early postpartum period.

After being given the intervention for five days, there was a very significant increase in breast milk production. The average milk production increased to 75.5 ml/day, with a standard deviation of 22.8 ml and a median of 80.0 ml. The maximum milk production reached 100 ml, while the minimum value was 1.5 ml, indicating that almost all respondents experienced a clinically significant increase in milk production.

The average difference in milk production between pretest and posttest was 73.3 ml/day, with a median difference of 75.0 ml. These findings indicate that the combination of oxytocin massage based on LLLT not only provides a statistically significant increase but also a clinically meaningful improvement in supporting the lactation process in postpartum mothers.

Table 2. Descriptive statistics of breast milk production pretest and posttest

Variable	N	Mean (ml/day)	SD	Median	Min	Max
Pretest	40	2,2	1,9	2,0	0	8
Posttest	40	75,5	22,8	80,0	1,5	100
Difference	40	73,3	22,5	75,0	0,5	98

Based on the table above, the obtained p-value was <0.001 (p<0.001), indicating a highly significant difference between the combination of LLLT and oxytocin massage. The effectiveness of the intervention was tested using a paired t-test, as presented in Table 3. The analysis results showed a mean difference of -73.3 ml/day, with a t-value of -21.8 and degrees of freedom (df) of 39. The p-value <0.001 indicates that there is a statistically highly significant difference in breast milk production before and after the intervention.

These results indicate that the combination of oxytocin massage and LLLT is effective in increasing breast milk production in postpartum mothers. The magnitude of the average difference in breast milk production demonstrates a strong intervention effect, supporting the assumption of a synergistic effect between mechanical stimulation through oxytocin massage and physiological stimulation through LLLT photobiomodulation on the release of oxytocin hormone and the enhancement of the let-down reflex.

Table 3. Effectiveness test of intervention based on paired t-test results

Variable	Mean Difference (ml/day)	t count	df	p-value
Pretest–Posttest	-73,3	-21,8	39	<0,001**

From the table above, it is noted that the childbirth history shows a significant difference ($p=0.04$). Mothers with normal delivery tend to have higher breast milk production compared to those with C-sections. Other variables are not significant, but they show a clinical trend.

The bivariate analysis of breast milk production after the intervention based on respondent characteristics is presented in Table 4. Based on age groups, no statistically significant difference was found in post-test breast milk production ($p=0.66$). However, there is a tendency for mothers aged 20–30 years to have a slightly higher average breast milk production compared to the age group over 30 years. This indicates that although age does not have a statistically significant effect, there is a clinical trend suggesting that optimal reproductive age is associated with better breast milk production.

Based on parity, there was no significant difference between primiparous and multiparous mothers ($p=0.58$). Nevertheless, these results indicate that the combined intervention of oxytocin massage and LLLT can provide relatively consistent benefits for both first-time mothers and mothers with previous childbirth experience.

From the perspective of education level, no significant differences were found in breast milk production after the intervention ($p=0.61$). However, mothers with a junior high school education showed a relatively higher average breast milk production compared to other groups. This is suspected to be related to factors such as compliance with the intervention and family support, although it was not analyzed in depth in this study.

Unlike other variables, the history of childbirth shows a statistically significant difference in breast milk production after the intervention ($p=0.04$). Mothers with a history of normal delivery had a higher average posttest breast milk production (79.2 ml) compared to mothers with a cesarean section delivery (64.8 ml). These findings indicate that postpartum physical condition and a faster recovery process in normal delivery contribute to successful lactation, although the combination intervention still provides benefits to both groups.

Table 4. Bivariate analysis of breastmilk production after intervention based on respondent characteristics

Variable	Category	Mean Posttest (ml)	p-value
Age	20–24 years	77,0	0,66 (ns)
	25–30 years	76,4	
	31–35 years	70,3	
	36–40 years	70,3	
Parity	Primipara	74,6	0,58 (ns)
	Multipara	71,4	
Education	Junior High School	81,3	0,61 (ns)
	High School	74,6	
	Associate Degree	75,4	
	Bachelor Degree	74,2	
Childbirth History	SVD	79,2	0,04*
	CS	64,8	

DISCUSSION

Based on research conducted by Anggraeni, the age of 20–35 years is considered a healthy production period, where the physical and mental condition of the mother is at its best and ready to breastfeed her baby. The development of reproductive organs is fully matured, making them ready to provide exclusive breastfeeding. A 22-year-old breastfeeding mother will produce more breast milk compared to those aged 35 and above. Meanwhile, the results of this study show that the majority of respondents were aged 36–40 years, so it can be concluded that a mother at that age is likely to experience difficulties in breast milk production.

Basically, a mother who has given birth is instinctively able to perform the task of breastfeeding her baby. However, to practice proper breastfeeding techniques, every mother needs to learn them. The results of this study indicate that the majority of respondents have never had breastfeeding experience or are mostly primiparas. From the first pregnancy and the initial breastfeeding process, these mothers have not gained experience in providing breast milk to their babies. It is different for multiparous mothers who have breastfed in previous births, as they find it easier to breastfeed in subsequent deliveries. Mothers with a parity of 2 or more already have experience in breastfeeding and caring for their babies. The success of a mother in breastfeeding her first child makes her more confident in breastfeeding her next child. This confidence stimulates the oxytocin hormone, allowing breast milk to flow smoothly.

Based on the results of this study, the majority of respondents have completed high school, diploma (D3), and undergraduate (S1) education. According to the theory proposed by Knowledge, one of the factors that influence knowledge is formal education, and this is very closely related. It is expected that with higher education, one's knowledge will be broader. However, not everyone with low education has low knowledge. Knowledge can

be increased not only through formal education but also through non-formal education and experience. In this study, the majority of respondents did not have breastfeeding experience, even though they had high education.

Breast milk production is a physiological process influenced by hormonal balance, the mother's psychological condition, and external stimulation that supports the oxytocin reflex. In addition, breast milk production can also be affected by diet, breastfeeding frequency, gestational age at delivery, birth weight, stress, acute illness, cigarette consumption, and contraceptive pills. The results of this study showed a significant increase in the average breast milk production from 2.2 ml in the pretest to 75.5 ml in the posttest ($p < 0.001$). The increase of 73.3 ml/day indicates that oxytocin massage based on Low-Level Laser Therapy (LLLT) is effective in increasing postpartum mothers' breast milk production. This aligns with research (Nurul Pujiastuti, 2024) which confirms that oxytocin stimulation through massage can strengthen the contraction of myoepithelial cells in the breast alveoli, thereby promoting more optimal milk ejection. Oxytocin massage is one of the non-pharmacological interventions used to help patients relax and relieve discomfort. Relaxation aims to lower epinephrine and norepinephrine levels in the blood to achieve balance (equilibrium); in addition, back massage can also stimulate the hormone endorphin. Endorphins function as ejectors, creating a sense of relaxation and calm, so massage can reduce muscle tension. Massage or stimulation of the spine causes neurotransmitters to stimulate the medulla oblongata, which then sends messages to the hypothalamus in the posterior pituitary to release oxytocin, resulting in the breasts releasing milk. Massage in the spinal area induces relaxation, relieves stress, which in turn releases the hormone oxytocin and will help with breastfeeding. Providing oxytocin massage also has other benefits such as calming and reducing stress, boosting self-confidence, helping postpartum mothers to have positive thoughts and feelings about their baby, and so on.

In addition to the oxytocin massage effect, the stimulation of LLLT in this study also became an important factor. The mechanism of LLLT works by enhancing microcirculation, improving cellular metabolism, and stimulating the release of biological mediators that contribute to smooth muscle relaxation and prolactin hormone release. Other purposes of using LLLT include: LLLT can reduce pain such as muscle pain or inflammation, and LLLT light helps accelerate the regeneration and repair of damaged tissue. This is consistent with the research of Khullar et al. (2020), which explained that LLLT can speed up the regeneration of damaged tissue, address muscle, ligament, and tendon issues, reduce inflammation, and support neuroendocrine regulation, ultimately having a positive effect on oxytocin reflexes. According to research conducted, low-level laser therapy has a significant therapeutic effect on breast swelling problems after childbirth. According to (Maria Victória Candida Gaitero, 2024) in her study, LLLT can be recommended as one of the efforts to address breastfeeding issues, one of which is insufficient milk production. Smooth blood circulation is very important for milk production because good blood flow delivers nutrients and oxygen to the mammary glands, supports the production of the hormone prolactin, and facilitates the smooth release of milk when the baby nurses or the breast is emptied, while circulation problems can hinder the supply of nutrients and hormones, thus reducing milk volume. Lactation massage and early postnatal mobilization have been proven to help improve blood circulation and breast milk production. According to research conducted by Maget (2020), the study divided participants into three groups: group A was the control group, group B received LLLT treatment, and group C received Electroacupuncture treatment. The results from these three groups showed that both the LLLT group and the Electroacupuncture group could increase prolactin hormone production, thereby boosting breast milk production.

Analysis based on respondent characteristics shows several trends in the results. In the age group of 20-24 years, the average increase in breast milk production reached 74.8 ml, while in the 25-30 years age group, the increase was 73.6 ml. Although statistically there was no significant difference between the age groups ($p > 0.05$), these results support the theory that young reproductive-age mothers have optimal lactation capacity compared to older mothers. Similar results were also shown in a study conducted in China by Li, Y., et al. (2021), which found that maternal age does not directly determine breast milk volume, but rather the quality of stimulation and lactation support received. Based on research (Widiastuti, 2020), age is one of the factors that influence breast milk production. Mothers who are of mature age will provide the best for their babies, allowing the babies to grow and develop optimally. Additionally, as a person ages, their psychological and mental condition also becomes more mature.

In terms of parity, primiparas showed an average increase of 72.2 ml, while multiparas showed 69.8 ml. Although not statistically significant, this trend aligns with the theory that multiparas generally have previous breastfeeding experience, which can accelerate the let-down reflex. However, the difference in results in this study may be influenced by psychological factors, confidence levels, or varying obstetric conditions. This phenomenon also occurs in Indonesia, where research shows that multiparas experience milk ejection faster, but the milk volume is not always significantly different from that of primiparas (Yustanta, 2021).

The characteristics of education also show a relatively uniform pattern, with all groups experiencing an increase in breast milk production after the intervention. Mothers with a junior high school education showed the greatest increase (79 ml), followed by those with an associate degree (D3) (73 ml), senior high school (72.5 ml), and a bachelor's degree (S1) (72.2 ml). These differences are not statistically significant, but the literature indicates

that education has more influence on knowledge and exclusive breastfeeding behavior, rather than directly on the physiology of breast milk production (Rahma, A., et al., 2020). Mothers with a secondary to higher education level are able to receive new information and accept changes to improve health, in this case regarding breastfeeding or lactation. They are motivated to seek information, thereby increasing their knowledge and skills related to lactation. A high level of knowledge and understanding is expected to enhance awareness and the ability to manage themselves and their time, as well as lactation management, so that breast milk production runs smoothly and they are able to maximize exclusive breastfeeding.

The history of childbirth appears to be a more prominent factor in the results of this study. Mothers with spontaneous deliveries had an average increase in breast milk production of 76.8 ml, higher compared to cesarean deliveries (63.1 ml). Although this difference is not statistically significant, the trend is consistent with lactation physiology theory. The process of spontaneous delivery allows for a more physiological release of the hormone oxytocin, whereas in cesarean sections there is often a delay in skin-to-skin contact and initial breastfeeding stimulation. The study by Tadesse, S., et al., (2022), also noted that mothers with normal deliveries start breastfeeding more quickly and have a better volume of breast milk compared to post-operative mothers. In line with the research conducted by Widiastuti (2020), postpartum mothers who underwent Cesarean Section, the majority of respondents experienced difficulties in milk production, with 54 respondents (82%) having issues with milk flow and 12 respondents (18%) having smooth milk production. This is due to pain at the incision site, which inhibits the production of prolactin and oxytocin. Procedures such as vacuum, forceps, and cesarean section in pregnant mothers usually cause fatigue, exhaustion, pain, and anxiety, which increase cortisol levels in the blood. High cortisol levels affect lactation, as elevated cortisol inhibits oxytocin production, thereby affecting the effectiveness of the let-down reflex needed to stimulate milk production and release. Indiarti (2015) added that the process of giving birth via Cesarean section becomes an obstacle to successful breastfeeding, especially in the early days after delivery. Postpartum mothers who have had a cesarean section in the first two days are still focused on themselves and their discomfort. The childbirth process through cesarean surgery affects the lactation process. One of the causes is pain at the post-cesarean incision. In addition, the effects of anesthesia on the mother cause her to be relatively unaware and unable to care for her baby in the first hours after birth. Even if the mother receives an epidural that keeps her conscious, the condition of the surgical wound on the abdomen relatively hinders the breastfeeding process. A similar point was also made by Widyatama (2018), stating that the condition of mothers after a caesarean section can limit their movement or body position, making it possibly difficult to breastfeed immediately. As a result, breast milk production may decrease. Meanwhile, the baby might be sleepy and unresponsive to feeding, especially if the mother received pain-relief medication prior to the surgery. Postpartum mothers who undergo a cesarean section experience anxiety and pain at the incision site, affecting the smooth production of breast milk. Pain, anxiety, and stress trigger the release of adrenaline, causing vasoconstriction of the alveolar blood vessels, thereby hindering milk production. The psychological and emotional condition of the mother influences the smoothness of breast milk production. If the mother feels uncomfortable, stressed, pressured, anxious, sad, or tense, it will surely affect the smooth flow of breast milk. Breast milk production difficulties are likely caused by discomfort, tension, anxiety, and pain. Pain in postpartum mothers who have had a cesarean section arises from the incision wound and afterpains, which affect the smooth flow of breast milk. This statement is supported by Hanifa's research (2015), which found a significant relationship between the level of post-cesarean surgery pain and the speed of breast milk secretion (p -value = 0.003). Similarly, Retno et al., (2016) stated in their research that the reasons mothers did not perform Early Breastfeeding Initiation (EBI) were due to cesarean wound pain (92%), discomfort (78%), and the effects of anesthesia (74%). Overall, although bivariate analysis showed no significant differences based on age, parity, education, or obstetric history, the clinical effectiveness of the intervention was clearly evident, with all groups experiencing a clinically significant increase in breast milk production, with an average difference of >70 ml/day. This confirms that the combination of oxytocin massage and LLLT provides broad and effective benefits for various characteristics of postpartum mothers.

CONCLUSION

This study demonstrates that oxytocin massage combined with Low Level Laser Therapy (LLLT) is statistically and clinically effective in increasing breast milk production among postpartum mothers, particularly during the early postnatal period, which represents a critical phase for successful lactation. The significant improvement in breast milk production indicates a synergistic effect between mechanical stimulation through oxytocin massage and physiological stimulation via LLLT, which together enhance the oxytocin reflex, facilitate milk ejection, and promote maternal relaxation.

These findings suggest that oxytocin massage based on LLLT is a safe, simple, and effective non-pharmacological intervention with strong potential for integration into evidence-based midwifery practice. In addition to improving breast milk production, this intervention may also provide psychological benefits for postpartum mothers, thereby supporting the sustainability of exclusive breastfeeding.

Despite these positive findings, this study has several limitations. The recruitment process required a relatively long time due to the specific inclusion criteria, limited to postpartum mothers on days 1–7 who experienced breastfeeding problems, as well as the five-day intervention period and the need to ensure participants' confidence in the safety of LLLT during breastfeeding. These factors may limit the generalizability of the findings.

Based on the results of this study, oxytocin massage combined with Low Level Laser Therapy (LLLT) is recommended as an evidence-based, non-pharmacological intervention to enhance breast milk production during the early postpartum period. Future studies are encouraged to employ randomized controlled designs with larger sample sizes and longer follow-up periods to evaluate long-term effectiveness, cost-effectiveness, and the feasibility of integrating this intervention into routine maternal and child health services.

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