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Effectiveness of the Stimulation of Endorphin, Oxytocin, and Serotonin (SPEOS) Method in Improving Sleep Quality among Postpartum Women: A Quasi-Experimental Study in Primary Maternal Healthcare in Gorontalo, Indonesia

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ABSTRACT

Postpartum sleep disturbance is a clinically relevant maternal health problem because it may weaken physical recovery, emotional regulation, breastfeeding continuity, and early mother infant adaptation. This study analyzed the effectiveness of the Stimulation of Endorphin, Oxytocin, and Serotonin (SPEOS) method in improving sleep quality among postpartum women in the working area of Telaga Primary Health Center, Gorontalo, Indonesia. A quasi-experimental pretest and posttest control group design using consecutive sampling and convenience sub-district cluster allocation was used. Sixty-two postpartum women were allocated into an intervention group and a control group (n = 31 per group). The intervention group received the home-based SPEOS method for seven consecutive days, whereas the control group received routine postpartum care. Sleep quality was measured using the Pittsburgh Sleep Quality Index. Because the data were not normally distributed, the Wilcoxon Signed Rank Test and Mann Whitney U Test were applied. After the intervention, mild sleep disturbance in the intervention group increased from 16.1% to 83.9%, while severe sleep disturbance was no longer observed. Wilcoxon tests revealed significant PSQI reductions in the intervention group (Z = -4.564; p < 0.001; r = 0.82). The Mann Whitney U Test also demonstrated a significant difference in score change between groups (U = 118.500; Z = -4.921; p < 0.001; r = 0.62). These findings indicate that SPEOS provides a statistically and clinically meaningful non-pharmacological approach for postpartum sleep restoration. Its effect is hypothesized to be linked to pathways involving tactile relaxation, oxytocinergic activation, endorphin release, reduced stress response, and increased maternal comfort. SPEOS is recommended as a feasible midwife-led community-based intervention in postpartum nursing and midwifery care.

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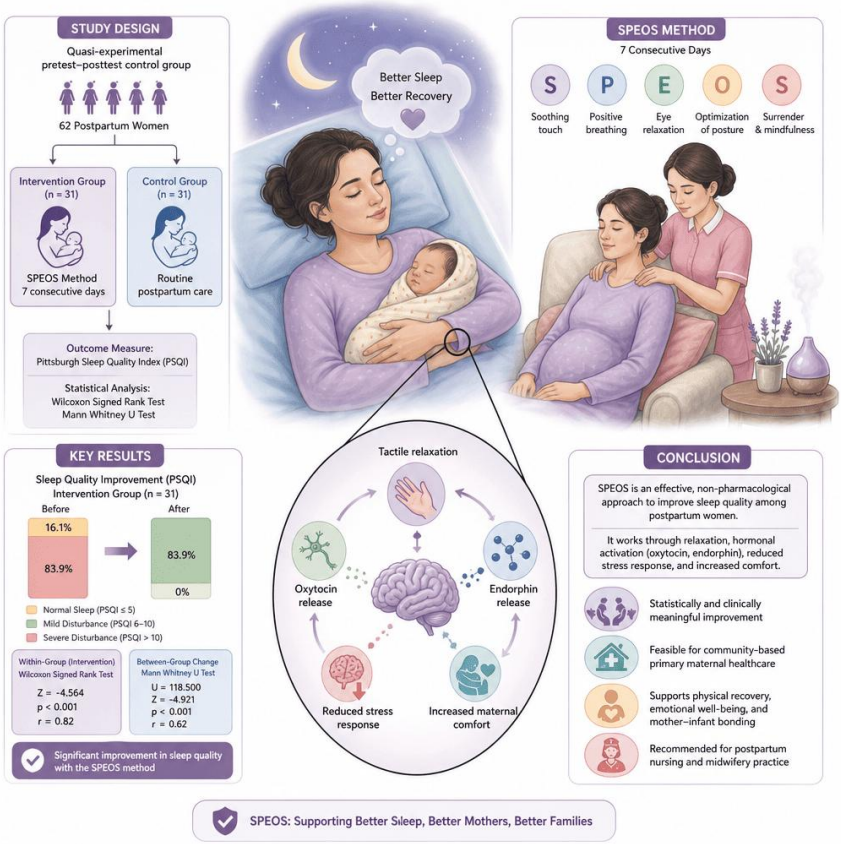
Key Messages:

- This study is among the first to reposition the SPEOS method from a traditionally lactation-oriented tool to a broader recovery framework, targeting postpartum sleep restoration as a primary clinical outcome.
- A structured seven-day SPEOS protocol achieved an absolute clearance of severe sleep disturbances and enabled 83.9% of participants to successfully cross below the diagnostic threshold for poor sleep quality, yields a robust practical effect size (r = 0.62).
- Administered directly in the home by trained community midwives, the SPEOS method serves as a feasible, low-cost, and non-pharmacological modality that can be integrated into routine regional primary maternal healthcare frameworks.

GRAPHICAL ABSTRACT



INTRODUCTION

Postpartum sleep disturbance has increasingly been recognized as a maternal health concern rather than a minor inconvenience following childbirth. Sleep fragmentation during the early postnatal period is closely related to fatigue, impaired emotional regulation, breastfeeding challenges, reduced maternal functioning, and vulnerability to postpartum depressive symptoms (1). The problem is not simply that mothers wake up at night. More critically, repeated sleep interruption occurs during a period when the maternal body is still recovering, breastfeeding is being established, and a new caregiving identity is being negotiated (2).

Current postnatal care priorities emphasize positive maternal and newborn experiences, including physical recovery, breastfeeding support, emotional well-being, and family-centered care (3). Within this framework, sleep quality becomes a strategic clinical outcome because it connects biological recovery with psychosocial adaptation. A mother who sleeps poorly may experience greater pain sensitivity, emotional irritability, reduced confidence, and difficulty sustaining responsive infant care. Thus, sleep restoration should be positioned as part of essential postpartum care, particularly in primary healthcare settings where mothers have frequent contact with midwives and nurses.

Pharmacological sleep management is rarely the first choice for breastfeeding mothers because of concerns about medication exposure, sedation, and caregiving safety. Consequently, non-pharmacological interventions such as massage, relaxation, behavioral education, and supportive counseling have become increasingly relevant (4). These approaches are attractive because they are relatively safe, low cost, and compatible with routine maternal care. Although massage, reflexology, and other non-pharmacological interventions have shown beneficial effects on postpartum sleep quality, evidence regarding integrated touch-based interventions such as the SPEOS method remains scarce, particularly within Indonesian primary healthcare settings. Consequently, further multicenter randomized controlled trials are needed to establish their effectiveness and facilitate broader implementation in routine maternal care (5). Furthermore, existing domestic studies on the SPEOS method have predominantly focused on short-term

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lactation outcomes such as breast milk volume and onset of lactation (6,7), leaving a distinct gap regarding its longitudinal efficacy on maternal sleep architecture and psychological recovery.

The SPEOS method combines endorphin massage, oxytocin massage, and positive suggestion. In previous maternal care practice, SPEOS has often been associated with lactation support and breast milk production. However, the same physiological pathways that support lactation may also contribute to sleep restoration. Tactile stimulation may activate parasympathetic responses, reduce muscular tension, stimulate oxytocin release, and strengthen maternal feelings of safety (8). Neurobiologically, elevated systemic oxytocin levels actively attenuate the hypothalamic-pituitary-adrenal (HPA) axis, thereby suppressing cortisol secretion and diminishing sympathetic nervous system arousal (9,10). This reduction in physiological stress signals works in tandem with positive suggestion to mitigate cognitive hyperarousal, facilitating the activation of sleep-promoting structures in the brain, specifically the ventrolateral preoptic area (VLPO) (11). Consequently, this dual mechanism helps transition the maternal body from a state of hypervigilant alertness into deep, restorative slow-wave sleep (12).

The novelty of this study lies in repositioning SPEOS from a primarily lactation-oriented intervention toward a broader maternal recovery intervention, with sleep quality as the primary clinical outcome. This shift is scientifically significant because postpartum sleep disturbance is both a symptom and a mechanism through which maternal vulnerability may intensify. By examining SPEOS using non-parametric pretest and posttest comparison, this study offers practical evidence for a simple intervention that can be integrated into community-based postpartum care (8). Therefore, this study aims to evaluate the effectiveness of the SPEOS method specifically on the sleep quality of postpartum women within the primary healthcare framework.

METHODS

This study used a quasi-experimental design with a pretest and posttest control group approach. The design was selected to evaluate the effectiveness of the SPEOS method under real primary healthcare conditions while maintaining a comparison group. The study was conducted in the working area of Telaga Primary Health Center, Gorontalo. To recruit participants systematically, consecutive sampling was employed, wherein all postpartum women meeting the eligibility criteria during the enrollment window were invited to participate. Because random individual assignment was logistically impractical due to contamination risks within the community healthcare framework, a convenience allocation method was utilized to distribute participants into their respective cohorts based on their geographic sub-district cluster. To address potential baseline confounding variables, such as maternal age disparities that could independently affect sleep architecture, between-group homogeneity was statistically evaluated using the Independent *t*-test (or Chi-Square test depending on data type) to ensure that maternal characteristics did not significantly differ between the intervention and control groups at baseline.

The population consisted of postpartum women receiving postnatal care in the study area. A total of 75 postpartum women were initially screened for eligibility. Of these, 8 women failed to meet the baseline inclusion criteria, and 5 declined participation, leaving a final sample of 62 respondents who were included and divided into an intervention group and a control group, with 31 respondents in each group. All 62 enrolled participants completed both the baseline measurements and the post-intervention follow-up, resulting in a 0% attrition rate across the 7-day observation period; consequently, an intention-to-treat (ITT) analysis framework was maintained as complete-case data. The intervention group received the SPEOS method for seven consecutive days, while the control group received routine postpartum care. Inclusion criteria included postpartum women who were willing to participate, able to communicate clearly, and available for pretest and posttest measurement. Mothers with severe postpartum complications or conditions requiring urgent referral were excluded.

The SPEOS intervention was administered in the participants' homes by a certified community midwife who had undergone standardized training administered by the research team and achieved inter-rater reliability protocol clearance (Kappa > 0.80) prior to the study. Each session lasted exactly 30 minutes and was executed using a strict, identical checklist to maintain intervention fidelity and guarantee uniform administration across all subjects. The 30-minute protocol comprised three distinct, structured phases: (a)

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15 minutes of endorphin massage using gentle effleurage strokes along the neck, shoulders, and arms to promote somatic relaxation; (b) 10 minutes of oxytocin massage using firm, bilateral circular petrissage friction using the thumbs along the paravertebral muscles from the cervical spine down to the scapula region to target neuroendocrine pathways; and (c) 5 minutes of positive suggestion delivered in a calm, supportive tone. The suggestion phase followed a fixed, scripted verbal protocol focusing on maternal competence, physical healing, and breastfeeding confidence to mitigate cognitive hyperarousal. The control group continued to receive standard postpartum services according to primary healthcare procedures.

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), which assesses subjective sleep quality across several domains, including sleep latency, duration, efficiency, disturbance, and daytime dysfunction (13). The standard PSQI global score ranges from 0 to 21, with scores greater than 5 indicating poor sleep quality. For this study, the instrument was adapted using a validated Indonesian version (14). The global continuous scores were utilized for primary non-parametric modeling; additionally, to capture clinical thresholds, scores were categorically classified using the instrument's established cut-off points where a score of 0–5 signifies good sleep quality, and scores greater than 5 represent poor sleep quality. Higher PSQI scores indicate poorer sleep quality.

Data were analyzed using IBM SPSS or equivalent statistical software. Normality testing indicated that the data were not normally distributed; therefore, the Wilcoxon Signed Rank Test was used for within-group comparison and the Mann Whitney U Test was used for between-group comparison. To quantify the practical magnitude of the intervention, the correlation effect size r was calculated. For the within-group Wilcoxon test, r was computed using the formula $r = Z/\sqrt{N}$, where N represents the number of paired observations ($N = 31$). For the between-group Mann-Whitney U test, r was computed using $r = Z/\sqrt{N_{total}}$, where N_{total} represents the total number of subjects across both cohorts ($N_{total} = 62$). The resulting non-parametric correlation effect size r values around 0.10, 0.30, and 0.50 were interpreted as small, moderate, and large effects, respectively, distinguishing them clearly from standardized mean difference metrics.

Ethical principles were maintained through informed consent, confidentiality, voluntary participation, and respect for maternal comfort. Participants were informed that they could withdraw at any time without consequences for the postpartum care they received.

RESULTS

The baseline demographic assessment reveals distinct distributive variations in age and parity between the study groups, highlighting specific reproductive profiles prior to the administration of the intervention (Table 1). To evaluate baseline comparability, homogeneity testing was performed. While parity distribution was statistically comparable between cohorts ($\chi^2 = 0.271$, $p = 0.603$), a severe and statistically significant baseline imbalance was observed in maternal age distribution ($\chi^2 = 13.513$, $p = 0.001$). The intervention group is predominantly characterized by adults within the peak childbearing age of 20 to 35 years (58.1%) and a higher proportion of primiparous women (61.3%), a demographic that often experiences pronounced physiological transitions and heightened vulnerability to initial maternal adaptation challenges. Conversely, the control group is heavily skewed toward younger maternal age, with 64.5% of respondents under 20 years old, while maintaining a relatively comparable distribution of primiparity (54.8%). This prominent age disparity stems from the non-randomized, convenience cluster allocation design utilized under real-world community healthcare constraints, representing a notable baseline confounding variable that must be accounted for when interpreting subsequent outcomes.

To evaluate the clinical magnitude of the intervention on a continuous scale, the global PSQI scores and clinical resolution rates were systematically analyzed (Table 2). At baseline, both cohorts exhibited marked sleep disturbances, with mean global scores substantially exceeding the established diagnostic cut-off of 5 (Intervention: 10.77 ± 3.34; Control: 9.61 ± 4.87). Following the 7-day trial, the intervention group demonstrated a statistically meaningful reduction in sleep metrics, achieving a posttest mean score of 6.42 ± 2.08. This represents a net mean improvement of 4.35 points (95% CI [2.97, 5.74]) in sleep quality. Conversely, the control group exhibited a slight longitudinal deterioration, with posttest scores increasing to a mean of 10.23 ± 4.54, reflecting a negative mean change of -0.62 points (95% CI [-1.14, -0.09]).

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Furthermore, evaluation of the absolute clinical resolution threshold (PSQI ≤ 5) revealed that the proportion of mothers achieving healthy sleep post-intervention rose to 29.0% (*n* = 9) in the intervention group, compared to 16.1% (*n* = 5) in the control cohort.

Table 1. Baseline Characteristics of Respondents by Age and Parity

Characteristic	Intervention Group (*n* = 31) *n* (%)	Control Group (*n* = 31) *n* (%)	Homogenity Testing (χ^2, *p-value)*
Age Category			
< 20 years	6 (19.4)	20 (64.5)	$\chi2$ = 13.513, p = 0.001
20 to 35 years	18 (58.1)	9 (29.0)	
> 35 years	7 (22.5)	2 (6.5)	
Parity			
Primipara	19 (61.3)	17 (54.8)	$\chi2$ = 0.271, p = 0.603
Multipara	12 (38.7)	14 (45.2)	
Total	31 (100)	31 (100)	

Table 2. Global PSQI Metrics and Clinical Cut-Off Tracking at Pretest and Posttest

PSQI Metric	Intervention Group (*n* = 31)	Control Group (*n* = 31)
Pretest Score (Mean ± SD)	10.77 ± 3.34	9.61 ± 4.87
Posttest Score (Mean ± SD)	6.42 ± 2.08	10.23 ± 4.54
Mean Score Change (95% CI)[1]	4.35 (2.97 to 5.74)	−0.62 (−1.14 to −0.09)
Clinical Resolution Rate (PSQI ≤5), n (%)[2]	9 (29.0%)	5 (16.1%)

Note: PSQI ≤5: good sleep quality

To provide descriptive granularity on clinical thresholds, global scores were sub-categorized into disturbance bands (Table 3). Prior to the intervention, the majority of participants in both the intervention (71.0%) and control (32.3%) groups suffered from moderate sleep disturbances, with severe disturbances observed in 12.9% and 19.3% of mothers, respectively (Table 3). Following the seven-day trial, the intervention group demonstrated a pronounced clinical improvement: severe sleep disturbances were completely eradicated (0.0%), and mild sleep disturbances became the predominant category, skyrocketing from 16.1% to 83.9%. This absolute clearance of severe-range clinical sleep disturbances represents a major clinical milestone for the touch-based protocol. Conversely, the control group, which received only routine postpartum care, exhibited a degenerative trend where moderate sleep disturbances increased to 48.4%, and severe sleep disturbances remained entirely stagnant at 19.3%. This descriptive divergence suggests that the SPEOS method acts as a potent catalyst for down-regulating postpartum sleep severity compared to standard care.

Table 3. Comparison of Sleep Quality Categories Before and After Intervention Between Groups

Sleep Quality Category	Intervention Group		Control Group	
	Pretest, *n* (%)	Posttest, *n* (%)	Pretest, *n* (%)	Posttest, *n* (%)
Mild (PSQI ≤ 5)	5 (16.1)	26 (83.9)	15 (48.4)	10 (32.3)
Moderate (PSQI 6 – 12)	22 (71.0)	5 (16.1)	10 (32.3)	15 (48.4)
Severe (PSQI ≥ 13)	4 (12.9)	0 (0.0)	6 (19.3)	6 (19.3)
Total	31 (100)	31 (100)	31 (100)	31 (100)

Note: PSQI ≤5: good sleep quality; PSQI >5: poor sleep quality

To determine if these descriptive changes were statistically meaningful within each cohort, a within-group longitudinal analysis was executed using the Wilcoxon Signed Rank Test (Table 4). The inferential data reveal that the intervention group experienced a highly significant, uniform reduction in sleep disturbance parameters (Z = -4.564, p < 0.001), yielding a remarkably robust practical magnitude (r = 0.82, large effect) with 24 negative ranks and zero positive ranks. Interestingly, the control group also exhibited a statistically significant change (Z = -2.236, p = 0.025, r = 0.40), but this was characterized by positive ranks indicating slight structural deterioration in sleep metrics over the 7-day period. Having established these internal longitudinal trajectories, a direct between-group comparison was then conducted to isolate the true effect of the intervention.

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Table 4. Wilcoxon Signed-Rank Test Results for Within-Group Changes in Sleep Quality Scores

Group	Negative ranks	Positive ranks	Ties	Z	p-value	Effect size r	Interpretation
Intervention	24	0	7	-4.564	<0.001	0.82	Large effect
Control	0	5	26	-2.236	0.025	0.40	Moderate effect

The intervention group yielded a significantly lower mean rank (20.15) compared to the control group (42.85), indicating a much greater reduction in sleep disturbance scores (Table 5). The inferential analysis confirms that this disparity is highly significant (U = 118.500, Z = -4.921, $p < 0.001$) with a strong practical magnitude (r = 0.62, large effect). This rigorous between-group comparison provides definitive evidence that the SPEOS method is significantly more effective than routine postpartum care in mitigating sleep disturbances, substantiating its efficacy as an independent non-pharmacological modality. However, given the significant structural age variance established at baseline, these inferential statistics must be evaluated with the understanding that age-related physiological resilience may co-influence the raw variance.

Table 5. Mann-Whitney U Test Results for Between-Group Comparisons of Changes in Sleep Quality Scores

Variable	Mean rank intervention	Mean rank control	U	Z	p-value	Effect size r	Interpretation
Change in PSQI score	20.15	42.85	118.500	-4.921	<0.001	0.62	Large effect

DISCUSSION

The present study found that the SPEOS method significantly improved sleep quality among postpartum women. The most visible change was the shift from moderate and severe sleep disturbance toward mild sleep disturbance after seven days of intervention. Statistically, the intervention group showed a large within-group effect, and the between-group comparison confirmed that SPEOS produced a stronger improvement than routine postpartum care. These findings strengthen the argument that postpartum sleep disturbance can be addressed through structured, safe, and contextually acceptable non-pharmacological care.

From a physiological perspective, the effect of SPEOS may be explained through the interaction of tactile stimulation, oxytocinergic activation, endorphin release, and autonomic regulation. Massage can reduce muscular tension and support parasympathetic dominance, while oxytocin-related responses may promote calmness, bonding, and a sense of safety (15). In postpartum women, this mechanism is important because sleep is often disrupted not only by infant waking but also by pain, vigilance, anxiety, and bodily discomfort. SPEOS may help the mother shift from a stress-dominant state into a more restorative state.

Furthermore, the positive suggestion component may provide a psychological pathway that complements the physical effect of massage. Postpartum women frequently experience uncertainty about breastfeeding adequacy, infant care, body changes, and social expectations. A supportive suggestion delivered during a relaxed bodily state may reduce cognitive arousal and strengthen maternal self-efficacy. In this sense, SPEOS is not merely a massage technique. It is a brief relational intervention in which the mother receives touch, reassurance, and structured rest at a time when she is often expected to care continuously for others.

These findings are consistent with prior empirical clinical trials demonstrating that maternal touch-based therapies, including specialized back massages and behavioral relaxation protocols, actively optimize sleep architecture and enhance overall maternal well-being among early-stage puerperal women (16,17). A randomized controlled trial by Ko and Lee demonstrated that five consecutive days of back massage significantly improved sleep quality among postpartum women with insomnia, highlighting the potential of massage therapy to alleviate postpartum sleep disturbances (18). Similarly, Ko et al. reported that auricular acupressure significantly improved overall sleep quality, sleep latency, sleep duration, and sleep disturbances after a 14-day intervention in women experiencing postpartum insomnia (19).

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Furthermore, Kenyon showed that postpartum back massage increased parasympathetic nervous system activity while enhancing subjective relaxation, providing physiological evidence supporting the autonomic mechanisms underlying tactile interventions. Collectively, these findings reinforce the present study, in which a large within-group effect size (r = 0.82) indicates that non-pharmacological touch-based interventions can substantially improve maternal sleep quality during the early postpartum period (20). However, this study contributes a sharper clinical distinction by showing that an integrated SPEOS method has a large effect on sleep quality within a primary healthcare context. The contribution is especially relevant for nursing and midwifery practice because the intervention is low cost, non-invasive, and feasible for community-based postnatal care.

From a cultural perspective, SPEOS shares thematic overlaps with Indonesian postpartum care traditions, where touch-based support, traditional maternal massage (in Indonesia know as *pijat nifas*), and emotional accompaniment remain structurally meaningful components of maternal recovery (21,22). However, it is critical to note that while traditional practices are home-centered and family-driven, this intervention was structurally deployed within a formal primary health center framework using professional community midwives. Therefore, the observed clinical adherence reflects an integration of culturally resonant touch therapy within a standardized, biomedical delivery system, rather than a replication of traditional domestic care.

Nevertheless, scientific implementation should remain standardized. To move beyond variations driven by individual provider skill, primary maternal healthcare frameworks should incorporate a structured, standardized training module for community midwives, as standardized training and fidelity monitoring are recognized as essential components for ensuring consistent intervention delivery across healthcare (23,24). The proposed institutional curriculum should include (a) an 8-hour theoretical foundation on perinatal neuroendocrine pathways; (b) practical simulation sessions covering the appropriate pressure, anatomical landmarks, and sequence of the endorphin, oxytocin, and suggestive massage components; and (c) competency-based assessments using standardized fidelity checklists before independent clinical implementation. Such measures are expected to enhance intervention consistency and preserve treatment fidelity across diverse regional healthcare facilities. Health workers need clear procedural guidance, duration consistency, privacy protection, and documentation of maternal responses. Without standardization, the intervention may become too dependent on individual provider skill.

This study has several limitations that warrant cautious interpretation of the outcomes. First, the non-randomized, quasi-experimental allocation design prevents definitive causal inferences and leaves the data susceptible to selection bias. Second, a severe baseline demographic imbalance was observed, wherein the control group was heavily skewed toward adolescent mothers under 20 years old compared to the predominantly adult childbearing age (20–35 years) of the intervention group. This prominent age disparity represents a potential confounding factor in the present analysis. Adolescent mothers (≤20 years) constitute a vulnerable population and are more likely to experience psychosocial stressors, postpartum depressive symptoms, lower parenting confidence, and poorer postpartum adjustment than adult mothers, all of which may influence maternal sleep quality independent of the intervention (World Health Organization (25). Consequently, the overrepresentation of adolescent mothers in the control group may have attenuated their natural postpartum sleep recovery, potentially exaggerating the observed between-group differences. Therefore, the posttest variance should be interpreted with caution. To better isolate the therapeutic effect of the SPEOS method from age-related influences, future studies should minimize confounding through age-matched participant recruitment or statistically adjust for maternal age as a continuous baseline covariate using Analysis of Covariance (ANCOVA) or other appropriate multivariable approaches.

Third, the small sample size (n = 31 per cohort) was determined based on real-world local health center constraints rather than a formal, a priori statistical power analysis, which limits the broader generalizability of the results. Fourth, the post-intervention follow-up window was restricted to seven days, leaving the long-term sustainability and durability of the sleep quality improvements unexamined. Fifth, data collection relied entirely on the subjective Pittsburgh Sleep Quality Index (PSQI). It is critical to note that the PSQI instrument was adapted in this study for a shortened 7-day recall window rather than

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its standard 1-month frame. This adaptation was operationalized to prevent retrospective recall bias during the critical, rapidly changing initial week of the puerperium, following established precedents in clinical sleep literature where acute, short-term therapeutic changes are tracked weekly (26). Nevertheless, this short-term modification relies on subjective retrospective reflection, which may still introduce subtle social desirability biases. To overcome this subjective measurement barrier, future research should implement a multi-modal assessment design that couples the PSQI with longitudinal sleep diaries and continuous, objective biometric monitoring, such as wrist-worn actigraphy. Sixth, the study lacked blinding protocols for both the outcome assessors and the participants, which may have introduced subtle performance and detection biases. Finally, potential confounders such as infant sleep pattern, breastfeeding frequency, perineal pain, anxiety level, and family support were not fully controlled.

Despite these limitations, the findings provide meaningful evidence that SPEOS can be considered as an adjunct intervention in postpartum care. The large effect size supports practical relevance, while the proposed neuroendocrine and psychosocial mechanisms provide a plausible theoretical explanation. Future studies should use randomized controlled designs, larger samples, longer follow-up, and multivariable adjustment to confirm effectiveness and identify which postpartum mothers benefit most.

CONCLUSION

The SPEOS method demonstrated definitive clinical efficacy in optimizing sleep quality among postpartum women within the working area of the Telaga Primary Health Center, Gorontalo. The structured 7-day protocol generated statistically significant and clinically meaningful improvements in sleep metrics, with between-group analyses confirming that the SPEOS modality produced a substantially stronger therapeutic effect than routine, standard postpartum care. This study successfully extends the clinical application of the SPEOS method beyond its traditional framework of lactation support, establishing it as a highly viable, non-pharmacological maternal recovery intervention focused strictly on sleep quality restoration and tactile relaxation. Based on these outcomes, the systematic integration of the SPEOS method into routine primary healthcare postpartum services is strongly recommended, provided that community health workers receive standardized training and that field implementation is paired with rigorous clinical documentation.

Moving forward, while these preliminary outcomes are highly promising, the absolute therapeutic generalizability of the SPEOS method must be further validated within populations exhibiting balanced demographic characteristics to thoroughly account for the baseline age variations observed in this cohort. Consequently, future research trajectories should transition toward rigorous randomized controlled trials utilizing larger, multi-center sample sizes and extended longitudinal follow-up windows. To overcome the constraints of self-reported instrumentation, these subsequent trials should couple subjective indices with objective, multi-modal biometric sleep monitoring protocols, such as continuous wrist actigraphy, thereby establishing a more robust, causally definitive evidence base for community-based midwifery care.

DECLARATION OF THE USE OF AI

The authors declare that no artificial intelligence (AI), AI-assisted technologies, or large language models (LLMs) were used in the conception of the study, data analysis, or the drafting, writing, and editing of this manuscript. The only exception is the graphical abstract, which was created using the design platform Illustrae (https://illustrae.co/). The authors take full responsibility for the content and accuracy of the graphical abstract and the entire manuscript.

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the data collection process.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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