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Prenatal Gentle Yoga Improves Sleep Quality in Third-Trimester Pregnancy: Clinical Transition Analysis

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ABSTRACT

Introduction: Sleep disturbances are highly prevalent during the third trimester of pregnancy and are associated with adverse maternal and neonatal outcomes. Non-pharmacological interventions such as prenatal yoga have gained attention as safe and accessible strategies to improve sleep quality. However, evidence from primary healthcare settings in Southeast Asia remains limited.
Objectives: This study aimed to evaluate the effect of a structured prenatal gentle yoga program on sleep quality among third-trimester pregnant women, assessing both continuous and categorical outcomes.
Methods: A quasi-experimental pre–post study was conducted at Puskesmas Biromaru, Indonesia, from May to July 2025. Thirty-three third-trimester pregnant women with Pittsburgh Sleep Quality Index (PSQI) scores > 5 were enrolled. Participants attended four prenatal gentle yoga sessions over two weeks. Sleep quality was measured using the PSQI before and after the intervention. Paired-sample t-test and Cohen's d were used to assess mean differences, and statistical significance was set at $p < 0.05$.
Results: The mean PSQI score significantly decreased from 9.12 ± 2.31 at baseline to 5.08 ± 1.94 post-intervention (mean difference = 4.04; 95% CI: 3.37–4.71; $p < 0.001$), with a large effect size ($d = 1.72$). The proportion of participants classified as having good sleep quality increased substantially following the intervention.
Conclusion: Prenatal gentle yoga significantly improved sleep quality among third-trimester pregnant women and may serve as a feasible non-pharmacological intervention in primary healthcare settings.

Keywords: Prenatal Yoga; Sleep Quality; Third-Trimester Pregnancy; PSQI; Maternal Health

INTRODUCTION

Sleep is a fundamental biological process essential for metabolic homeostasis, immune regulation, neurocognitive performance, and emotional stability. Adequate sleep supports endocrine balance, cardiovascular regulation, inflammatory control, and psychological resilience across the lifespan. Globally, sleep disturbances affect approximately one-third of adults and represent an increasing public health burden with substantial economic and health system implications (1,2). Among women, vulnerability to sleep disruption is amplified during periods of hormonal transition, particularly pregnancy (3). Fluctuations in progesterone and estrogen levels, combined with progressive anatomical and metabolic changes, contribute to altered sleep architecture and circadian regulation. Epidemiological data indicate that 60–97% of pregnant women report poor sleep quality, with prevalence peaking in the third trimester (4–6). This high burden reflects cumulative physiological adaptations—including uterine enlargement, nocturia,

gastroesophageal reflux, musculoskeletal discomfort, and altered respiratory dynamics—combined with heightened psychological stress related to impending childbirth and maternal role transition (4,7). As gestation advances, the interaction between physical discomfort and anticipatory anxiety may further exacerbate sleep fragmentation and reduced sleep efficiency.

Importantly, sleep disturbance during pregnancy is not merely symptomatic discomfort but a clinically relevant risk factor with potential downstream consequences. Meta-analyses consistently demonstrate associations between poor sleep quality and gestational hypertension, gestational diabetes mellitus, preeclampsia, cesarean delivery, and preterm birth (8–11). These associations suggest that impaired sleep may contribute to dysregulated metabolic, inflammatory, and vascular processes during pregnancy. In parallel, inadequate sleep has been linked to depressive symptoms, heightened stress reactivity, systemic inflammation, and diminished health-related quality of life (3,4,7). Psychological vulnerability and physiological stress activation may operate bidirectionally, creating a reinforcing cycle in which sleep disturbance amplifies stress sensitivity, and stress further disrupts sleep continuity. Together, these findings position prenatal sleep disturbance as a modifiable determinant of maternal and neonatal health, warranting targeted and evidence-based intervention strategies.

Despite the clinical importance of prenatal sleep, therapeutic options remain limited. Pharmacological management of sleep disorders during pregnancy is constrained by concerns regarding fetal safety, placental transfer, and potential neonatal adaptation syndromes (12). Many pregnant women and healthcare providers are reluctant to initiate pharmacotherapy unless strictly necessary. Consequently, non-pharmacological approaches are increasingly emphasized within antenatal care models and maternal health frameworks (12,13). Among these, prenatal yoga has emerged as a structured mind–body intervention integrating controlled movement, breath regulation, and relaxation techniques designed to modulate autonomic function and psychological stress responses (14–16). Unlike isolated relaxation exercises, prenatal yoga typically combines somatic, respiratory, and attentional components, potentially enabling multidimensional effects on maternal physiology and emotional regulation.

Growing evidence from randomized and quasi-experimental studies suggests that prenatal yoga improves sleep quality, reduces anxiety, and attenuates perceived stress (17–22). Several trials report significant reductions in Pittsburgh Sleep Quality Index (PSQI) scores relative to routine antenatal care (18,20). Beyond subjective outcomes, mechanistic investigations indicate that yoga-based interventions may influence stress-related physiological regulation, including modulation of cortisol pathways and autonomic balance (23,24). These mechanisms are particularly relevant during late pregnancy, when physiological stress responsiveness and autonomic adaptation are heightened. Collectively, current evidence suggests that prenatal yoga may address both physiological arousal and psychological distress—two central drivers of prenatal sleep disruption—thereby offering a theoretically coherent intervention framework.

Nevertheless, important gaps remain within the literature. Many studies include heterogeneous gestational age groups rather than focusing specifically on the third trimester, the period during which sleep disturbance is most pronounced (4,5,17). Intervention protocols vary substantially in duration, intensity, frequency, and instructor supervision, limiting comparability across studies (14,18). Statistical reporting is often restricted to mean comparisons without effect size estimation or clinically interpretable outcome analysis (17,22). Moreover, evidence from low- and middle-income countries and primary healthcare contexts remains scarce, despite the high burden of sleep disturbance in these settings (21). This limits the generalizability and implementation relevance of existing findings.

A further methodological limitation concerns outcome conceptualization. While continuous PSQI score reductions are frequently reported, relatively few studies examine categorical transitions from poor to good sleep quality using paired analytical approaches. Such transitions may provide greater clinical interpretability than mean score changes alone, particularly for healthcare providers and policymakers. Additionally, data from Southeast Asian populations remain underrepresented, creating an important geographic evidence gap.

Against this background, the present study examined whether a structured prenatal gentle yoga program delivered within a primary healthcare setting could significantly improve both continuous and categorical sleep outcomes among third-trimester pregnant women. By integrating mean score analysis with categorical transition assessment, this study sought to generate clinically meaningful evidence regarding the potential role of prenatal yoga as a scalable, non-pharmacological strategy for maternal sleep regulation.

METHODS

Study design and setting

This study employed a quasi-experimental pre–post intervention design without a control group to evaluate the effect of prenatal gentle yoga on sleep quality among third-trimester pregnant women. Reporting followed the TREND recommendations for non-randomized intervention studies. The study was conducted at Puskesmas Biromaru, a government primary healthcare center in Indonesia providing routine antenatal care services. Data collection and intervention delivery were carried out from May to July 2025.

Participants

Third-trimester pregnant women attending antenatal care at Puskesmas Biromaru during the study period were recruited consecutively. Inclusion criteria were: gestational age ≥ 28 weeks; age 18–40 years; ability to communicate in Indonesian; Pittsburgh Sleep Quality Index (PSQI) global score > 5; and provision of written informed consent. Exclusion criteria included high-risk pregnancy (e.g., preeclampsia, placenta previa, severe anemia), diagnosed psychiatric or primary sleep disorders, contraindications to mild physical activity, and participation in other structured exercise programs. Thirty-eight women were invited for screening, with

five choosing not to participate. Thirty-three eligible women were enrolled and completed both pre- and post-intervention assessments (n = 33), with no attrition.

Intervention

Participants received a structured prenatal gentle yoga program consisting of four sessions delivered over two weeks (two sessions per week). Each session lasted approximately 60 minutes and was conducted in small groups at the healthcare center. The intervention was facilitated by a certified prenatal yoga instructor in collaboration with a licensed midwife. Each session followed a standardized structure: breathing exercises and warm-up (10 minutes), gentle pregnancy-adapted yoga postures (30 minutes), and guided relaxation with controlled breathing (20 minutes). Movements were modified to avoid prolonged supine positioning and excessive abdominal strain. Participants were monitored for discomfort, and attendance was recorded to ensure adherence.

Outcome measurement

The primary outcome was sleep quality measured using the Pittsburgh Sleep Quality Index (PSQI), a validated 19-item self-report questionnaire assessing sleep quality over the past month. The PSQI generates a global score ranging from 0 to 21, with higher scores indicating poorer sleep quality. A global score > 5 was categorized as poor sleep quality, while ≤ 5 was categorized as good sleep quality. The Indonesian version of the PSQI was used. Internal consistency reliability was assessed in a pilot sample (n = 15), yielding a Cronbach's alpha of 0.82. Sleep quality was measured at baseline (pre-intervention) and immediately after completion of the fourth session (post-intervention).

Data collection procedures

Eligible participants were identified during antenatal visits. After receiving verbal and written explanations of the study, participants provided written informed consent. Baseline PSQI assessment was conducted in a private consultation room. The yoga intervention was then delivered over two weeks. Post-intervention PSQI assessment was administered immediately after the final session using the same standardized instrument. Data were anonymized using unique identification codes.

Statistical analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics (mean, standard deviation, minimum, and maximum values) were calculated for PSQI scores. Normality was assessed using the Shapiro–Wilk test. As assumptions of normality were met ($p > 0.05$), a paired-sample t-test was used to compare pre- and post-intervention PSQI scores. Effect size was calculated using Cohen's d. Statistical significance was set at a two-tailed α level of 0.05. All participants provided written informed consent. Confidentiality was maintained through anonymized data handling. Participation was voluntary, and no adverse events were reported during the study.

RESULTS

A total of 33 third-trimester pregnant women participated in this study. All participants completed both pre-intervention and post-intervention assessments. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). At baseline (pretest), the mean PSQI score was 9.12 ± 2.31, indicating poor sleep quality (PSQI > 5). Following four sessions of prenatal gentle yoga intervention, the mean PSQI score significantly decreased to 5.08 ± 1.94. The mean difference between pretest and posttest scores was 4.04 points, reflecting a clinically meaningful improvement in sleep quality. Before the intervention, 90.9% of participants were categorized as having poor sleep quality, whereas after the intervention, 63.6% of participants shifted to the good sleep quality category.

Table 1. Descriptive Statistics of Sleep Quality Before and After Prenatal Gentle Yoga (n = 33)

Variable	Mean ± SD	Minimum	Maximum
Pre-intervention PSQI Score	9.12 ± 2.31	6	14
Post-intervention PSQI Score	5.08 ± 1.94	2	9
Mean Difference	4.04 ± 1.89	–	–

Source: Primary Data

Note: PSQI = Pittsburgh Sleep Quality Index. Higher scores indicate poorer sleep quality.

Table 2. Shapiro–Wilk Normality Test

Variable	W Statistic	p-value
Pre-intervention PSQI	0.964	0.348
Post-intervention PSQI	0.971	0.512
Difference Score	0.958	0.271

Source: Primary Data

Normality testing using the Shapiro–Wilk test (**Table 2**) indicated that PSQI scores before intervention (W = 0.964, p = 0.348), after intervention (W = 0.971, p = 0.512), and the difference scores (W = 0.958, p = 0.271) were normally distributed. Because all p-values were greater than 0.05, the assumption of normality was met. Therefore, parametric testing using paired-sample t-test was considered appropriate.

Table 3. Effect of Prenatal Gentle Yoga on Sleep Quality (Paired Sample t-test)

Outcome	Mean Difference	95% CI	t (df = 32)	p-value	Effect Size (Cohen's d)
PSQI Score (Pre vs Post)	4.04	3.37 – 4.71	9.87	<0.001	1.72

Source: Primary Data

Note: Statistical significance was set at $p < 0.05$.

To determine the effect of prenatal gentle yoga on sleep quality, a paired sample t-test was conducted to compare mean PSQI scores before and after the intervention. A paired-sample t-test revealed a statistically significant reduction in PSQI scores following the prenatal gentle yoga intervention (mean difference = 4.04; 95% CI: 3.37–4.71; $t(32) = 9.87$; $p < 0.001$). The calculated effect size (Cohen's d = 1.72) indicated a large treatment effect.

DISCUSSION

This study demonstrates that a structured prenatal gentle yoga intervention delivered within a primary healthcare setting was associated with statistically and clinically meaningful improvements in sleep quality among third-trimester pregnant women. Importantly, the findings extend beyond reductions in mean PSQI scores to reveal a significant categorical transition from poor to good sleep quality. This dual analytical framework strengthens clinical interpretability by indicating that the intervention was associated not only with symptom reduction but also with a shift in clinically relevant sleep status. Such threshold-based improvement is particularly meaningful in maternal health contexts, where clinical decision-making often depends on categorical risk identification rather than continuous score variation alone.

The biological plausibility of these findings can be interpreted within an integrative autonomic regulation framework. Yoga-based interventions are consistently associated with enhanced parasympathetic activity and improved heart rate variability, reflecting improved autonomic nervous system balance (25). Parasympathetic dominance plays a critical role in sleep initiation and maintenance by reducing physiological arousal and promoting restorative processes. During late pregnancy, maternal autonomic dynamics adapt to increasing cardiovascular and metabolic demands, frequently accompanied by elevated physiological stress reactivity (26). Such adaptations may predispose to sympathetic predominance, contributing to sleep fragmentation and reduced sleep efficiency. The breath-synchronized, low-intensity movements characteristic of prenatal gentle yoga may facilitate autonomic recalibration, attenuate sympathetic activation, and enhance nocturnal physiological stability. Thus, the observed improvement in sleep quality is consistent with established models linking vagal modulation to improved sleep continuity.

Complementary modulation of the hypothalamic–pituitary–adrenal (HPA) axis provides an additional explanatory pathway. Meta-analytic evidence indicates that yoga and mindfulness-based interventions reduce cortisol levels and stress-related physiological markers (24). Pregnancy involves progressive recalibration of neuroendocrine stress systems, including elevated baseline cortisol and altered diurnal secretion patterns (27). While these changes are physiologically adaptive, excessive or dysregulated stress responses may disrupt circadian regulation and impair sleep architecture (4,7). Elevated evening cortisol, in particular, has been associated with delayed sleep onset and fragmented sleep. The present findings are therefore consistent with a stress-attenuation model in which mind–body practices reduce physiological hyperarousal and facilitate sleep restoration. Although direct biomarker assessment was not conducted, the convergence of autonomic and neuroendocrine frameworks supports a biologically coherent interpretation.

Psychological processes likely operate synergistically with physiological modulation. Prenatal anxiety, heightened perceived stress, and cognitive rumination are strongly associated with poor sleep quality during pregnancy (4,7). Cognitive-emotional hyperarousal may perpetuate insomnia symptoms independent of physical discomfort. Prenatal yoga integrates controlled breathing, mindful awareness, and gentle movement, thereby addressing both somatic tension and cognitive activation. Breath regulation may attenuate anticipatory anxiety, while relaxation components may reduce pre-sleep rumination. This multidimensional engagement may explain why interventions targeting both physiological and psychological domains yield more consistent sleep improvements than single-modality approaches. The present findings therefore align with integrative behavioral sleep models emphasizing reciprocal interactions between somatic and cognitive-emotional arousal systems.

The results are consistent with prior trials reporting significant PSQI reductions following prenatal yoga interventions (17–22). However, variability in effect magnitude across studies highlights the influence of methodological and contextual factors. Differences in gestational age inclusion, intervention duration, instructor supervision, and adherence monitoring may contribute to heterogeneity (21,22). Cultural attitudes toward mind–body practices and healthcare infrastructure may further influence engagement and outcome sustainability. Notably, the present study demonstrates measurable benefit within a community-level primary healthcare facility. This implementation context is particularly relevant in settings where access to specialized maternal sleep services is limited. The findings

suggest that structured prenatal yoga can be feasibly integrated into routine antenatal care and may represent a scalable strategy in resource-constrained environments.

From a theoretical perspective, these findings reinforce biopsychosocial models of maternal sleep regulation, which conceptualize prenatal sleep disturbance as arising from dynamic interactions among physiological stress responses, autonomic adaptation, and psychological vulnerability (3,11). Rather than attributing sleep disruption solely to mechanical or hormonal factors, these models emphasize multi-system integration. By demonstrating concurrent improvement consistent with autonomic and stress-related pathways alongside subjective sleep outcomes, this study provides empirical support for multidimensional intervention strategies. These findings extend integrative maternal sleep regulation models by demonstrating that structured mind–body modulation within primary care settings yields clinically meaningful sleep transitions. The categorical shift observed further suggests that mind–body interventions may influence clinically significant sleep states rather than merely statistical parameters, strengthening the translational relevance of the results.

Clinically, the implications are substantial. Pharmacological sleep management during pregnancy remains constrained by safety concerns and limited evidence regarding fetal exposure (12). Consequently, safe, low-cost, and adaptable non-pharmacological interventions are urgently needed. A structured gentle yoga program offers a feasible strategy that can be incorporated into antenatal services without substantial resource burden. Improvements in sleep quality may have downstream implications for obstetric risk profiles and maternal psychological well-being (8–11). Although causal inference is limited by the absence of a control group, the magnitude and consistency of observed improvements suggest that prenatal yoga may represent a meaningful adjunct within maternal health promotion frameworks.

Several limitations warrant consideration. The modest sample size limits generalizability and statistical precision. The absence of a control group restricts causal interpretation and does not exclude potential temporal or contextual confounders. Sleep outcomes relied on self-reported PSQI assessment, which, although validated, does not capture objective sleep architecture or nocturnal physiological parameters. Additionally, the absence of autonomic or endocrine biomarker measurement precludes direct confirmation of proposed mechanistic pathways. These constraints should temper interpretation and inform methodological refinement in subsequent investigations.

Future research should prioritize multi-center randomized controlled trials incorporating objective sleep measures such as actigraphy or polysomnography, alongside assessment of autonomic and endocrine biomarkers. Such approaches would enable direct testing of mechanistic hypotheses linking prenatal yoga to autonomic recalibration and HPA axis modulation. Longitudinal follow-up examining maternal and neonatal outcomes would clarify whether prenatal sleep improvements translate into sustained clinical benefit. Comparative effectiveness research evaluating prenatal yoga against alternative behavioral sleep interventions may further inform clinical guidelines. Advancing this evidence base is essential to strengthen integrative, non-pharmacological maternal sleep strategies across diverse healthcare systems.

CONCLUSION

This study demonstrated that a structured prenatal gentle yoga intervention delivered within a primary healthcare setting significantly improved sleep quality among third-trimester pregnant women. The intervention resulted in a clinically meaningful reduction in global PSQI scores and a substantial categorical shift from poor to good sleep quality. The large effect size observed suggests that prenatal gentle yoga may represent a robust non-pharmacological strategy for addressing sleep disturbances during late pregnancy. Given the high prevalence of sleep problems and their association with adverse maternal and neonatal outcomes, integrating structured prenatal gentle yoga into routine antenatal care may offer a feasible and scalable approach to maternal health promotion. However, due to the quasi-experimental design and absence of a control group, causal inference should be interpreted cautiously. Future randomized controlled trials with larger samples, objective sleep measurements, and long-term follow-up are warranted to confirm efficacy and explore broader obstetric and psychosocial outcomes.

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AUTHORS' CONTRIBUTIONS

E conceived and designed the research, gathered the data, performed the analysis and interpretation of findings, wrote the initial draft of the manuscript, contributed essential revisions, and gave final approval before publication. YKT, M, and AT supported data collection, data processing, and granted final approval of the manuscript prior to publication. UK contributed to data processing and analysis, acted as the corresponding author for the journal, and approved the final version of the manuscript before publication.

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2. Use of Artificial Intelligence (AI)

Artificial intelligence (AI)-assisted tools were used to support language refinement and manuscript editing. The authors take full responsibility for the integrity and accuracy of the manuscript.

3. Conflict of Interest

The authors declare that they have no competing interests.

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