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Comparative Effectiveness of Infant Massage and Foot Reflexology on Infant Sleep Quality: An Explanatory Mixed-Methods Study

***Ivanie Dwi Gadilaj, Fitriana and Iis Tri Utami**

[1]Midwifery Study Program, Faculty of Health Sciences, Universitas Aisyah Pringsewu

*Corresponding Author: idgadilaj23@gmail.com

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Abstract

Background: Adequate sleep is essential for optimal infant growth and neurodevelopment, as approximately 75% of growth hormone secretion occurs during sleep. Sleep disturbances in infancy remain prevalent and may adversely affect physical, emotional, and neurological development. Infant massage and foot reflexology are widely used non-pharmacological interventions to improve infant sleep quality; however, comparative evidence supported by both quantitative outcomes and caregiver experiences remains limited.

Objective: This study aimed to compare the effectiveness of infant massage and foot reflexology on infant sleep quality and to explore maternal perceptions of sleep changes following these interventions.

Method: An explanatory mixed-methods study was conducted using a quantitative quasi-experimental two-group pretest–posttest design, followed by a qualitative descriptive approach. The quantitative phase involved 32 infants aged 1-12 months with sleep disturbances, who were allocated to an infant massage group (n = 16) or a foot reflexology group (n = 16). Infant sleep quality was assessed before and after intervention using a structured sleep quality questionnaire. Data were analysed using the Wilcoxon Signed-Rank Test and Mann–Whitney U Test ($\alpha = 0.05$). The qualitative phase included in-depth interviews with seven mothers, purposively selected from both groups, and the data were analysed using thematic analysis to explain and enrich quantitative findings.

Result: Both infant massage and foot reflexology significantly improved infant sleep quality ($p < 0.001$). However, post-intervention sleep quality was significantly higher in the infant massage group compared to the foot reflexology group ($p < 0.001$). Qualitative findings revealed improvements in sleep duration and continuity, reduced fussiness before sleep, and increased maternal confidence in managing infant sleep routines, particularly among mothers whose infants received massage therapy.

Conclusion: Infant massage and foot reflexology are effective non-pharmacological interventions for improving infant sleep quality, with infant massage demonstrating superior effectiveness. The integration of quantitative and qualitative findings highlights infant massage as a practical and family-centred intervention to support healthy sleep in infancy.

Keywords: infant, sleep quality, infant massage, foot reflexology, mixed methods

1. INTRODUCTION

Infancy is a critical period of rapid physical growth and neurological development, during which adequate, high-quality sleep is essential for optimal physiological functioning. Sleep plays a vital role in synaptic development, memory consolidation, and hormonal regulation, particularly the secretion of growth hormone, which occurs approximately 75% of the time during sleep (1). Insufficient or disrupted sleep during infancy may adversely affect growth, emotional regulation, and neurodevelopmental

outcomes(2).

Despite its importance, sleep disturbances among infants remain common worldwide. Reports indicate that more than half of infants experience sleep-related problems, including short sleep duration, frequent nighttime awakenings, and difficulty initiating sleep(3). In Indonesia, the prevalence of infant sleep disturbances remains high, yet many caregivers perceive these problems as a normal developmental phase rather than a condition requiring attention. Persistent sleep disturbances have been associated with impaired weight gain, delayed motor development, increased irritability, and suboptimal parent–infant interactions(4).

Infant sleep disturbances are multifactorial, involving biological immaturity of the central nervous system, irregular sleep–wake rhythms, feeding patterns, and environmental factors such as sleep setting and bedtime routines. Caregiving practices, including excessive pre-sleep stimulation or reliance on feeding and rocking, may further interfere with the development of self-soothing abilities. These complex interactions underscore the importance of developmentally appropriate, safe, and family-centred interventions to promote healthy sleep in infancy(5).

Non-pharmacological approaches are recommended as the first-line management of infant sleep disturbances due to their safety and minimal risk of adverse effects. Among these approaches, tactile-based interventions have gained increasing attention. Tactile stimulation is known to activate the parasympathetic nervous system, reduce stress responses, and promote relaxation, thereby supporting sleep regulation while strengthening caregiver–infant bonding(6).

Infant massage and foot reflexology are complementary therapies frequently applied in baby spas and community health settings. Infant massage involves systematic, rhythmic tactile stimulation across the infant's body and has been shown to improve circulation, increase vagal tone, reduce cortisol levels, and enhance the secretion of serotonin and melatonin—hormones essential for sleep regulation. Foot reflexology, which applies gentle pressure to specific reflex points on the feet, is believed to promote relaxation and autonomic balance through neural pathways linked to internal(7).

Although both interventions have demonstrated benefits in improving infant sleep, most existing studies have examined them separately. Comparative evidence evaluating their relative effectiveness remains limited, particularly when supported by caregiver experiences that provide insight into how sleep improvements are perceived and sustained in daily life. Therefore, this study aimed to compare the effectiveness of infant massage and foot reflexology on infant sleep quality using an explanatory mixed-methods approach, integrating quantitative outcomes with qualitative insights to provide comprehensive evidence for clinical and caregiving practice.

2. MATERIALS AND METHODS

a. Study Design and Setting

This study employed an explanatory mixed-methods design, consisting of a quantitative quasi-experimental phase followed by a qualitative descriptive phase. The quantitative phase aimed to evaluate and compare the effects of infant massage and foot reflexology on infant sleep quality, while the qualitative phase explored maternal experiences and explained the quantitative findings in greater depth.

The quantitative phase used a two-group pretest–posttest design, whereas the qualitative phase used in-depth interviews with selected participants from the quantitative phase. The study was conducted at Baby Spa Littlealbee. Id, Bandar Lampung City, Indonesia, from September to October 2025.

b. Quantitative Phase

1) Population and Sample

The quantitative study population comprised all infants aged 1–12 months who visited Baby Spa Littlealbee.ID during the study period (N = 38). A total of 32 infants were selected using purposive sampling, based on predefined inclusion and exclusion criteria. The minimum sample size was determined using Federer's formula. The findings of the present study are consistent with a randomised controlled trial conducted (8) by Saatsaz et al, which

demonstrated that bedtime infant massage significantly improved several objective sleep indicators, including sleep latency, frequency of nighttime awakenings, and longest continuous sleep duration. Although improvements in overall maternal sleep quality were limited, the study reported significant increases in maternal sleep duration and reductions in maternal sleep disturbances. These results reinforce the physiological and behavioural benefits of infant massage in supporting sleep regulation for both infants and caregivers.

The infants were allocated into two intervention groups: the Infant massage group (n = 16) and the Foot reflexology group (n = 16).

Inclusion criteria were infants aged 1–12 months with sleep disturbances and parents willing to provide written informed consent. Exclusion criteria included infants with congenital abnormalities, acute illness or fever during the intervention period, or those receiving concurrent sleep-related therapies.

2) Intervention Procedures

Both interventions were conducted in accordance with standardised operating procedures (SOPs) and were administered by trained and certified midwives or nurses.

The infant massage intervention consisted of gentle, rhythmic strokes systematically applied to the infant's body to promote relaxation. The foot reflexology intervention involved applying gentle pressure to specific reflex points on the infant's feet, associated with relaxation and autonomic nervous system regulation(9).

Each intervention was administered three times per week during the intervention period. The duration, pressure, and sequence of both techniques were standardised to ensure consistency across participants. Foot reflexology was performed by applying gentle pressure to specific reflex points on the infant's feet associated with relaxation and autonomic nervous system regulation, as illustrated in **Figure 1.**

Figure 1. Application of foot reflexology on an infant involves applying gentle pressure to specific reflex points on the sole of the foot to promote relaxation and improve sleep quality.

3) Variables and Measurement

The independent variables were infant massage and foot reflexology, while the dependent variable was infant sleep quality.

Infants categorized as having very severe sleep disturbances met all criteria for poor sleep quality, including insufficient total sleep duration, frequent nighttime awakenings, and prolonged nighttime wakefulness(10). The questionnaire evaluated three components: total sleep duration, frequency of nighttime awakenings, and duration of nighttime wakefulness.

Sleep quality was categorized as good if the infant had a total sleep duration of ≥ 9 hours per day, experienced ≤ 2 nighttime awakenings, and had nighttime wakefulness lasting < 1 hour. Measurements were conducted before (pretest) and after (posttest) the intervention in both groups.

4) Data Collection Procedure

Quantitative data collection consisted of two phases: an administrative phase and a technical phase. During the administrative phase, parents were informed about the study objectives, procedures, potential benefits, and risks, and written informed consent was obtained.

The technical phase included pretest assessment of infant sleep quality, implementation of the assigned intervention

(infant massage or foot reflexology), and posttest assessment using the same measurement tools and procedures to ensure consistency.

5) Data Analysis (Quantitative)

Quantitative data were analyzed using statistical software. Univariate analysis was conducted to describe respondent characteristics and the distribution of infant sleep quality.

Data normality was assessed using the Shapiro–Wilk test due to the sample size being less than 50. As the data were not normally distributed ($p < 0.05$), non-parametric statistical tests were applied. The Wilcoxon Signed Rank Test was used to analyze differences in sleep quality before and after intervention within each group, while the Mann–Whitney U Test was employed to compare post-intervention sleep quality between the two groups(11). Statistical significance was set at $p < 0.05$.

c. Qualitative Phase

1) Participants and Data Collection

The qualitative phase involved seven mothers, purposively selected from participants in the quantitative phase to represent variation in intervention type and infant sleep outcomes. This phase was conducted after completion of the quantitative data collection.

Qualitative data were collected through semi-structured in-depth interviews, focusing on maternal experiences, perceived changes in infant sleep patterns, and confidence in managing infant sleep following the intervention. Interviews were conducted in a private, comfortable setting and audio-recorded with participants' permission.

2) Data Analysis (Qualitative)

Qualitative data were analysed using thematic analysis. Interview recordings were transcribed verbatim and reviewed repeatedly to achieve data familiarisation. Initial codes were generated and grouped into categories, which were subsequently developed into overarching themes reflecting maternal perceptions and experiences of infant sleep changes.

The qualitative findings were used to explain and enrich the quantitative results, consistent with the explanatory mixed-methods design.

d. Ethical Considerations

This study adhered to ethical principles governing research involving human participants. Parental informed consent was obtained prior to participation, the confidentiality of participant data was maintained, and participants were informed of their right to withdraw from the study at any time without consequences.

3. RESULTS

a. Respondent Characteristics

Table 1. Respondent Characteristics and Frequency Distribution of Infant Sleep Conditions

Variable	Category	Massage Group (n=16)		Reflexology Group (n=16)	
		n	%	n	%
Maternal age	<20 and >35 years	3	18.8	3	18.8
	20–35 years	13	81.3	13	81.3
Infant age (months)	0–3	6	37.5	6	37.5
	4–6	4	25.0	5	31.3
	7–9	2	12.5	1	6.3
	10–12	4	25.0	4	25.0
Infant sex	Male	8	50.0	8	50.0

	Female	8	50.0	8	50.0
Sleeping arrangement	Bed-sharing with mother	6	37.5	9	56.3
	Crib in parents' room	10	62.5	7	43.8
Sleeping position	Supine	8	50.0	8	50.0
	Side-lying	8	50.0	8	50.0
Method used to induce sleep	Breastfeeding	11	68.8	14	87.5
	Rocking/holding	5	31.3	2	12.5
Infant condition before sleep	Crying	9	56.3	15	93.8
	Being cuddled	7	43.8	1	6.3
Severity of sleep problem	Very severe	16	100.0	16	100.0
Total		16	100.0	16	100.0

Table 1. shows that the majority of mothers in both groups were aged 20–35 years (81.3%). Most infants were aged 0–3 months (37.5%), followed by those aged 4–6 months. The distribution of infant sex was equal between males and females in both groups.

In the massage group, most infants slept in a crib located in the parents' room (62.5%), whereas in the reflexology group, more infants shared a bed with their mothers (56.3%). Breastfeeding was the most commonly used method to induce sleep, particularly in the reflexology group (87.5%). Crying before sleep was frequently reported, especially in the reflexology group (93.8%). All respondents were classified as having very severe sleep disturbances, defined as insufficient total sleep duration, frequent nighttime awakenings, and prolonged nighttime wakefulness based on standardised sleep quality criteria(10).

b. Univariate Analysis

Table 2. Mean Infant Sleep Quality Scores Before and After Massage Intervention

Sleep Quality	Mean	SD	Min	Max	N
Before intervention	0.25	0.40	0	1	16
After intervention	2.88	0.34	2	3	16

The mean infant sleep quality score before massage intervention was 0.25 ± 0.40, which increased to 2.88 ± 0.34 after intervention, indicating a substantial improvement following massage therapy.

Table 3. Mean Infant Sleep Quality Scores Before and After Reflexology Intervention

Sleep Quality	Mean	SD	Min	Max	N
Before intervention	0.25	0.40	0	1	16
After intervention	1.13	0.62	0	2	16

Following reflexology intervention, the mean sleep quality score increased from 0.25 ± 0.40 to 1.13 ± 0.62, indicating improvement, although to a lesser extent than in the massage group.

c. Normality Test

Table 4. Normality Test of Infant Sleep Quality Data (Shapiro–Wilk Test)

Group	Sleep Quality	Shapiro–Wilk (p)	Distribution
Massage	Before	0.000	Not normal
	After	0.000	Not normal
Reflexology	Before	0.000	Not normal
	After	0.001	Not normal

The Shapiro–Wilk test showed that sleep quality data in both groups were not normally distributed ($p < 0.05$). Therefore, non-parametric statistical tests were used for further analysis.

d. Bivariate Analysis

Table 5. Effect of Massage Intervention on Infant Sleep Quality

Variable	Median (Min–Max)	p-value
Before intervention (n=16)	0 (0–1)	<0.001
After intervention (n=16)	3 (2–3)	

The Wilcoxon Signed Rank Test showed 16 positive ranks, indicating that all infants experienced improved sleep quality after massage intervention ($p < 0.001$).

Table 6. Effect of Reflexology Intervention on Infant Sleep Quality

Variable	Median (Min–Max)	p-value
Before intervention (n=16)	0 (0–1)	<0.001
After intervention (n=16)	1 (0–2)	

The Wilcoxon test indicated 13 positive ranks and 3 ties, demonstrating a significant improvement in sleep quality following reflexology intervention ($p < 0.001$).

Table 7. Comparison of Post-Intervention Infant Sleep Quality Between Groups

Group	Median (Min–Max)	p-value
Massage (n=16)	3 (1–3)	<0.001
Reflexology (n=16)	1 (0–2)	

Mann–Whitney U test revealed that the massage group had a higher mean rank (23.56)

than the reflexology group (9.44), indicating that massage intervention was significantly more effective in improving infant sleep quality.

d. Qualitative Findings from In-Depth Interviews

To complement the quantitative findings, an in-depth qualitative study was conducted involving seven mothers whose infants participated in the intervention. Participants were selected purposively to represent variations in infant age, sleep disturbance severity, and type of intervention received. Data were collected through semi-structured interviews and analysed using thematic analysis.

Analysis of interview data yielded three main themes describing maternal experiences and observed changes in infant sleep patterns following massage and reflexology interventions.

Theme 1: Improvement in Infant Sleep Duration and Sleep Continuity

Most participants reported a noticeable improvement in their infants' sleep duration and continuity after the intervention. Mothers reported that their infants slept longer at night and had fewer awakenings than before the therapy.

Several participants stated that their infants slept more soundly and did not wake up frequently, crying during the night. This improvement was reported more consistently among mothers whose infants received massage therapy.

"Sebelum pijat, bayi saya sering terbangun dan rewel malam hari. Setelah dipijat, tidurnya lebih lama dan jarang terbangun." (P3)

Theme 2: Reduction in Fussiness and Crying Before Sleep

Participants commonly reported a reduction in infant fussiness and crying before bedtime. Infants appeared calmer and transitioned to sleep more easily after the intervention sessions.

Mothers noted that the intervention helped create a relaxing sleep routine, particularly when massage was performed in the evening.

"Biasanya sebelum tidur anak saya menangis lama, sekarang lebih cepat tenang dan langsung tertidur." (P5)

Theme 3: Increased Maternal Confidence and Comfort in Managing Infant Sleep

In addition to changes in infant behaviour, mothers reported increased confidence and comfort in managing their infants' sleep routines. The intervention was perceived as safe, easy to perform, and beneficial for strengthening mother–infant bonding.

Several participants expressed willingness to continue the therapy at home after observing positive effects on their infants' sleep quality.

"Saya jadi lebih percaya diri mengurus tidur bayi karena sudah tahu caranya, dan hasilnya memang terasa." (P7)

This research produced three formulations of Sacha Inchi cookies combining arrowroot flour and banana flour, with Sacha Inchi percentages of 30% (Formula 01A), 40% (Formula 02B), and 50% (Formula 03C). The banana flour ratio was 3:2:1 for each respective formula, while the arrowroot flour composition remained the same in all formulas. These three cookie formulations were subsequently subjected to chemical analysis and organoleptic quality assessment.

4. DISCUSSION

a. Quantitative Phase Discussion

The results of this study showed that both infant massage and reflexology significantly improved infant sleep quality, with the massage intervention producing a greater effect. These findings are consistent with prior research demonstrating the positive impact of infant massage on sleep outcomes. For example, Hartanti et al. reported that infant massage significantly increased sleep duration and reduced the number of nighttime awakenings, indicating overall improvements in sleep quality ($p < 0.001$) after the intervention.

Additionally, several local quasi-experimental studies have similarly shown that infant massage can improve sleep quality in infants aged 0–12 months, as demonstrated in other Indonesian settings using Wilcoxon analysis.

The greater improvement observed in the massage group compared to the reflexology group may be related to the extent and intensity of tactile stimulation. Massage provides whole-body tactile engagement that can activate mechanoreceptors and increase parasympathetic

nervous system activity, potentially enhancing vagal tone and relaxation responses that promote sleep regulation. This aligns with physiological evidence suggesting that tactile stimulation through massage may influence serotonin and melatonin pathways, which are critical in sleep–wake cycle regulation(12). Moreover, while effective, reflexology delivers stimulation to limited areas (the feet), which may explain its relatively smaller effect size compared to massage. Similar patterns have been observed in controlled studies comparing massage with other therapies, where massage produced more robust improvements in sleep quality than alternative non-pharmacological interventions(13).

These findings support the broader literature on infant massage as a practical and effective non-pharmacological strategy for improving sleep quality in infants. The current study extends this evidence by including reflexology as a comparative intervention, highlighting that tactile interventions with greater sensory input (such as full-body massage) may offer superior sleep benefits in early infancy.

b. Qualitative Phase Discussion

The qualitative findings provided important insights into how these improvements in sleep were experienced by mothers and observed in infant behaviour. Mothers consistently reported that after massage, their infants fell asleep more easily, slept longer, and woke less frequently during the night. Such maternal observations reflect meaningful behavioural and functional changes that complement quantitative measurements. This interpretation is supported by caregiving theory, which emphasises the role of consistent tactile interaction in promoting emotional security and physiological regulation in infants(14).

This theme aligns with studies showing that regular massage contact not only improves sleep but also fosters emotional bonding and caregiver confidence. For example, massage has been associated with enhanced bonding between mothers and infants, which may further facilitate infants' emotional regulation and sleep consolidation(15).

Increased confidence among mothers is particularly important, as positive caregiver perceptions can reinforce consistent sleep management practices, leading to sustained behavioural improvements in infants.

Although reflexology was perceived as beneficial, several participants noted that its effects were less immediate or pronounced than those of full-body massage. This aligns with the quantitative findings and suggests that the scope of sensory stimulation influences both objective sleep outcomes and caregiver perceptions of effectiveness(16).

Integration of Findings

The combined quantitative and qualitative results strengthen the overall conclusion that tactile interventions are effective for improving infant sleep quality. Quantitative evidence demonstrated statistically significant improvements, while qualitative insights explained the behavioural and psychosocial mechanisms underlying these changes.

This explanatory mixed-methods approach enhances clinical relevance by linking measurable outcomes with real-life caregiving experiences, supporting the implementation of massage and reflexology as feasible, non-invasive strategies in primary maternal and child health care.

c. Theoretical and Practical Implications

From a theoretical perspective, these findings reinforce the importance of sensory stimulation and maternal–infant interaction in early neurobehavioral development and sleep regulation. In practice, the results support the inclusion of infant massage in health education programs for caregivers, especially in community health settings.

However, limitations such as the quasi-experimental design and reliance on maternal reports for sleep quality should be acknowledged. Future research should incorporate larger randomised controlled trials and objective sleep measures (e.g., actigraphy) to further validate these findings.

5. CONCLUSION

This study concludes that both infant massage and foot reflexology are effective non-pharmacological interventions in improving sleep quality among infants aged 1–12 months experiencing sleep

disturbances. Statistically significant improvements were observed in sleep duration, frequency of nighttime awakenings, and sleep continuity following both interventions. Nevertheless, infant massage demonstrated a significantly greater effect compared to foot reflexology The integration of quantitative and qualitative findings provides comprehensive evidence that the observed improvements are not only statistically significant but also clinically meaningful, as reflected in maternal reports of enhanced infant sleep patterns, reduced pre-sleep fussiness, and increased maternal confidence in managing infant sleep routines. The broader tactile stimulation involved in infant massage may contribute to its superior effectiveness through enhanced physiological relaxation responses.

In conclusion, infant massage may be recommended as a safe, practical, and family-centred intervention to improve infant sleep quality and support optimal growth and neurodevelopment. The incorporation of infant massage into maternal and child health programs is strongly advocated to enhance caregiving practices and promote infant well-being.

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