



Clinical trial

Effects of oxytocin massage and music listening on breastfeeding success: A randomized controlled trial

Elham Sadeghi^{a,*}, Gulcin Bozkurt^b^a School of Nursing and Midwifery, University of Lancashire, Preston, United Kingdom^b Department of Midwifery, Faculty of Health Sciences, Istanbul University-Cerrahpaşa, Istanbul, Turkey

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ABSTRACT

Introduction: Non-pharmacological methods such as oxytocin massage and music listening are increasingly used to address breastfeeding challenges by enhancing milk production and reducing maternal stress. This study aimed to evaluate the effects of oxytocin massage and music listening on breastfeeding success (primary outcome: LATCH score at day 7), as well as breastfeeding self-efficacy, neonatal weight gain, and breastfeeding problems (secondary outcomes).

Methods: A randomized controlled trial was conducted in the obstetrics units of two hospitals. A total of 138 postpartum mothers were randomly assigned to one of three groups: oxytocin massage (n = 47), music listening (n = 47), or control (n = 44). A per-protocol analysis was completed with 120 mothers (n = 40 per group) at day 7. Data collection included a pilot study and two implementation phases. Instruments used were the Personal Information Form, the LATCH Breastfeeding Assessment Tool, and the Breastfeeding Self-Efficacy Scale. Data were analyzed using one-way ANOVA, repeated-measures ANOVA, Kruskal–Wallis, Mann–Whitney U, and Wilcoxon signed-rank tests, with a significance threshold of $p < 0.05$.

Results: The mean age of participating mothers was 24.95 ± 2.99 years, with no significant differences between groups ($p > 0.05$). Both oxytocin massage and music listening significantly improved LATCH scores (mean increase: 2.68 and 2.28, respectively; $p < 0.001$) and breastfeeding self-efficacy scores (mean increase: 11.73 and 9.13, respectively; $p < 0.001$) compared to the control group, which showed minimal improvement. Neonates in the oxytocin massage and music listening groups demonstrated significantly greater weight gain (mean gain: 181.38g and 97.75g, respectively; $p < 0.001$), whereas control neonates showed a mean weight loss of 33.88g ($p = 0.17$). The occurrence of breastfeeding problems also decreased significantly in both intervention groups ($p < 0.05$). While oxytocin massage showed slightly greater improvements than music listening, the difference between the two interventions was not statistically significant.

Conclusion: Oxytocin massage and music listening are equally effective, low-cost, non-invasive complementary interventions that enhance breastfeeding outcomes and neonatal weight gain. Both methods may be recommended as supportive strategies in postpartum care.

1. Introduction

The World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF) recommend that neonates be exclusively breastfed for the first six months and that breastfeeding continues along with complementary foods until at least

two years of age [1,2]. However, in Turkey, only 41% of neonates aged 4–5 months are exclusively breastfed [3]. Breast milk protects children against infectious diseases, while also reducing the risk of various types of cancer in mothers [4]. Among the global goals, increasing the rate of exclusive breastfeeding for the first six months to 70% by 2030 is an aim [5].

Abbreviations: ANOVA, Analysis of variance; APGAR, Appearance, Pulse, Grimace, Activity, and Respiration; BSES-SF, Breastfeeding self-efficacy scale–short form; CONSORT, Consolidated standards of reporting trials; LATCH, Latch, Audible swallowing, Type of nipple, Comfort, Hold; RA, Rank average; RCT, Randomized controlled trial; RS, Rank sum; SD, Standard deviation; SPSS, Statistical package for the social sciences; UNICEF, United Nations International Children's Emergency Fund; WHO, World Health Organization.

* Corresponding author.

E-mail address: elham.sadeghi86@gmail.com (E. Sadeghi).

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Breastfeeding success is influenced by sociocultural, psychological, and individual factors [6]. A mother's breastfeeding experience, knowledge, and support are critical factors that influence the duration of breastfeeding [7]. Emotional stress after childbirth negatively affects milk production [8,9].

Pharmacological and nonpharmacological methods are used to solve

breastfeeding problems. Among the nonpharmacological methods, oxytocin massage and playing music are included. While oxytocin massage has the potential to increase milk production, playing music can provide peace to mothers and support breastfeeding [10,11].

Oxytocin massage is a type of massage applied along the spine to the fifth and sixth rib bones after childbirth, stimulating the prolactin and

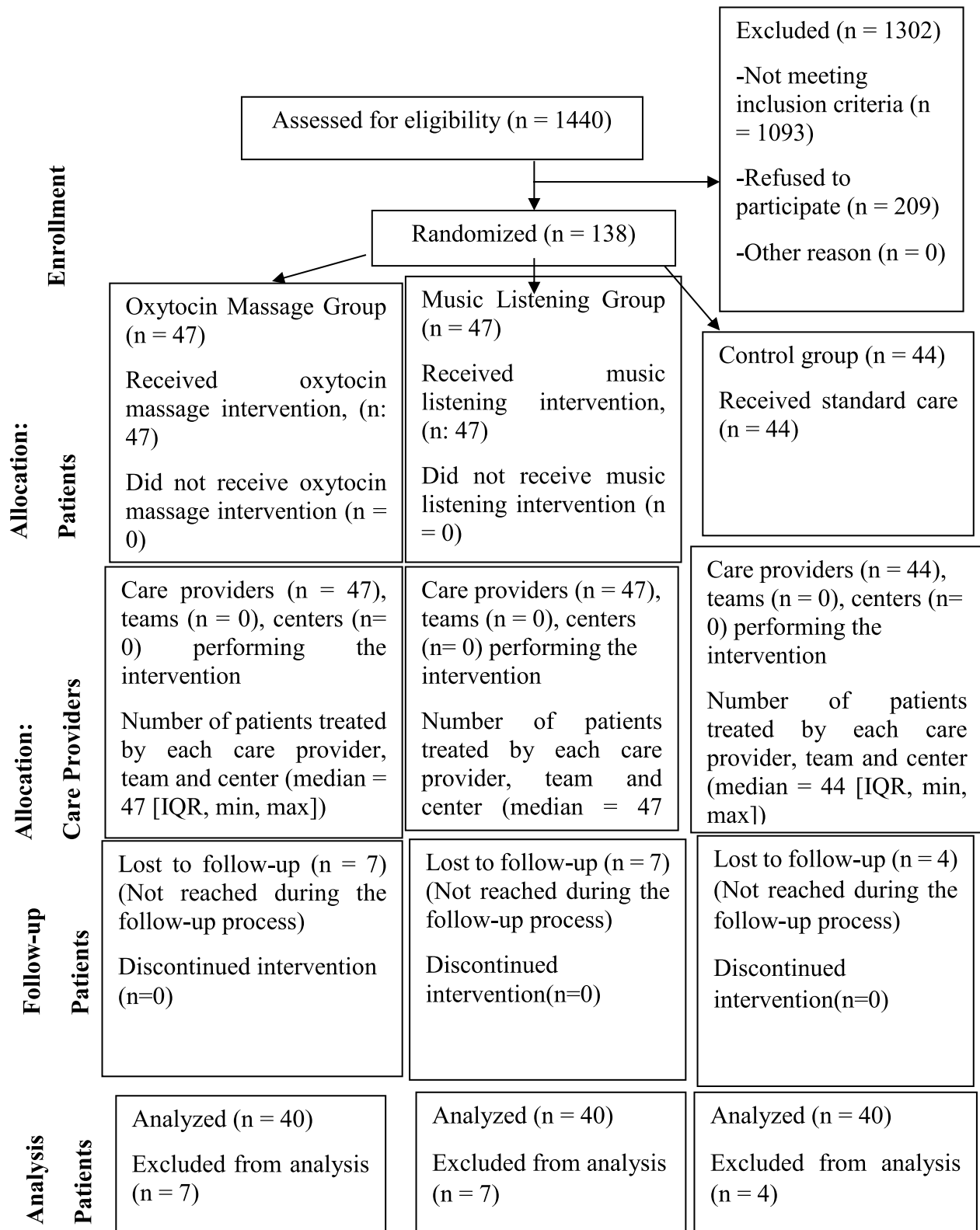


Fig. 1. Flow CONSORT diagram of the study.

oxytocin hormones to increase breast milk secretion [12]. Oxytocin promotes the contraction of cells surrounding milk glands, facilitating milk flow and making it easier for babies to receive milk while breastfeeding [13]. When breastfeeding begins, actions such as the mother touching, smelling, or seeing her neonate stimulate the oxytocin reflex; however, if the mother is in pain or emotionally stressed, this reflex may be inhibited [14].

Additionally, this massage is an effective method to increase oxytocin release and provide mothers with confidence and comfort [15]. When massage is applied to the spine, neurotransmitters stimulate the medulla oblongata, sending a message to the hypothalamus to increase oxytocin release and support milk production. Additionally, this massage helps reduce stress and alleviate tension [16].

Listening to music is an effective nonpharmacological method that supports breastfeeding and is used in various fields of medicine, such as mental health, rehabilitation, pain management, and stress [17]. Music is also an important tool for increasing breast milk production. Through regular tempos, rhythms, and melodies, it provides mental and emotional relaxation [18]. Additionally, listening to music has been shown to support milk production by increasing oxytocin levels and reducing stress levels. Moreover, owing to its effects on the hypothalamic-pituitary axis, it can reduce the release of stress hormones and increase prolactin production [17,19]. Music contributes to the reduction in stress by promoting the dilation of blood vessels and increasing the production of nitric oxide and endorphins in the body. Music interventions can be applied actively or passively. In active music intervention, individuals participate by singing or playing instruments, whereas in passive music intervention, listeners listen to music selected by the therapist [17].

There are no studies in the literature comparing these two methods. The primary outcome of this study was breastfeeding success measured by the LATCH Breastfeeding Assessment Tool score at day 7. Secondary outcomes included breastfeeding self-efficacy, neonatal weight gain, and the occurrence of breastfeeding problems.

2. Methods

2.1. Research design

This randomized controlled trial (RCT) was conducted in the obstetrics units of two hospitals between 2022 and 2023. The study was registered with the ClinicalTrials.gov under NCT05059028. Participant flow was reported using the CONSORT diagram (Fig. 1).

2.2. Setting and context

This study was conducted in the maternity and obstetrics units of two public (state) tertiary hospitals located in Turkey, where breastfeeding is widely promoted as the primary method of neonate feeding. Although hospital initiation rates are high, exclusive breastfeeding often declines rapidly postpartum due to societal stigma, return to work, and inconsistent lactation support. Complementary methods such as oxytocin massage or music therapy are not widely used or known within routine care.

2.3. Sample and randomization

Participants were postpartum women who met the following inclusion criteria: age ≥ 20 years; singleton, term (38–42 weeks) vaginal birth; no history of breast surgery or substance use during pregnancy; absence of complications that might hinder breastfeeding for either mother or neonate; no communication barriers; neonate 5-minute Appearance (skin color), Pulse (heart rate), Grimace (reflex irritability), Activity (muscle tone), and Respiration (breathing) (APGAR) ≥ 8 and birth weight between 2500 and 4000 g. Exclusion criteria at baseline included: severe maternal or neonatal medical complications that

prohibited breastfeeding, or communication barriers.

Sample size was calculated using G*Power version 3.1.3. Based on a projected 0.5-point difference in post-intervention LATCH scores, a minimum of 39 participants per group was required ($\alpha = 0.05$, power = 0.80) [20]. To account for potential attrition, a total of 138 eligible participants were enrolled and randomized into three groups: music listening ($n = 47$), oxytocin massage ($n = 47$), and control ($n = 44$). A per-protocol analysis was conducted on the 120 participants ($n = 40$ per group) who completed all study procedures and day 7 follow-up evaluations. Eighteen participants (7 in the music listening group, 7 in the oxytocin massage group, and 4 in the control group) were lost to follow-up or discontinued before day 7 and were excluded from the final analysis.

Randomization was performed using Research Randomizer software (<https://www.randomizer.org/>), a validated web-based tool for generating random allocation sequences. Simple random allocation without stratification or blocking was used. The randomization sequence was generated by an independent researcher who was not involved in participant recruitment or outcome assessment. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes that were opened after participant enrollment.

Despite randomization, a small baseline difference in LATCH scores was observed between groups ($p = 0.026$), which is likely attributable to chance given multiple baseline comparisons. Therefore, the primary analyses focused on changes in outcomes from day 1 to day 7 and comparisons of change scores between groups.

Due to the nature of the interventions, participants and intervention providers could not be blinded. However, the researcher responsible for outcome assessment was blinded to group allocation.

2.4. Data collection tools

Personal Information Form: Included 17 items related to maternal demographics, obstetric history, and breastfeeding characteristics (e.g., initiation timing, breastfeeding issues).

LATCH Breastfeeding Assessment Tool: Developed by Jensen, Wallace, and Kelsay (1994) [21], the LATCH scale evaluates breastfeeding effectiveness across five dimensions: latch, audible swallowing, type of nipple, comfort, and hold. Each item is scored from 0 to 2, for a total score of 0–10. Higher scores indicate more effective breastfeeding. Cronbach's α in this study was 0.83.

Breastfeeding Self-Efficacy Scale–Short Form (BSES-SF): Developed by Dennis (2003) [22], this 14-item scale measures maternal confidence in breastfeeding. Responses range from 1 (not at all confident) to 5 (always confident), with total scores ranging from 14 to 70. Cronbach's α in this study was 0.85.

2.5. Pilot study

A pilot test with five mothers was conducted to evaluate the feasibility of the interventions and the clarity of data collection tools. Participants listened to three music samples—pentatonic, Buzurk makam, and Mozart. Four preferred the Buzurk makam, which was selected for the main trial. These mothers were excluded from the final sample.

2.6. Intervention protocols

All participants received standard postpartum care. In oxytocin massage group; to ensure standardization, all relatives were trained in-hospital by the same researcher using a standardized illustrated protocol and written brochure. Training included a live demonstration, supervised practice, and return demonstration until proficiency was achieved. The massage technique was standardized as follows: mother leaning forward with upper back exposed; bilateral thumb pressure applied from the 7th cervical vertebra to the 5th–6th thoracic vertebrae using firm, circular strokes. Each session lasted 10–15 min, twice daily

(morning and evening) within one hour before breastfeeding. Adherence was verified through daily phone calls for the first 3 days and in-person evaluation on day 7, during which relatives demonstrated the technique again to confirm continued proficiency. Retraining was provided if needed; no major deviations were identified. In Music Listening Group; All participants received the same Buzurk makam recording, selected based on pilot testing. Listening occurred twice daily for 7 days, starting 5 min before breastfeeding and continuing throughout the feeding session. Volume level and use of headphones versus speakers were self-selected to reflect real-world conditions and maximize maternal comfort and adherence. Participants maintained a daily listening log, and adherence was verified through daily phone calls (first 3 days) and day 7 in-person evaluation. In Control Group; participants received standard care without any additional intervention. After study completion, they were informed about the massage and music therapies.

All participants were given the researcher's contact information for questions. Intervention adherence was verified through follow-up phone

calls and in-person evaluations on day 7.

In follow-up and evaluation, postnatal evaluations were conducted during routine Fourth Postnatal Visits (days 2–5) at Family Health Centers. On day 7, all participants underwent follow-up assessments where LATCH and BSES-SF scales were re-administered. Neonate evaluations were performed in line with national postpartum care protocols (Fig. 2).

2.7. Ethical considerations

Participants provided written informed consent and were reminded of their right to withdraw at any time (autonomy). Data confidentiality, anonymity, and security were ensured throughout, in accordance with ethical research principles. Ethical approval was obtained from the Clinical Research Ethics Committee (16.09.2021; No: 2017-KAEK-120, 10/2/2021.G-140) and the Hospital Group Directorate (07.01.2022). Therefore this study was registered with the ClinicalTrials.gov under the

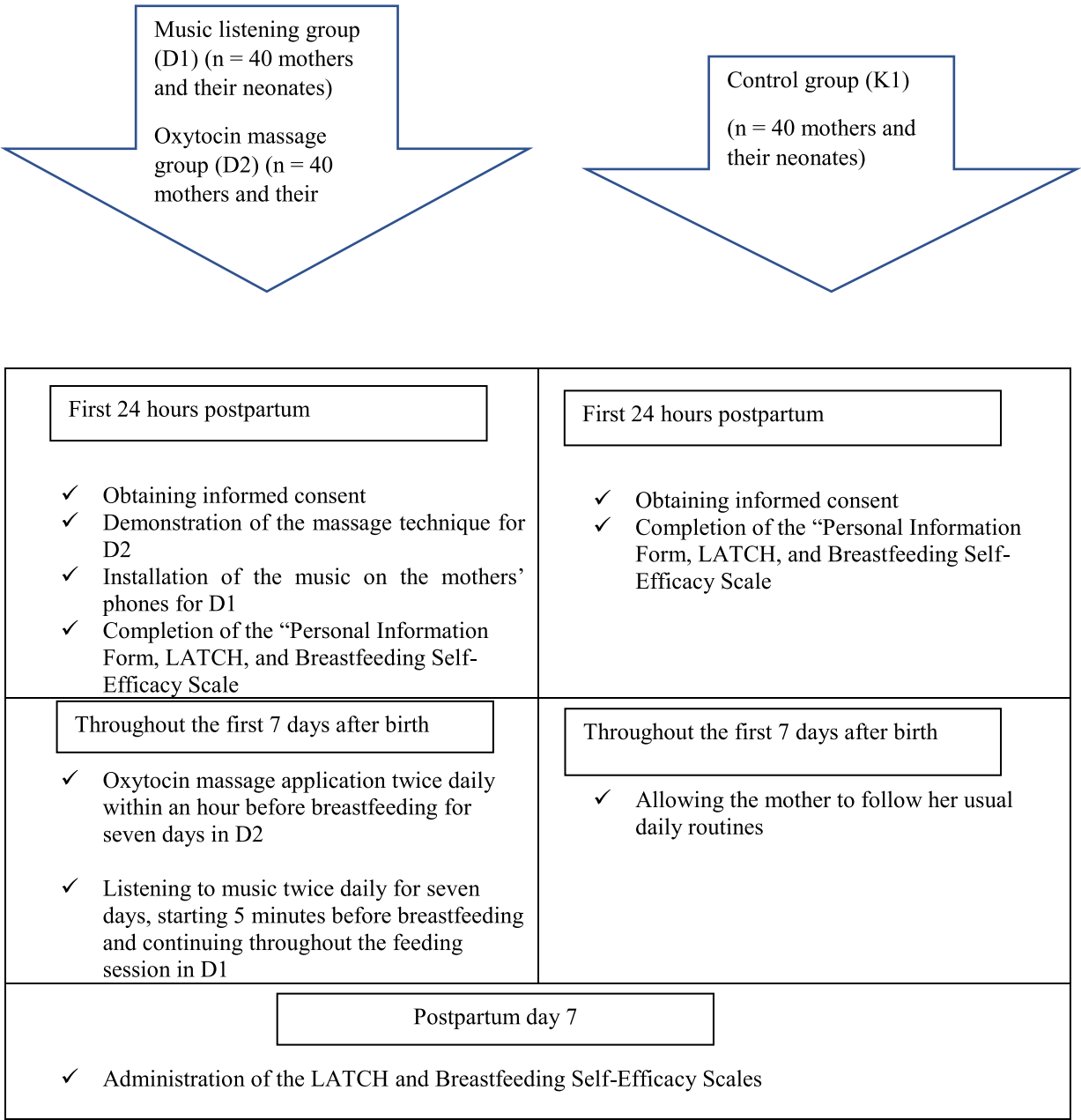


Fig. 2. Research flow diagram.

number NCT05059028 on August 2022.

Trial registration

This study was registered with the ClinicalTrials.gov under the number NCT05059028 on August 2022.

Ethical approval

Ethical approval was obtained from the Clinical Research Ethics Committee (16.09.2021; No: 2017-KAEK-120, 10/2/2021.G-140) and the Hospital Group Directorate (07.01.2022).

2.8. Data analysis

Data were analyzed using SPSS version 22.0. Descriptive statistics (mean, standard deviation, median, frequency, percentage) were used to summarize baseline maternal and neonatal characteristics. Categorical baseline variables were compared using the Chi-square test (with Cramer's V for effect size). Normality of continuous variables was assessed via skewness, kurtosis, and Shapiro-Wilk tests. For continuous outcomes measured across multiple groups, parametric one-way ANOVA (with post-hoc Tukey tests) was used when normality assumptions were met, while Kruskal–Wallis and Mann–Whitney U tests were applied for non-normally distributed data. To evaluate within-group longitudinal changes from day 1 to day 7, non-parametric Wilcoxon signed-rank tests were used for LATCH, BSES-SF, and breastfeeding problems due to ordinal scoring structures or skewed distributions. For between-group comparisons of change scores (day 7 minus day 1) in continuous outcomes, one-way ANOVA was utilized. For continuous physiological measurements with baseline and follow-up data (neonatal weight gain), a repeated-measures ANOVA was performed to evaluate the main effects of time, group, and the group-by-time interaction. Statistical significance was set at $p < 0.05$ throughout.

3. Results

The mean ages of mothers in the music listening (D1) and oxytocin massage (D2) groups were 25.42 ± 3.07 and 25.25 ± 3.06 years, respectively, while the control group averaged 24.20 ± 2.79 years. No statistically significant differences were observed between the groups in maternal age, education level, employment status, income, or family structure ($p > 0.05$) (Table 1). Baseline obstetric characteristics such as pregnancy planning, delivery mode, gravida, abortus, time to first skin-to-skin contact, and time of first breastfeeding were also comparable across groups ($p > 0.05$).

3.1. Primary outcome

3.1.1. LATCH breastfeeding assessment

On day 1, LATCH scores differed significantly among groups \ [F (2.117) = 3.76, $p = 0.026$], with both the music listening and oxytocin

massage groups showing higher scores than the control group. By day 7, the increase in LATCH scores from baseline was significantly greater in both intervention groups compared to controls [F (2.117) = 12.22, $p < 0.001$, $\eta^2 = 0.173$ (moderate effect)]. The mean increase was 2.68 (95% CI: 2.12–3.24) in the oxytocin massage group and 2.28 (95% CI: 1.69–2.87) in the music listening group, compared to 0.95 (95% CI: 0.48–1.42) in the control group, with no significant difference between the two interventions. Within-group comparisons demonstrated significant pre-post improvements in all groups (music: $Z = -4.48$, $p < 0.01$; massage: $Z = -5.31$, $p < 0.001$; control: $Z = -3.59$, $p < 0.001$), although the magnitude of improvement was greatest in the intervention groups (Table 2).

3.2. Secondary outcomes

3.2.1. Breastfeeding self-efficacy

Between-group analysis showed a significant difference in breastfeeding self-efficacy scores at day 7 across the three groups (F(2.117) = 34.88, $p < 0.001$, $\eta^2 = 0.37$), indicating a large effect size. Post-hoc comparisons demonstrated that both the music listening group and the oxytocin massage group had significantly higher breastfeeding self-efficacy scores compared with the control group ($p < 0.001$ for both comparisons), while no significant difference was observed between the two intervention groups. Within-group analyses showed significant increases in breastfeeding self-efficacy from day 1 to day 7 in the music listening group ($Z = -4.81$, $p < 0.001$) and the oxytocin massage group ($Z = -5.30$, $p < 0.001$), whereas no significant change was observed in the control group ($p > 0.05$). These findings indicate that both interventions were associated with meaningful improvements in maternal breastfeeding confidence over the first postpartum week (Table 3).

3.2.2. Breastfeeding problems

On Day 1, no breastfeeding problems were reported in the control

Table 2

Within-group comparison of LATCH breastfeeding assessment scores between day 1 and day 7 (Wilcoxon signed-rank test).

Group	Comparison (Day 7 – Day 1)	n	Rank Average (RA)	Rank Sum (RS)	z	p
Music Listening (D1)	Negative Rank	1	11.50	11.50	-4.484	.001
	Positive Rank	28	15.13	423.50		
	Ties	11				
Oxytocin Massage (D2)	Negative Rank	0	.00	.00	-5.318	.001
	Positive Rank	36	18.50	666.00		
	Ties	4				
Control (K)	Negative Rank	1	7.50	7.5	-3.598	.001
	Positive Rank	17	9.62	163.50		
	Ties	22				

RA = Rank Average; RS = Rank Sum; Z = Wilcoxon Signed-Rank Test statistic.

* Negative ranks indicate decreased scores at day 7 compared with day 1, whereas positive ranks indicate increased scores.

Table 1

Distribution and comparison of mothers' demographic characteristics.

Variables		Music (D1)		Oxytocin Massage (D2)		Control (K)		V	X ²	p
		n	%	n	%	n	%			
Mother's age	≤ 25	20	16.7	22	18.3	26	21.7	.13	1.90	.39
	> 25	20	16.7	18	15.0	14	11.7			
Mother's education level	Elementary	0	0	3	2.5	0	0	.18	8.12	.09
	Secondary & High	12	10.0	14	11.7	18	15.0			
	University	28	23.3	23	19.2	22	18.3			
Mother's employment status	Employed	10	8.3	15	12.5	8	6.7	.17	3.26	.19
	Housewife	30	25.0	25	20.8	32	26.7			

N: sample size, V: test statistic, X²: chi-square test, p: p-value.

Table 3

Within-group comparison of Breastfeeding Self-Efficacy Scale scores between day 1 and day 7.

Group	Comparison (Day 7 – Day 1)	n	Rank Average (RA)	Rank Sum (RS)	z	p
Music Listening (D1)	Negative Rank	3	9.00	27.00	-4.816	.001
	Positive Rank	33	19.36	639.00		
	Ties	4				
Oxytocin Massage (D2)	Negative Rank	0	.00	.00	-5.308	.001
	Positive Rank	37	19.00	703.00		
	Ties	3				
Control (K)	Negative Rank	16	24.13	386.00	-1.165	.24
	Positive Rank	19	12.84	244.00		
	Ties	5				

RA = Rank Average; RS = Rank Sum; Z = Wilcoxon Signed-Rank Test statistic.

* Negative ranks indicate decreased scores at day 7 compared with day 1, whereas positive ranks indicate increased scores.

group (0.0%), compared with 22.5% in the music listening group and 10.0% in the oxytocin massage group. Because participants were randomly allocated, this baseline difference reflects expected chance variation. To account for this baseline difference, primary evaluations focused on the relative reduction and pre-post change scores within and between groups from Day 1 to Day 7. The occurrence of breastfeeding-related problems decreased significantly from day 1 to day 7 in both intervention groups. In the music listening group, a significant reduction was observed ($Z = -2.83$, $p = 0.005$), while the oxytocin massage group also demonstrated a significant improvement ($Z = -2.00$, $p = 0.046$). In contrast, no statistically significant change occurred in the control group ($p > 0.05$). The magnitude of change indicates that both interventions contributed to reducing common breastfeeding difficulties during the early postpartum period (Tables 4 and 5).

3.2.3. Neonatal weight gain

A repeated-measures ANOVA examined neonatal weight changes from day 1 to day 7 across the study groups. No significant differences were observed in baseline neonatal weights between groups ($F(2,117) = 0.260$, $p = 0.772$, $\eta^2 = 0.004$). A significant main effect of time indicated overall neonatal weight gain during the first postpartum week ($F(1,117) = 33.922$, $p < 0.001$, $\eta^2 = 0.225$). Importantly, a significant interaction effect between group and time was detected ($F(2,117) = 19.923$, $p < 0.001$, $\eta^2 = 0.254$), demonstrating that weight gain differed across groups over time. Neonates in the music listening group gained a mean of 97.75 g, while those in the oxytocin massage group gained a mean of 181.38 g between day 1 and day 7. In contrast, neonates in the control group experienced a mean weight change of -33.88 g during the same period. These findings suggest that both interventions were associated with greater neonatal weight gain compared with routine care (Table 6).

Table 4

Changes in breastfeeding problems between day 1 and day 7.

Group	Comparison (Day 7 – Day 1)	n	Rank Average (RA)	Rank Sum (RS)	z	p
Music Listening (D1)	Negative Rank	8	4.50	36.00	-2.828	.005
	Positive Rank	0	0.00	0.00		
	Ties	32				
Oxytocin Massage (D2)	Negative Rank	4	2.50	10.00	-2.000	.046
	Positive Rank	0	.00	.00		
	Ties	36				
Control (K)	Negative Rank	0	.00	.00	-0.000	1.000
	Positive Rank	0	.00	.00		
	Ties	40				

RA = Rank Average; RS = Rank Sum; Z = Wilcoxon Signed-Rank Test statistic.

Note. * Negative ranks indicate a reduction in the occurrence of breastfeeding problems at day 7 compared with day 1, reflecting clinical improvement.

Table 5

Distribution of breastfeeding problems on day 1 and day 7.

Group	Breastfeeding Problem	Day 1 n (%)	Day 7 n (%)	Change n (%)
Music Listening (D1)	Yes	9 (22.5)	1 (2.5)	-8 (-20.0%)*
	No	31 (77.5)	39 (97.5)	+8 (+20.0%)
Oxytocin Massage (D2)	Yes	4 (10.0)	0 (0.0)	-4 (-10.0%)*
	No	36 (90.0)	40 (100.0)	+4 (+10.0%)
Control (K)	Yes	0 (0.0)	0 (0.0)	0 (0.0%)
	No	40 (100.0)	40 (100.0)	0 (0.0%)

* Represents absolute risk reduction in breastfeeding problems from Day 1 to Day 7.

Table 6

Neonate weight changes between day 1 and day 7 by study group.

Group	Day 1 Mean $\pm$ SD (g)	Day 7 Mean $\pm$ SD (g)	Mean Change (g)	p
Music Listening (D1)	3219 $\pm$ 59	3317 $\pm$ 58	+97.75	.001
Oxytocin Massage (D2)	3210 $\pm$ 59	3392 $\pm$ 58	+181.38	.001
Control (K)	3260 $\pm$ 59	3226 $\pm$ 58	-33.88	.17

Repeated-measures ANOVA was used to examine weight change over time between groups.

3.2.3.1. Adverse events and safety. No adverse events, physical discomfort, skin irritation, pain, or unwanted effects were reported by participants or observed by researchers in any of the three groups during the study period. Safety and potential side effects were systematically monitored through daily follow-up telephone calls during the first three days and verified during the in-person assessment on day 7.

4. Discussion

The theoretical framework underpinning this study is grounded in the psychophysiological mechanisms of lactation and maternal-neonate bonding. Oxytocin, a neuropeptide released in response to nipple stimulation, plays a central role in the milk ejection reflex and has been linked to increased maternal relaxation, bonding, and emotional regulation [23]. Oxytocin massage, which involves gentle tactile stimulation of the back along the spine, is believed to stimulate endogenous oxytocin release through sensory nerve pathways, thereby enhancing lactation outcomes [12,13]. Similarly, music listening has been associated with reduced stress and anxiety, potentially facilitating oxytocin release via the limbic system [17,30]. Listening to soothing music has also been shown to modulate cortisol levels, regulate autonomic nervous system responses, and improve maternal mood—factors that may positively influence breastfeeding behaviors [24].

From a calculation perspective, the effects of both interventions were evaluated through changes in quantitative measures, including the LATCH score, the Breastfeeding Self-Efficacy Scale (BSES), and neonatal weight gain. Repeated measures ANOVA and between-group comparisons provided empirical support for the efficacy of both interventions, confirming their basis in the psychophysiological theory of oxytocin-mediated lactation support.

In our study, both methods were found to improve breastfeeding success, with neither showing statistical superiority over the other. This finding aligns with prior research demonstrating the positive effects of oxytocin massage [25–27], and its association with increased milk production [28,29]. WHO (2009) also recommends oxytocin massage as a method to enhance milk supply by promoting relaxation and maternal

confidence [12].

In cases where massage is not feasible, music therapy presents a viable alternative. Music has been shown to stimulate the release of oxytocin and endorphins, thereby enhancing milk production [15,30]. It also reduces maternal stress and anxiety, indirectly improving lactation outcomes [31,32]. A systematic review found that music interventions increased milk production by promoting the secretion of oxytocin and prolactin [17]. Recommendations vary, but studies suggest that optimal benefits occur when music is listened to daily or several times per week [17,31,33].

Although our results did not show a significant difference in efficacy between the two methods, music listening stands out for its practical advantages. It can be self-administered without requiring another person, making it a more accessible and scalable intervention. Physiologically, music stimulates alpha brain waves, improves vascular function, and triggers the release of nitric oxide and endorphins—factors associated with improved emotional well-being and mother–neonate bonding [34].

Regarding breastfeeding success, baseline LATCH scores showed a small statistical difference across groups on Day 1 ($p = 0.026$). However, post-intervention evaluations on Day 7 revealed significant improvements in both the oxytocin massage and music listening groups compared to controls. This is consistent with previous findings that both music and massage interventions enhance LATCH scores and breastfeeding outcomes [33,35–37]. Additionally, oxytocin massage provided by spouses has been linked to reduced breastfeeding support needs and greater maternal self-efficacy [20]. Its effectiveness has also been demonstrated in cesarean births, where it boosts colostrum production and lactation success [38–40].

Neonate weight gain was significantly greater in both intervention groups compared to the control. Previous studies have similarly shown that oxytocin massage is associated with improved neonate weight gain, likely due to enhanced prolactin and oxytocin secretion facilitating milk ejection and nutrient transfer [41,42]. The calming effects of massage on the autonomic nervous system may also contribute to better milk flow.

Breastfeeding self-efficacy plays a pivotal role in a mother's commitment to breastfeeding and her ability to overcome challenges [22,43,44]. In our study, self-efficacy scores were significantly higher in both the music and massage groups. These results are in line with previous literature indicating that oxytocin massage enhances breastfeeding confidence [20,45], and that combining massage with music therapy further improves self-efficacy [41,46].

Finally, the incidence of breastfeeding problems was lower in both intervention groups compared to the control. This finding supports the use of both methods as preventive strategies against common early postpartum breastfeeding difficulties.

4.1. Clinical relevance

While the statistical significance of our findings has been reported, it is essential to address their clinical meaningfulness to guide practice.

Neonatal weight gain; The mean weight gain of 181.38 g in the oxytocin massage group and 97.75 g in the music listening group over seven days represents clinically meaningful outcomes. Exclusively breastfed neonates typically experience early physiological weight loss before regaining birth weight in the second week of life. The observation that neonates in both intervention groups demonstrated positive weight gain by day 7 is clinically favorable, whereas control neonates showed a mean weight loss (−33.88 g).

LATCH scores; A mean increase of 2.68 points (oxytocin massage) and 2.28 points (music listening) on the 10-point LATCH scale reflects substantial clinical improvement in breastfeeding positioning, latching, and audible swallowing during the first postpartum week. Improvements of this magnitude correspond to noticeable reductions in maternal pain and feeding difficulties.

Breastfeeding self-efficacy; Mean increases of 11.7 points (oxytocin

massage) and 9.1 points (music listening) on the 70-point BSES-SF scale reflect meaningful gains in maternal confidence. Mothers who experience such increases in confidence are better equipped to overcome common early challenges, such as perceived insufficient milk supply, and are more likely to sustain exclusive breastfeeding.

Breastfeeding problems; The absolute risk reduction observed in the intervention groups translates to favorable numbers needed to treat (NNT = 5 for music listening; NNT = 10 for oxytocin massage). This underscores the utility of both non-pharmacological methods as practical preventive strategies in routine postpartum care.

Practical implications; For clinical practice, both interventions offer low-cost, non-invasive options. Music listening may be preferred when a trained family member is unavailable or when the mother desires a self-administered intervention. Oxytocin massage may be preferred when a family member is willing and able to provide hands-on support, as it showed numerically (though not statistically) greater improvements across most outcomes.

4.2. Limitations

Despite the study's rigorous design and randomized structure, several limitations should be acknowledged. First, the sample was restricted to women receiving care at specific hospitals, which may limit the generalizability of the findings to broader or more diverse populations. Second, certain potential confounding variables—such as maternal education level, socioeconomic status, or emotional and social support—were not fully controlled and could have influenced the outcomes. Additionally, while we trained all relatives in a standardized massage technique, some variability in pressure and technique across different relatives cannot be entirely ruled out. Similarly, the self-selected volume and listening conditions for music, while pragmatic, may have contributed to intervention heterogeneity. Finally, the relatively short follow-up duration constrained the evaluation of longer-term effects on breastfeeding success, neonate growth, and maternal self-efficacy. Additionally, conducting a per-protocol analysis rather than an intention-to-treat analysis carries an inherent risk of attrition bias. Excluding participant's post-randomization due to loss to follow-up or protocol non-adherence may overestimate the effectiveness of the interventions, as discontinuation of breastfeeding or inability to adhere could be related to intervention failure or early breastfeeding challenges.

Furthermore, despite randomized allocation, a baseline variation was observed on Day 1 regarding the frequency of breastfeeding problems across groups. While this reflects random chance variation, change scores and relative reductions were utilized to evaluate true intervention outcomes.

5. Conclusion

This study demonstrated that both music listening and oxytocin massage significantly enhanced maternal breastfeeding self-efficacy and reduced the incidence of breastfeeding-related problems compared to the control group. Furthermore, neonates of mothers in the intervention groups showed greater weight gain. However, no statistically significant difference was observed between the music and oxytocin massage groups in terms of breastfeeding success scores.

In conclusion, both methods are effective, non-invasive strategies that support breastfeeding outcomes and may be offered to postpartum mothers based on individual preference and feasibility.

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Sustainability statement

The interventions evaluated in this study (oxytocin massage and music listening) require minimal resources and can be delivered in home or community settings with brief training. Both methods are low-cost, non-invasive, and suitable for integration into routine postpartum care, supporting sustainable improvements in breastfeeding outcomes without reliance on specialized equipment or infrastructure.

Regarding the preparation of this manuscript, the authors used generative AI tools solely for language refinement and grammar checking. While AI tools can reduce writing-related energy consumption compared to extensive manual revisions, the authors acknowledge that AI models have associated environmental costs (e.g., energy use for training and inference). We have therefore limited AI use to essential tasks and encourage continued efforts to improve the carbon efficiency of AI technologies.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Gemini (Google) solely for language refinement and grammar checking. No AI tools were used for data analysis, interpretation, or the generation of scientific conclusions. The authors take full responsibility for the content of the publication.

CRedit authorship contribution statement

Elham Sadeghi: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Gulcin Bozkurt:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to ethical restrictions concerning participant confidentiality, the data are not publicly available.

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