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Effectiveness of an Integrated Health Education and Prenatal Yoga–Relaxation Program on Stress and Sleep Quality among Pregnant Women

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Abstract

Aims: Stress and poor sleep quality are common during pregnancy and may adversely affect maternal well-being. This study aimed to analyze the effectiveness of an integrated health education and prenatal yoga–relaxation program on stress levels and sleep quality among pregnant women.

Materials & Methods: This controlled quasi-experimental study with repeated measures was conducted at four independent midwife practices in Surabaya, Indonesia, in April–May 2026, and involved 60 pregnant women allocated by site to an intervention or a control group (30 each). The intervention group received health education and prenatal yoga–relaxation for 10 sessions over 5 weeks. Stress was assessed using the Depression Anxiety Stress Scales stress subscale and sleep quality using the Pittsburgh Sleep Quality Index at baseline (T0), after the fifth session (T1), and after the tenth session (T2). Data were analyzed using repeated-measures analysis of variance or the Friedman test, as appropriate.

Findings: In the intervention group, mean stress scores decreased from 18.63 (T0) to 17.00 (T1) and 11.27 (T2), compared with 19.47, 20.07, and 19.70 in the control group (time×group interaction: $F=69.179$; $p<0.001$). Mean PSQI scores decreased from 7.77 to 6.47 and 4.73 in the intervention group, compared with 8.57, 7.97, and 7.67 in the control group ($F=13.862$; $p<0.001$). Perceived benefits, self-efficacy, activity-related affect, and commitment also increased more in the intervention group than in the control group.

Conclusion: Integrated health education and prenatal yoga–relaxation are associated with a progressive reduction in stress and improvement in sleep quality among pregnant women over 10 sessions.

Keywords

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Introduction

Pregnancy involves complex physiological, psychological, and social changes. Hormonal changes, physical discomfort, concerns about fetal health, preparation for childbirth, changes in family roles, and socioeconomic demands may increase pregnant women's vulnerability to stress. To a certain extent, stress represents an adaptive response; however, persistent stress may increase activation of the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system, thereby affecting cortisol regulation, inflammatory responses, autonomic balance, and maternal psychological well-being. A meta-analysis showed that stress during pregnancy was associated with an increased risk of preterm birth, low birth weight, and small-for-gestational-age infants [1]. Sleep disturbance is a common maternal problem but does not always receive adequate attention in antenatal care. Increased urinary frequency, back and pelvic pain, fetal movement, difficulty finding a comfortable sleeping position, and pregnancy-related concerns may interfere with sleep duration, continuity, and efficiency. A meta-analysis of 24 studies involving 11,002 pregnant women found that approximately 45.7% of pregnant women experienced poor sleep quality, which tended to deteriorate with advancing gestational age, particularly from the second to the third trimester [2]. Another meta-analysis reported that the prevalence of poor sleep quality reached 44.5% during the perinatal period, indicating that sleep problems constitute an important component of the maternal health burden [3].

Stress and sleep disturbances have a bidirectional relationship. Increased psychological tension and physiological arousal may prolong sleep latency, increase the frequency of nighttime awakenings, and reduce sleep quality, while inadequate sleep may impair emotional regulation, increase fatigue, and exacerbate responses to stress. This relationship is particularly important during pregnancy because sleep disturbances not only affect maternal comfort but are also associated with maternal and perinatal complications. A systematic review and meta-analysis of 120 studies found that sleep disturbances during pregnancy were associated with preeclampsia, gestational hypertension, gestational diabetes, cesarean delivery, preterm birth, and stillbirth, with a 2.80-fold increase in the odds of preeclampsia and a 1.74-fold increase in the odds of gestational hypertension [4]. Stress management and improvement of sleep quality should therefore be incorporated into health promotion and complication prevention during pregnancy.

Nonpharmacological approaches based on mind–body interventions may represent safe and easily applicable strategies in maternal care. Prenatal yoga combines physical postures modified according to pregnancy conditions, breathing techniques, focused attention, body awareness, and relaxation [5]. This combination has the potential to reduce muscle tension, improve breathing patterns, decrease sympathetic nervous system activity, increase parasympathetic activity, and help women achieve a state of physical and psychological relaxation. A randomized controlled trial demonstrated that prenatal yoga could reduce stress and cortisol levels and improve maternal immune function, as indicated by increased immunoglobulin A levels [6]. Broader evidence also supports the use of prenatal yoga to improve psychological health during pregnancy, with reported benefits for stress, anxiety, depression, pain, and several childbirth outcomes [7]. A meta-analysis of randomized controlled trials also found that mind–body interventions produced greater reductions in antenatal stress than control conditions [8].

Prenatal yoga combined with relaxation may influence stress and sleep quality by regulating both psychological and physiological responses. Relaxation following yoga practice may help maintain the calm state established during the exercise. In the present study, relaxation was conducted after prenatal yoga, allowing pregnant women an opportunity to reduce bodily tension, slow their breathing, and focus their attention on calming stimuli. A systematic review and meta-analysis showed that relaxation interventions during pregnancy, including muscle relaxation, breathing exercises, meditation, yoga, mindfulness, and music therapy, could reduce maternal stress and improve mental health; however, substantial variation remains in the forms, frequency, and intensity of these interventions, highlighting the need for studies employing more structured programs and repeated evaluations [9].

Prenatal yoga and relaxation may produce beneficial psychophysiological responses; however, changes in health behavior are not determined solely by the physical experience of exercise. Knowledge, perceived benefits, self-efficacy beliefs, affective responses to activities, interpersonal support, and commitment to maintaining an action also play roles in sustaining health behaviors. Health education can help women understand the risks associated with stress and sleep disturbances, recognize the benefits of preventive actions, enhance self-efficacy, and strengthen their commitment to engaging in health-promoting behaviors. Research has shown that self-efficacy-based pregnancy education classes can reduce anxiety and depression and improve maternal preparedness for childbirth [10], and that structured prenatal education can reduce health anxiety among primigravid women [11].

Based on these considerations, integrating health education with prenatal yoga–relaxation may provide more comprehensive benefits than

interventions focusing on only one component. Health education addresses cognitive and affective aspects and the development of commitment, whereas prenatal yoga–relaxation provides direct experiences for managing physical tension and stress responses. Repeated exposure may also facilitate learning, adaptation, reinforcement of self-efficacy, and gradual habit formation. Although evidence regarding the benefits of prenatal yoga, relaxation, and antenatal education continues to grow, several research gaps remain. First, some studies have evaluated prenatal yoga or health education separately, resulting in limited evidence regarding programs that integrate both approaches. Second, prenatal yoga protocols vary considerably and often do not incorporate factors that contribute to behavioral commitment. Third, many studies use a single pre- and post-intervention measurement, making it difficult to determine when changes begin to occur and whether the benefits increase with greater exposure to the intervention. Reviews of pregnancy yoga have also emphasized the substantial heterogeneity of intervention protocols and the need for studies with more structured intervention designs and reporting [7].

To address these gaps, this study developed an integrated health education and prenatal yoga–relaxation program delivered over 10 sessions, with evaluations at three time points: before the intervention at the first session, after the fifth session, and after the tenth session. Repeated measurements enabled an evaluation of the pattern and progression of responses throughout the program rather than merely of differences in scores before and after the intervention. This study aimed to analyze the effectiveness of an integrated health education and prenatal yoga–relaxation program on stress levels and sleep quality among pregnant women. It was hypothesized that there would be a time-by-group interaction, with reductions in stress levels and improvements in sleep quality in the intervention group occurring progressively and being greater than those observed in the control group.

Materials and Methods

Study design, setting, and allocation

This study employed a controlled quasi-experimental design with repeated measures, using a control group with time-series measurements. The study was conducted from April to May 2026 at four Independent Midwife Practice Sites (TPMB) in Surabaya City, East Java, Indonesia. Two TPMBs were assigned to the intervention condition, which received an integrated health education and prenatal yoga–relaxation program, and two to the control condition, which received routine antenatal care and standard pregnancy exercise. Because the intervention was delivered in groups at the TPMB level, allocation was performed by site rather than by individual participant, and no individual-level randomization was used. The intervention sites were selected based on site eligibility and operational feasibility, including the availability of a sufficiently large space to accommodate approximately 15 pregnant women simultaneously for the prenatal yoga–relaxation sessions. Intervention and control sites were geographically separated to reduce the possibility of information exchange and contamination between groups. Potential site-related bias was further addressed by including two sites in each study condition and applying the same eligibility criteria across sites.

Participants and sampling

The study population consisted of pregnant women with a gestational age of 12–20 weeks who were receiving antenatal care at the participating TPMBs. The inclusion criteria were: (1) a gestational age of 12–20 weeks; (2) ability to communicate in Indonesian; (3) no medical contraindications to participation in prenatal yoga; (4) willingness to participate in the study procedures; and (5) willingness to provide written informed consent. The exclusion criteria were: (1) pregnancy complications that contraindicated participation in the intervention; (2) musculoskeletal disorders or other medical conditions that could interfere with prenatal yoga; and (3) current participation in a similar yoga program outside the study.

A total of 60 pregnant women were recruited, with 15 participants selected from each of the four TPMBs, giving 30 participants in the intervention group and 30 in the control group. The sample size was calculated using the formula proposed by Lwanga and Lemeshow[12]:

$$n = \frac{2\sigma^2\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2}{(\mu_1 - \mu_2)^2}$$

$$n = \frac{2 \times 26.83 \times (2.8)^2}{(4)^2} = 26.29 \cong 27$$

where σ^2 is the variance of the outcome (26.83), $Z_{1-\alpha/2}$ is 1.96 (α=0.05), $Z_{1-\beta}$ is 0.84 (power: 80%), and $\mu_1-\mu_2$ is the expected mean difference between the groups (4). Based on this formula, the minimum required sample size was 27 pregnant women per group; because a minimum of 30 participants per group is recommended for experimental and quasi-experimental studies[13], 30 women were included in each group. Participant selection was performed using simple random sampling within each TPMB. The sampling frame consisted of eligible pregnant women identified from the antenatal-care records of each TPMB; eligible women were assigned identification numbers, and 15 women per TPMB were selected by drawing lots. When a selected participant declined participation or did not provide informed consent, a replacement was selected

randomly from the remaining eligible women in the same TPMB.

Data collection and intervention procedures

Eligible participants received an explanation of the study objectives, procedures, potential benefits and risks, confidentiality, and their right to withdraw from the study, and written informed consent was obtained before baseline data collection. Measurements were performed at three time points in both study groups: before the intervention at the first session (T0), at the end of the fifth session (T1), and at the end of the tenth session (T2). The intervention was conducted for five weeks, with two sessions per week, giving a total of 10 sessions.

Intervention group. Participants in the intervention group received an integrated health education and prenatal yoga–relaxation program. Each session lasted approximately 65–80 minutes and consisted of three parts. First, health education and discussion (15–30 minutes): each session began with health education, discussion, and question-and-answer activities covering hypertension in pregnancy, complementary care, and the roles of family members, health professionals, and peers in supporting maternal health. Second, prenatal yoga (approximately 30 minutes): under the supervision of a trained facilitator, participants performed stretching and prenatal yoga postures, including Sukhasana, Tadasana, Ardha Kati Chakrasana, Trikonasana (triangle pose), Baddha Konasana (bound angle pose), Ardha Pavanamuktasana, and side-lying positions, guided by the facilitator and supported by an instructional yoga video. Third, relaxation with music (approximately 20 minutes): relaxation was performed in the side-lying position while participants listened to Mozart music.

The facilitator had received prenatal-yoga training and was responsible for guiding participants, monitoring the implementation of the yoga postures, and ensuring that the activities were performed according to the intervention protocol. Participants received a study module containing educational materials related to hypertension in pregnancy and complementary care, intended as supplementary reading at home to reinforce the educational content rather than as a manual for unsupervised prenatal yoga practice. Attendance was recorded at every session. Participants were monitored throughout each session for discomfort or other adverse symptoms; if a participant experienced such symptoms, the activity was stopped and the participant was assessed according to the study safety procedure.

Control group. Participants in the control group continued to receive routine antenatal care at their respective TPMBs and participated in standard pregnancy exercise provided at the site. They did not receive the integrated program during the study period, so the amount and content of participant contact were not identical between groups. The control group nevertheless underwent the same outcome assessments at T0, T1, and T2.

Measurement instruments

Data were collected using structured questionnaires administered in Indonesian, covering participant characteristics, previous pregnancy experience, cognitive and affective factors, interpersonal support, commitment to action, stress, and sleep quality. Participant characteristics included education and household income, and previous experience included parity and pregnancy history.

Perceived benefits, including experience, understanding, and belief, were measured using a six-item questionnaire adapted from Puspita et al., with reported item validity coefficients of 0.550–0.816 [14]. Self-efficacy was assessed using the 10-item General Self-Efficacy Scale (GSES), with reported validity coefficients of 0.654–0.888 [15]. Activity-related affect, including positive and negative affect, was measured using a six-item instrument adapted from Bahabadi et al. (validity coefficients: 0.677–0.891) [16]. Family support was assessed using a 10-item questionnaire covering three dimensions (validity coefficients: 0.490–0.808) [17]. Support from health professionals was assessed using the four-item Health Care Climate Questionnaire (HCCQ) (validity coefficients: 0.488–0.804) [18]. Peer support was assessed using the 10-item Perceived Social Support from Friends (PSSF) scale (validity coefficients: 0.685–0.890) [19]. Commitment to action was assessed using an eight-item questionnaire measuring awareness to act (validity coefficients: 0.538–0.909) [20].

Stress was assessed using the 14-item stress subscale of the Depression Anxiety Stress Scales-42 (DASS-42) [21, 22], Indonesian version (validity coefficients: 0.451–0.864). For each item, participants indicated the extent to which the statement applied to them, and the stress score was calculated by summing the 14 items. The reported stress scores are raw scores (possible range: 0–42), with higher scores indicating greater perceived stress. Each item was rated on a 4-point scale (0–3), the raw scores were not multiplied by two, and stress levels were classified as normal (0–14), mild (15–18), moderate (19–25), severe (26–33), or extremely severe (≥34). Sleep quality was assessed using the Indonesian version of the Pittsburgh Sleep Quality Index (PSQI) [23], consisting of 15 questionnaire items with reported validity coefficients of 0.361–0.766 [24]; lower PSQI scores indicate better sleep quality.

For all instruments adapted for this study, the Indonesian-language versions were reviewed and, where applicable, subjected to validity testing before use. The score ranges and interpretation of each instrument were based on its scoring guidelines. The primary outcomes were stress level and sleep quality, both assessed at T0, T1, and T2 in both groups.

Statistical analysis

Statistical analyses were performed using SPSS version 29. Descriptive statistics are presented as mean (standard deviation [SD]) or median, as appropriate, and data normality was assessed using the Shapiro–Wilk test. The equivalence of baseline characteristics between the control and intervention groups was assessed using the chi-square test, or Fisher's exact test when expected cell counts were below five. To assess changes in outcomes across the three measurement time points within each group, repeated-measures analysis of variance (ANOVA) was used for normally distributed data, whereas the Friedman test was used for data that were not normally distributed. For repeated-measures ANOVA, Mauchly's test of sphericity was performed, and when this assumption was violated ($p<0.05$), the Greenhouse–Geisser correction was applied. The time×group interaction was assessed using mixed-design repeated-measures ANOVA. The significance level was set at 0.05, with 95% confidence intervals. When repeated-measures ANOVA indicated a statistically significant difference across time points, post hoc pairwise comparisons were conducted using the Bonferroni correction. When the Friedman test indicated a statistically significant difference, post hoc pairwise comparisons were conducted using the Wilcoxon signed-rank test. The significance level for post hoc comparisons was adjusted to 0.017 (0.05/3) for the three pairwise comparisons.

Findings

Baseline characteristics did not differ significantly between the groups (Table 1). In the control group, most respondents had a junior or senior high school education, an income below the regional minimum wage (UMR), were primigravid, and had low-risk pregnancies. In the intervention group, most respondents had a senior high school education and an income below the UMR, were multigravid, and all had low-risk pregnancies. There were no statistically significant differences between the groups in education ($p=0.425$), income ($p=0.577$), parity ($p=0.121$), or pregnancy history ($p=0.492$), indicating that the groups were comparable before the intervention.

Table 1. Baseline characteristics of the pregnant women in the control and intervention groups (n=60; numbers in parentheses are percentages)

Characteristic	Category	Control (n=30)	Intervention (n=30)	χ^2 (p-value)
Education	Elementary school	4 (13.3)	3 (10.0)	2.792 (0.425)
	Junior high school	11 (36.7)	6 (20.0)	
	Senior high school/vocational high school	11 (36.7)	14 (46.7)	
	Higher education	4 (13.3)	7 (23.3)	
Income	< Regional minimum wage	16 (53.3)	17 (56.7)	1.098 (0.577)
	Regional minimum wage	7 (23.3)	4 (13.3)	
	> Regional minimum wage	7 (23.3)	9 (30.0)	
Parity	Primigravida	18 (60.0)	11 (36.7)	2.403 (0.121)[a]
	Multigravida (1–4 previous pregnancies)	12 (40.0)	19 (63.3)	
Pregnancy history	Low risk	28 (93.3)	30 (100.0)	2.069 (0.492)[b]
	High risk	2 (6.7)	0 (0.0)	

p-values are from Pearson's chi-square test; [a]with continuity correction; [b]p-value from Fisher's exact test.

Stress levels

Changes in all outcomes are summarized in Table 2. In the control group, Mauchly's test indicated that the assumption of sphericity was violated ($\chi^2=61.080$; $p<0.001$), and the Greenhouse–Geisser corrected repeated-measures ANOVA showed no statistically significant change in stress scores over time ($F=0.875$; $p=0.363$); therefore, no post hoc tests were conducted. In the intervention group, the Friedman test revealed a statistically significant change in stress scores across T0, T1, and T2 ($\chi^2=56.165$; $p<0.001$), and all pairwise comparisons were statistically significant (all $p<0.001$). The time×group interaction for stress was statistically significant ($F=69.179$; $p<0.001$), indicating that the patterns of change differed between the groups.

Sleep quality

In the control group, the Friedman test indicated a statistically significant change in sleep quality scores across the time points ($\chi^2=15.462$; $p<0.001$), with significant differences between T0 and T1 ($p=0.008$), T1 and T2 ($p=0.006$), and T0 and T2 ($p=0.002$). In the intervention group, the Friedman test also indicated a statistically significant change ($\chi^2=41.407$; $p<0.001$), with all pairwise comparisons statistically significant (all $p<0.001$). The time×group interaction was statistically significant ($F=13.862$; $p<0.001$). Sleep quality improved in both groups, with a substantially greater improvement in the intervention group: the median PSQI score decreased from 8.50 at baseline to 8.00 at T2 in the control group and from 8.00 to 5.00 in the intervention group. Because lower PSQI scores indicate better sleep quality, these findings suggest a stronger improvement in the intervention group than in the control group.

Perceived benefits

In the control group, the Friedman test revealed a statistically significant difference in perceived benefit scores across T0, T1, and T2 ($\chi^2=11.565$; $p=0.003$); post hoc analysis showed no significant difference between T0 and T1 ($p=0.034$) or between T1 and T2 ($p=0.059$), but a significant difference between T0 and T2 ($p=0.014$). In the intervention

group, the change was also statistically significant (χ^2=56.214; p<0.001), with all pairwise comparisons significant (all p<0.001). The time×group interaction was statistically significant (F=32.351; p<0.001).

Table 2. Stress, sleep quality, perceived benefits, self-efficacy, activity-related affect, and commitment at T0, T1, and T2 in the control and intervention groups (n=30 per group)

Group	Statistic	T0	T1	T2	Test	p	Post hoc p-value			Time× group F
							T0–T1	T1–T2	T0–T2	
Stress (DASS-42 stress subscale)										
Control	Mean (SD)	19.47 (6.08)	20.07 (4.96)	19.70 (4.92)	F=0.875[a]	0.363	–	–	–	69.179
Intervention	Median	19.00	18.50	11.00	χ^2=56.165	<0.001	<0.001	<0.001	<0.001	
Sleep quality (PSQI)										
Control	Median	8.50	8.00	8.00	χ^2=15.462	<0.001	0.008	0.006	0.002	13.862
Intervention	Median	8.00	5.00	5.00	χ^2=41.407	<0.001	<0.001	<0.001	<0.001	
Perceived benefits										
Control	Median	18.00	18.00	18.00	χ^2=11.565	0.003	0.034	0.059	0.014	32.351
Intervention	Median	18.00	19.00	20.00	χ^2=56.214	<0.001	<0.001	<0.001	<0.001	
Self-efficacy										
Control	Mean (SD)	30.63 (3.378)	30.93 (3.216)	31.03 (3.135)	F=7.490[a]	0.006	0.052	0.249	0.015	51.461
Intervention	Mean (SD)	30.30 (4.580)	31.70 (3.993)	33.83 (3.185)	χ^2=53.626	<0.001	<0.001	<0.001	<0.001	
Activity-related affect										
Control	Mean (SD)	16.03 (3.846)	16.40 (3.663)	16.67 (3.437)	F=16.597[a]	<0.001	<0.001	0.027	<0.001	38.411
Intervention	Mean (SD)	16.27 (4.653)	17.30 (3.870)	19.23 (2.725)	F=38.966[a]	<0.001	<0.001	<0.001	<0.001	
Commitment										
Control	Median	9.50	11.00	12.00	χ^2=55.861	<0.001	<0.001	<0.001	<0.001	148.960
Intervention	Median	10.00	13.00	19.00	χ^2=60.000	<0.001	<0.001	<0.001	<0.001	

T0, baseline; T1, after the fifth session; T2, after the tenth session; SD, standard deviation; DASS-42, Depression Anxiety Stress Scales-42; PSQI, Pittsburgh Sleep Quality Index (lower scores indicate better sleep quality); χ^2, Friedman test; F, F-statistic. [a] Repeated-measures ANOVA with Greenhouse–Geisser correction (sphericity violated; Mauchly's χ^2=61.080, 23.190, 12.635, and 50.155 for stress [control], self-efficacy [control], and activity-related affect [control and intervention], respectively). Post hoc comparisons were performed using the Bonferroni correction after repeated-measures ANOVA and the Wilcoxon signed-rank test after the Friedman test (significance threshold: 0.017); post hoc tests were not performed for stress in the control group because the overall test was not significant. The time×group F indicates whether changes over time differed between the groups (all p<0.001).

Self-efficacy

In the control group, the assumption of sphericity was violated (Mauchly's χ^2=23.190; p<0.001), and the Greenhouse–Geisser corrected ANOVA indicated a statistically significant change in self-efficacy scores over time (F=7.490; p=0.006). Post hoc analysis showed that the score at T1 (mean=30.933; SE=0.587) was slightly higher than that at T0 (mean=30.633; SE=0.617), but this increase was not statistically significant (p=0.052); the score at T2 (mean=31.033; SE=0.572) did not differ significantly from that at T1 (p=0.249) but was significantly higher than that at T0 (p=0.015). In the intervention group, the Friedman test revealed a statistically significant change (χ^2=53.626; p<0.001), with all pairwise comparisons significant (all p<0.001). The time×group interaction was statistically significant (F=51.461; p<0.001).

Activity-related affect

In the control group, the assumption of sphericity was violated (Mauchly's χ^2=12.635; p=0.002), and the Greenhouse–Geisser corrected ANOVA indicated a statistically significant change in activity-related affect scores (F=16.597; p<0.001). The mean score at T1 (16.40±3.663) was significantly higher than that at T0 (16.03±3.846; p<0.001). Although the mean score increased further at T2 (16.667±3.437), the difference between T1 and T2 was not statistically significant after adjustment for multiple comparisons (p=0.027; adjusted threshold: 0.017). In the intervention group, sphericity was also violated (Mauchly's χ^2=50.155; p<0.001), and the corrected ANOVA indicated a statistically significant change over time (F=38.966; p<0.001), with scores increasing from 16.27±4.653 at T0 to 17.30±3.870 at T1 and 19.23±2.725 at T2 (all pairwise p<0.001). The time×group interaction was statistically significant (F=38.411; p<0.001).

Commitment

In the control group, the Friedman test indicated a statistically significant change in commitment (χ^2=55.861; p<0.001), with all pairwise comparisons significant (all p<0.001). The same was true for the intervention group (χ^2=60.000; p<0.001; all pairwise p<0.001). The time×group interaction was statistically significant (F=148.960; p<0.001). Commitment scores increased over time in both groups, with a substantially greater increase in the intervention group: the median score increased from 9.50 at baseline to 12.00 at T2 in the control group and from 10.00 to 19.00 in the intervention group. These findings suggest that the intervention, which included a pregnancy hypertension prevention module based on the Health Promotion Model and complementary care, was associated with greater commitment to practicing complementary care, specifically mind–body interventions.

Discussion

This study evaluated changes in stress levels and sleep quality among pregnant women receiving an integrated health education and prenatal yoga–

relaxation intervention at three measurement time points, compared with women receiving standard antenatal care supplemented with pregnancy exercise. The findings indicated more favorable descriptive changes in both primary outcomes in the intervention group. The significant time×group interactions for stress levels ($F=69.179$; $p<0.001$) and sleep quality ($F=13.862$; $p<0.001$) indicated that the patterns of change over time differed between the groups. However, because this study used a quasi-experimental, site-based design, the findings should be interpreted as associations rather than definitive evidence of causality. Repeated sessions provided opportunities for participants to become familiar with the educational materials, yoga movements, breathing techniques, and relaxation procedures. These experiences may have supported engagement with the program, although the internalization of educational materials and the application of learned skills in daily life were not directly assessed. These considerations are relevant to pregnancy, which involves physical, hormonal, psychological, social, and family-role changes [25].

Regarding stress levels, the intervention group demonstrated statistically significant changes in stress scores across T0, T1, and T2, whereas the control group showed no statistically significant within-group change over time ($F=0.875$; $p=0.363$). The significant time×group interaction provides evidence that the trajectories of stress scores differed between the groups. These findings are consistent with systematic reviews and meta-analyses reporting potential benefits of prenatal yoga for maternal stress, anxiety, depression, and emotional well-being [7, 26, 27]. However, differences in intervention duration, frequency, program components, and participant characteristics limit direct comparisons across studies. The present study also combined health education, prenatal yoga, and relaxation accompanied by Mozart music; therefore, the observed differences cannot be attributed exclusively to yoga or to any single intervention component. Moreover, the magnitude of benefit relative to previous studies cannot be established reliably without comparable effect estimates and measurement scales.

Several explanations for the observed stress-related changes have been proposed in previous literature. Breathing exercises, controlled movements, focused attention, and relaxation may help participants manage perceived tension and respond to stressful situations. Neurophysiological, neuroendocrine, psychological, and behavioral pathways have also been discussed as possible explanations for the relationship between mind–body practices and stress [28, 29, 30], and previous studies have reported changes in subjective and physiological stress indicators following prenatal yoga [6, 31]. Nevertheless, this study did not measure autonomic nervous system activity, hypothalamic–pituitary–adrenal axis function, or cortisol concentrations, so these mechanisms cannot be confirmed as explanations for the observed findings. Similarly, the specific contribution of Mozart music [32] was not evaluated separately. These possibilities should therefore be considered hypotheses informed by previous literature rather than mechanisms demonstrated by the present study.

The interpretation of sleep quality, the second primary outcome, requires consideration of the results in both groups. The median PSQI score decreased from 8.50 at T0 to 8.00 at T2 in the control group and from 8.00 to 5.00 in the intervention group, suggesting a greater improvement in the intervention group. Nevertheless, the control group also demonstrated statistically significant changes across measurement times ($\chi^2=15.462$; $p<0.001$), with significant pairwise comparisons between T0 and T1 ($p=0.008$), T1 and T2 ($p=0.006$), and T0 and T2 ($p=0.002$). The intervention group likewise demonstrated significant changes over time ($\chi^2=41.407$; $p<0.001$). These findings show that improvement was not exclusive to the intervention group. The significant time×group interaction supports a difference in the patterns of change between the groups, but it does not establish that every observed change resulted from the intervention itself.

Reduced physical discomfort, opportunities for relaxation, and engagement in structured activities may be relevant to understanding changes in sleep quality. Previous research on relaxation interventions during pregnancy, including yoga, music, breathing exercises, and mindfulness, provides context for the potential benefits of these approaches [9, 33, 34]. Sleep and stress may also be related, because stress can interfere with sleep, while adequate sleep may support emotional regulation and daily coping. However, the direction of this relationship was not examined in the present study, and no mediation analysis was conducted. It is therefore not possible to determine whether changes in stress contributed to changes in sleep quality, whether sleep-related changes influenced stress, or whether both outcomes were associated with other aspects of the intervention or participants' circumstances.

Changes in perceived benefits, self-efficacy, activity-related affect, and commitment provide secondary theoretical context for the primary outcomes. In the intervention group, median perceived benefit scores increased from 18.00 at T0 to 20.00 at T2, while the control group's median remained at 18.00. Perceived benefits may reflect participants' increasingly positive evaluations of complementary care. According to the Health Promotion Model, perceived benefits are associated with health-promoting behaviors, and previous research among pregnant women has identified perceived benefits

and self-efficacy as relevant predictors of such behaviors [16]. Mean self-efficacy scores in the intervention group increased from 30.30 to 33.83, compared with an increase from 30.63 to 31.03 in the control group, a pattern that may reflect increased confidence in performing prenatal yoga–relaxation. Information, demonstrations, guided practice, and facilitator feedback are possible contributors, consistent with previous studies of Health Promotion Model-based self-care interventions among pregnant women [35, 36]; however, the individual contributions of these components were not evaluated.

Activity-related affect also increased in the intervention group, with mean scores rising from 16.27 at T0 to 19.23 at T2, compared with an increase from 16.03 to 16.67 in the control group. Positive experiences during structured activities may be associated with willingness to repeat health-promoting behaviors, and the supportive group environment, interactions with the facilitator, and social support may also have contributed to participants' experiences. Although self-efficacy and activity-related affect increased in parallel, their reciprocal relationship and temporal sequence were not tested; these variables should therefore be interpreted as associated theoretical outcomes rather than established mediators of changes in stress or sleep quality.

Commitment scores also increased in both groups, with a larger descriptive increase in the intervention group (median: from 10.00 to 19.00 versus from 9.50 to 12.00), and the significant time×group interaction ($F=148.960$; $p<0.001$) indicated that changes differed between the groups. Within the Health Promotion Model, perceived benefits, self-efficacy, and positive affective experiences may support commitment to planned health-promoting actions. Nevertheless, commitment was not tested as a mediator between cognitive-affective changes and the primary outcomes, and the findings do not establish that increased commitment led to reduced stress or improved sleep, nor do they demonstrate that participants maintained these behaviors after the intervention ended.

Several limitations should be considered when interpreting the findings. First, the quasi-experimental design and allocation of participants across four independent midwifery practices may have introduced site-related confounding associated with healthcare personnel, facilities, service provision, and local practices; random selection of respondents within each practice and similar gestational-age eligibility criteria did not ensure equivalence in all baseline characteristics. Second, the control group received standard antenatal care supplemented with pregnancy exercise, meaning that the comparison involved two different intervention packages; differences in contact intensity, facilitator attention, participant expectations, and other activities during the study period may have contributed to the observed outcomes. Third, the relatively small sample size and five-week intervention period limit generalizability and prevent conclusions about the durability of the changes. Fourth, self-reported measures of stress and sleep quality may be affected by recall, reporting, and social desirability biases. Finally, the study did not assess objective physiological indicators or test the proposed mediating relationships among the theoretical variables and primary outcomes.

Despite these limitations, the findings suggest that the integrated program was associated with more favorable changes in stress levels and sleep quality than the comparison condition. The significant time×group interactions support further evaluation of this program as a complementary approach to antenatal care, rather than establishing its independent causal effect. Future research should employ randomized designs across a larger number of sites, use comparison conditions with similar levels of contact and attention, and extend follow-up beyond the intervention period. Where feasible, objective stress and sleep measures, prespecified effect estimates, and analyses of potential mediators should be included, and component-specific comparisons would help determine the contributions of education, yoga, relaxation, and music.

Conclusion

The integrated health education and prenatal yoga–relaxation program was associated with improvements in stress levels and sleep quality among pregnant women, with significant time×group interactions for both outcomes. However, given the quasi-experimental design, these findings should be interpreted cautiously. The intervention may be considered a complementary approach to antenatal care to support maternal psychological well-being and sleep quality, although further randomized studies with longer follow-up are needed to confirm its effects and sustainability.

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References

1- Ding X, Liang M, Wu Y, Zhao T, Qu G, Zhang J, et al. The impact of prenatal stressful life events on adverse birth outcomes: A systematic review and meta-analysis. J Affect Disord. 2021;287:406-16.

2- Sedov ID, Cameron EE, Madigan S, Tomfohr-Madsen LM. Sleep quality during pregnancy: A meta-analysis. Sleep Med Rev. 2018;38:168-76.

3- Yang Y, Li W, Ma TJ, Zhang L, Hall BJ, Ungvari GS, et al. Prevalence of poor sleep quality in perinatal and postnatal women: A comprehensive meta-analysis of observational studies. Front Psychiatry. 2020;11:161.

4- Lu Q, Zhang X, Wang Y, Li J, Xu Y, Song X, et al. Sleep disturbances during pregnancy and adverse maternal and fetal outcomes: A systematic review and meta-analysis. Sleep Med Rev. 2021;58:101436.

5- Sari RN, Ardhianingtyas N, Arwiyantasari WR, Indriani L. Prenatal yoga as an effort to maintain mental health of pregnant women. Health Dyn. 2025;2(5):209-15.

6- Chen PJ, Yang L, Chou CC, Li CC, Chang YC, Liaw JJ. Effects of prenatal yoga on women's stress and immune function across pregnancy: A randomized controlled trial. Complement Ther Med. 2017;31:109-17.

7- Corrigan L, Moran P, McGrath N, Eustace-Cook J, Daly D. The characteristics and effectiveness of pregnancy yoga interventions: A systematic review and meta-analysis. BMC Pregnancy Childbirth. 2022;22:250.

8- Guo P, Zhang X, Liu N, Wang J, Chen D, Sun W, et al. Mind–body interventions on stress management in pregnant women: A systematic review and meta-analysis of randomized controlled trials. J Adv Nurs. 2021;77:125-46.

9- Abera M, Hanlon C, Daniel B, Tesfaye M, Workicho A, Girma T, et al. Effects of relaxation interventions during pregnancy on maternal mental health, and pregnancy and newborn outcomes: A systematic review and meta-analysis. PLoS One. 2024;19:e0278432.

10- Mohammadi F, Kohan S, Farzi S, Khosravi M, Heidari Z. The effect of pregnancy training classes based on Bandura self-efficacy theory on postpartum depression and anxiety and type of delivery. J Educ Health Promot. 2021;10.

11- Nikoozad S, Safdari-Dehcheshmeh F, Sharifi F, Ganji F. The effect of prenatal education on health anxiety of primigravid women. BMC Pregnancy Childbirth. 2024;24:541.

12- Lwanga SK, Lemeshow S. Sample size determination in health studies: A practical manual. Geneva: World Health Organization; 1991.

13- Gay LR, Mills GE, Airasian P. Educational research: Competencies for analysis and applications. 10th ed. Upper Saddle River (NJ): Pearson Education; 2012.

14- Puspita RC, Tamtomo D, Indarto D. Health belief model for the analysis of factors affecting hypertension preventive behavior among adolescents in Surakarta. J Health Promot Behav. 2017;2(2):183-96.

15- Novrianto R, Marettih AKE, Wahyudi H. Construct validity of the Indonesian version of the General Self-Efficacy Scale. J Psychol. 2019;15(1):1. [Indonesian]

16- Jalili Bahabadi F, Estebsari F, Rohani C, Rahimi Khalifeh Kandi Z, Sefidkar R, Mostafaei D. Predictors of health-promoting lifestyle in pregnant women based on Pender's health promotion model. Int J Womens Health. 2020;12:71-7.

17- Ary M, Baharuddin A, Idrus H. Epidemiological determinants of hypertension in pregnancy. Window Health J Health. 2022;5(2):592-601. [Indonesian]

18- Kors J, Martin L, Verhoeven CJ, Henrichs J, Peerdeman SM, Kusurkar RA. Autonomy support in prenatal consultation: A quantitative observation study in maternity care. Eur J Midwifery. 2025;9:1-11.

19- Procidano ME, Heller K. Measures of perceived social support from friends and from family: Three validation studies. Am J Community Psychol. 1983;11(1):1-24.

20- Wang Y, Gu J, Zhang F, Xu X. The mediating role of social support and resilience between self-efficacy and prenatal stress: A mediational analysis. BMC Pregnancy Childbirth. 2023;23:866.

21- Shayan NA, Rahimi A, Waseq AM, Dag O, Özcebe H. Translation, validation and reliability of depression, anxiety, and stress 42 (DASS-42) among Herat University students. Discov Ment Health. 2025;5:199.

22- Anggraeni AD. Validity and reliability of the Indonesian version of the Depression, Anxiety, and Stress Scale-42 (DASS-42) in an emerging adulthood sample [master's thesis]. Yogyakarta: Gadjah Mada University; 2022. [Indonesian]

23- Tran K, Lane S, Dattilo DJ, Cillo JE. Sleep quality assessment with the Pittsburgh Sleep Quality Index (PSQI) in maxillomandibular advancement for the treatment of obstructive sleep apnea. J Oral Maxillofac Surg. 2020;78:e76-7.

24- Haney A, Buysse DJ, Okun M. Sleep and pregnancy-induced hypertension: A possible target for intervention? J Clin Sleep Med. 2013;9:1349-56.

25- Barba-Müller E, Craddock S, Carmona S, Hoekzema E. Brain plasticity in pregnancy and the postpartum period: Links to maternal caregiving and mental health. Arch Womens Ment Health. 2019;22:289-99.

26- Ranjbar M, Abdolalipour S, Payne E, Hassanzadeh R, Maghalian M, Mirghafourvand M. The effect of yoga on depression, anxiety, and stress during pregnancy and postpartum: A systematic review and meta-analysis. Best Pract Res Clin Obstet Gynaecol. 2026;106:102730.

27- Villar-Alises O, Martinez-Miranda P, Martinez-Calderon J. Prenatal yoga-based interventions may improve mental health during pregnancy: An overview of systematic reviews with meta-analysis. Int J Environ Res Public Health. 2023;20(2):1556.

28- Kurniawati YT. Enhancing prenatal mindfulness through self-affirmation and yoga: A case study approach. Sci J Midwifery. 2025;13(2):212-8.

29- Pan WL, Chang CW, Chen SM, Gau ML. Assessing the effectiveness of mindfulness-based programs on mental health during pregnancy and early motherhood: A randomized control trial. BMC Pregnancy Childbirth. 2019;19:346.

30- Gaitzsch H, Benard J, Hugon-Rodin J, Benzakour L, Streuli I. The effect of mind-body interventions on psychological and pregnancy outcomes in infertile women: A systematic review. Arch Womens Ment Health. 2020;23:479-91.

31- Nadholta P, Kumar K, Saha PK, Suri V, Singh A, Anand A. Mind-body practice as a primer to maintain psychological health among pregnant women: YOGESTA, a

randomized controlled trial. Front Public Health. 2023;11:1201371.
32- Hilal Z, Alici F, Tempfer CB, Rath K, Nar K, Rezniczek GA. Mozart for reducing patient anxiety during colposcopy. Obstet Gynecol. 2018;132:1047-55.
33- Awlachew S, Desalew A, Jibro U, Tura AK. Pregnant women's sleep quality and its associated factors among antenatal care attendants in Bahir Dar City, Northwest Ethiopia. Sci Rep. 2025;15:15613.
34- Hilmiy SW, Alfitri R, Sulistiyah S. The effect of yoga exercise on anxiety levels of primigravida third trimester pregnant women in PMB Eny Islamiati Bululawang Malang. Health Dyn. 2024;1(5):153-60.
35- Rezaei Z, Yazdanpanahi Z, Asadollahi A, Karimi M, Ghahremani L. Evaluating the impact of an educational self-care intervention on the empowerment of primigravida pregnant women covered by family medicine program in the Estahban City: An application of the Pender's health promotion model. BMC Pregnancy Childbirth. 2025;25:308.
36- Tavakoly Sany SB, Eslami V, Lael-Monfared E, Ghavami V, Peyman N. Effect of an educational intervention based on self-efficacy theory and health literacy skills on preventive behaviors of urinary tract infection in pregnant women: A quasi-experimental study. PLoS One. 2024;19:e0306558.