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RESEARCH

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Associations of Anxiety, Physical Activity, Parity, and Sleeping Position with Sleep Quality among Third-Trimester Pregnant Women in Palangka Raya, Indonesia

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Abstract

Poor sleep in late gestation has been associated with adverse maternal and neonatal outcomes. Psychological, behavioral, obstetric, and sleep-practice factors have usually been examined separately, leaving their relative contributions within a single population unclear. This study aimed to examine the associations of anxiety, physical activity, parity, and sleeping position with sleep quality among third-trimester pregnant women in Palangka Raya. A cross-sectional study was performed on a sample of 66 third-trimester pregnant women visiting a primary healthcare department in Palangka Raya, Central Kalimantan, Indonesia, who were recruited over a period of four weeks. The quality of sleep was evaluated by the Pittsburgh Sleep Quality Index (PSQI) that generated scores in the form of continuous global score, where higher scores suggest lower sleep quality. The level of anxiety was assessed via Hamilton Anxiety Rating Scale, while physical activity was calculated through Pregnancy Physical Activity Questionnaire as metabolic equivalent-hour per week. Simultaneously, parity and habitual position of sleep were assessed as dichotomous; the key analysis was completed with multiple linear regression model with all four factors put simultaneously with validity of coefficient estimates being examined by means of 5,000 bootstrapping and BCa 95% confidence intervals, as well as through two variations as sensitivity analyses. On average, the PSQI score was 7.23 ± 2.26 , while 80.3% of the participants showed the score higher than 5. The four-factor model was significant, $F(4,61) = 36.496$, $p < 0.001$, $R^2 = 0.705$. Supine sleeping was independently associated with a 4.249-point higher PSQI score than side sleeping ($p < 0.001$; BCa 95% CI 2.929 to 5.846) and remained so when parity was excluded ($B = 3.324$; BCa 95% CI 2.617 to 4.084). Parity reached conventional significance ($B = 1.140$, $p = 0.040$). However, it was not robust to resampling (BCa 95% CI: -0.106 to 2.608), and its coefficient reversed sign when sleeping position was removed, indicating a suppression artifact due to the near-complete overlap between the two variables (Cramer's $V = 0.817$). Anxiety and physical activity were associated with PSQI score bivariately but not after adjustment; excluding sleeping position rendered the anxiety coefficient significant and bootstrap-robust ($B = 0.086$, $p = 0.009$), indicating an association inseparable from sleeping position rather than absent. In this sample, habitual sleeping position was the only correlate robustly associated with sleep quality, supporting attention to sleeping practices in antenatal assessment; the magnitude was unusually large for observational data and requires replication.

Keywords: Anxiety; Parity; Physical Activity; Pregnant Women; Sleep Quality; Sleeping Position.

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1. INTRODUCTION

Poor sleep quality during pregnancy has been associated with preterm birth, cesarean delivery, preeclampsia, gestational diabetes, reduced birth weight, and antenatal and postpartum depression (Mislu & Terefe, 2025; Awlachev et al., 2025; Ojelere & Adeoye, 2024). Because sleep behavior is modifiable and non-pharmacological approaches can improve self-reported sleep in pregnancy (Chen et al., 2025), sleep assessment has been argued to belong in routine antenatal care rather than being treated as a self-limiting feature of pregnancy (Alasmer et al., 2025).

The burden concentrates in late gestation. A meta-analysis of 38 studies in low- and middle-income countries reported a pooled prevalence of poor sleep quality rising from 37.5% in the first trimester to 60.1% in the third trimester (Mislu et al., 2024), and a prevalence of third-trimester insomnia estimated at 42.4% (Salari et al., 2021). Individual studies show the same gradient after adjustment (Jemere et al., 2021; Ojelere & Adeoye, 2024; Mislu & Terefe, 2025).

Four correlates have received the most attention. Anxiety symptoms affect an estimated 37% of pregnant women (Aziz et al., 2025) and have been reported as independent correlates of the continuous PSQI score in multivariable analyses (Banaei et al., 2025; Alasmer et al., 2025). Physical activity is generally associated with better sleep (Cannon et al., 2023; Alomairah et al., 2023), although rigorous activity has been linked to higher odds of insomnia (Ojelere & Adeoye, 2024). Parous women show higher odds of poor sleep in several studies (Jemere et al., 2021; Awlachev et al., 2025; Mislu & Terefe, 2025) but not all (Ojelere & Adeoye, 2024). The habitual sleeping position has been studied the least in relation to maternal sleep quality. However, supine sleeping is associated with an increased risk of late stillbirth due to aortocaval compression, and side sleeping from 28 weeks is now recommended in several countries (Rossiter et al., 2021).

What remains unresolved is how these four factors behave when estimated together. Whether each retains an independent association once the others are held constant, or whether the associations reported in single-domain studies substantially overlap, cannot be answered by adding further single-domain studies. The four were prespecified here to represent four domains of the biopsychosocial account of sleep disturbance in late pregnancy: one psychological, one behavioral, one obstetric, and one sleep-practice, each measurable at the primary care level, and three of the four potentially modifiable.

Three features distinguish this analysis. To our knowledge, it is the first to model habitual sleeping position against the continuous global PSQI score in a multivariable framework. Most available studies dichotomize sleep quality at a cut-off and analyze it with logistic regression, discarding the gradation of a summed score from 0 to 21; retaining the continuous score preserves the information needed to detect partial attenuation (Lee et al., 2022). Moreover, the Indonesian evidence base consists largely of bivariate single-facility analyses (Rabiah et al., 2025; Christoper et al., 2026). This study, therefore, examines the associations of anxiety, physical activity, parity, and habitual sleeping position with sleep quality among third-trimester pregnant women in Palangka Raya, Central Kalimantan, entering all four simultaneously into a single multiple linear regression model for the continuous PSQI score, with bootstrap resampling used to assess coefficient stability.

2. RESEARCH METHOD

Study design, location and participants. This cross-sectional study is an analysis of secondary data that constituted the database used in the earlier study located in Puskesmas Kereng Bangkirai of Palangka Raya. Women participated in the study from 3rd to 31st January, 2026, with participation taking place after ethical approval was given. Routine antenatal women attending the Puskesmas Kereng Bangkirai were checked continuously until 66 eligible women were found. Inclusion criteria required for selection of participants were that women must be at

pregnancy stage of 28–40 weeks indicated in their health records, registered for the antenatal services in Puskesmas Kereng Bangkirai, and provide written consent. There was no requirement concerning maternal age and study participants were not required to be pregnant women with sleep problems. Exclusions for study participation were severe medical issues related to pregnancy and inability of women to complete questionnaires. There was no screening of women for having diagnosed sleep disorders, history of mental illness and any medications taken affecting sleep. Number of women screened and decided to withdraw was not recorded either. The data was collected with the help of a structured questionnaire and there were no missing data.

Regarding sample size and power, in this model no a priori calculations were made. There are 16.5 participants per predictor, which satisfies the customary requirement of 10-15. However, it does not meet Green's 82 rule for the overall testing of the model. Nevertheless, a sensitivity analysis was executed. With $N=66$, four predictors, $\alpha=0.05$ two-sided, and 80% power, the minimum effect that is detectable is $f^2=0.20$ for the model ($R^2=0.16$) and $f^2=0.13$ for an individual predictor. Hence, the study had medium and large effect power only.

Instruments. All three instruments were administered in their standard published form without modification; no adaptation or revalidation was undertaken, and reliability was reported in previous validation work; internal consistency was not computed in this sample. Sleep quality was measured with the Indonesian-language PSQI, whose 19 self-rated items generate seven components summed to a global score of 0 to 21, higher scores indicating poorer sleep; the continuous score was retained because the dimensional structure of the instrument shifts between mid- and late pregnancy (Lee et al., 2022), and a score >5 was used only descriptively. To our knowledge, the Indonesian PSQI has not been validated in pregnancy (Setyowati et al., 2021). Anxiety was measured with the 14-item HARS (0 to 56). HARS was developed as a clinician-rated instrument; here, it was completed by participants as a structured self-report, with a team member present to explain each item, as is common in Indonesian community-based maternal health research. This departure limits comparability with clinician-rated scores. Physical activity was measured with the PPAQ for the current trimester, each activity duration multiplied by its metabolic equivalent value, and summed to give MET-hours per week; the cited validation evidence refers to a Serbian adaptation (Rovcanin et al., 2022) and does not establish equivalence in an Indonesian pregnant population.

Habitual sleeping position. Participants reported the position in which they usually slept during the current pregnancy using three closed options: supine ($n=30$, 45.5%), left lateral ($n=33$, 50.0%), and right lateral ($n=3$, 4.5%). The item captures self-reported habitual position and not the position maintained through the night, and no objective measurement was undertaken. The exposure was analyzed as supine versus side sleeping ($n=36$, 54.5%). This follows the mechanism of interest, since aortocaval compression depends on whether the woman lies on her back rather than on which side, both lateral positions relieve it, and left and right lateral positions do not differ materially in their association with adverse outcomes (Rossiter et al., 2021); a separate indicator estimated from three observations would not have been informative. The combination concealed no difference, as all three right-lateral sleepers scored 6, the median and modal value among left-lateral sleepers. Because 33 of 36 side sleepers reported left-lateral sleeping, the comparison is in practice supine versus left lateral, and no inference about right-lateral sleeping is supported. Self-reported position predicts the position actually maintained in fewer than half of pregnant women (Katz et al., 2024). Still, such misclassification would be non-differential with respect to PSQI score and would bias the association toward the null.

Variables and analysis. Parity was classified in terms of "nulliparous" and "parous," and the sleeping position in terms of "side" and "supine." The variables maternal age, gestational age, and employment were all reported and examined in a bivariate manner but were not

included in the pre-specified four-factor model, which was defined based on domain coverage, as opposed to being developed from bivariate analysis results. The sample consisted of 66 participants; adding three other terms would drop the ratio to 9.4 per predictor. Residual confounding due to unmeasured factors cannot be excluded. The data were analyzed using IBM SPSS Statistics 29. Relationships among variables were assessed using Spearman's correlation and the Mann-Whitney U test. The relationship between parity and sleeping position was studied using the chi-square test, Pearson's exact test, and Cramer's V. The main analysis involved multiple linear regression (enter method), with all four predictors included in the analysis simultaneously. The model outputs included B, SE, β , 95% CI. Collinearity analysis was undertaken, and the results were reported in Supplementary File 1. Coefficient robustness was ensured through bootstrapping using 5,000 replications and bias correction. In case the conventional and bootstrap results yielded different results, the powerages were preferred. Out of 5,000 replications, 4,988 (99.8 %) resulted in estimable coefficients while a limited number of resamples yielded uninformative estimators because of missing variations. Two sensitivity analyses were performed: one of them excluded parity and the other sleeping position. Both tests were carried out two-sided, with significance level being set at $p < 0.05$.

Ethical issues. Ethics Committee of Poltekkes Kemenkes Palangka Raya provided exemption (No. 55/I/KE.PE/EXM/2026) from ethics review for the study on January 2, 2026. Ethics principles were fully complied with, including confidentiality and informed consent.

3. RESULTS AND DISCUSSION

Participant characteristics

Table 1. Characteristics of Third-Trimester Pregnant Women (N=66)

Characteristic	Value	Note
Maternal age, years (mean $\pm$ SD)	28.71 $\pm$ 5.81	Range 20–39
Gestational age, weeks (mean $\pm$ SD)	34.35 $\pm$ 3.75	Range 28–40
Employment: homemaker / employed	36 (54.5%) / 30 (45.5%)	
Parity: nulliparous/parous	30 (45.5%) / 36 (54.5%)	
Sleeping position: left lateral	33 (50.0%)	Combined as a side
Sleeping position: right lateral	3 (4.5%)	Combined as a side
Sleeping position: side (combined)	36 (54.5%)	Analytic category
Sleeping position: supine	30 (45.5%)	Analytic category

Participants had a mean age of 28.71 $\pm$ 5.81 years and a mean gestational age of 34.35 $\pm$ 3.75 weeks (Table 1). Slightly more than half were homemakers and parous. Sleeping position was left lateral in half the sample, supine in 45.5%, and right lateral in only three participants.

Descriptive statistics of the study variables.

Table 2. Sleep Quality, Anxiety, and Physical Activity (N=66)

Variable	Mean $\pm$ SD	Median (IQR)	Range
PSQI global score	7.23 $\pm$ 2.26	7.0 (3)	3–13
HARS total score	28.09 $\pm$ 7.47	—	15–46
PPAQ total activity, MET-h/week	43.66 $\pm$ 9.84	—	20.30–67.90

Fifty-three participants (80.3%) scored above the conventional PSQI cut-off of 5, and 13 (19.7%) scored at or below it, so the sample spanned the full range of the outcome rather than being concentrated at the poor-sleep end (Table 2). No participant scored below the conventional threshold for mild anxiety on the HARS.

Bivariate associations

Table 3. Bivariate Associations with Global PSQI Score

Variable	Comparison	Test statistic	P
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HARS total score	Spearman correlation	$\rho = 0.501$	<0.001
PPAQ total activity	Spearman correlation	$\rho = -0.404$	<0.001
Maternal age	Spearman correlation	$\rho = -0.049$	0.694
Gestational age	Spearman correlation	$\rho = -0.031$	0.803
Employment	Homemaker vs employed	U = 513	0.725
Parity	Nulliparous vs parous	U = 134	<0.001
Sleeping position	Side vs supine	U = 0; Z = -7.048	<0.001

Anxiety was moderately and positively associated with PSQI score and physical activity moderately and inversely, while maternal age, gestational age, and employment were not (Table 3). Nulliparous women and supine sleepers had higher PSQI scores. The separation by sleeping position was complete (U=0): among side sleepers, the observed scores were 3 to 7, and among supine sleepers, 8 to 13, with no score in between (Figure 1). Because this degree of separation is unusual, entries for sleeping position, parity, and PSQI score were re-checked for all 66 participants against the tabulated records of the original study, with particular attention to the six discordant cases; no transcription discrepancies were found.

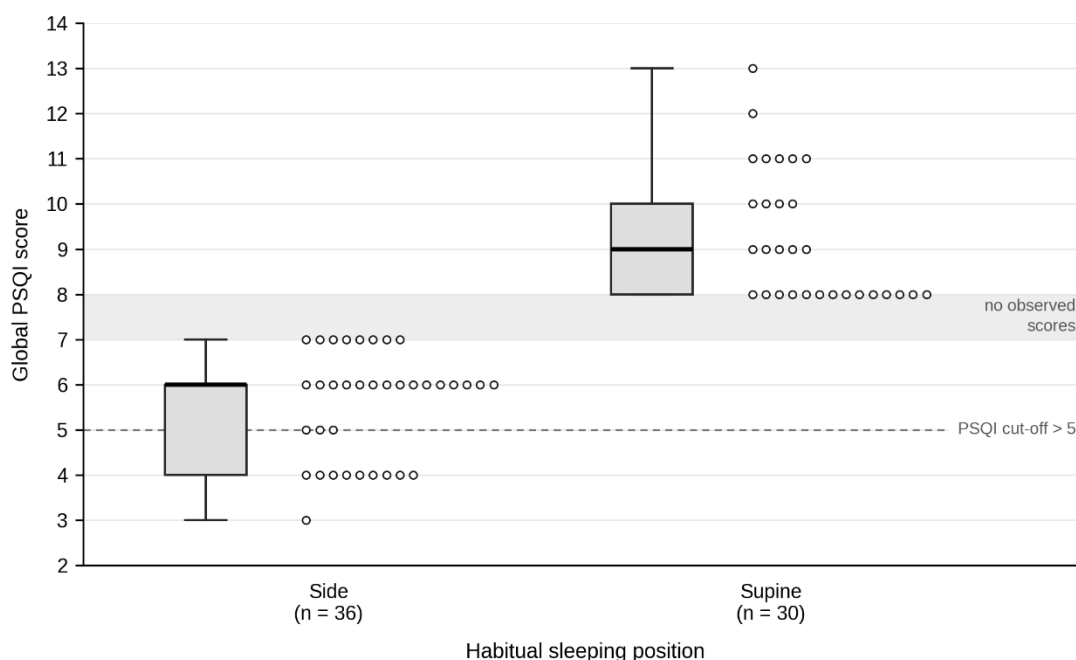


Figure 1. Distribution of global PSQI scores by habitual sleeping position (N = 66). Boxes show the median and interquartile range with whiskers to the observed minimum and maximum; circles show all individual observations, one per participant. Side sleeping (n = 36): median 6, range 3 to 7. Supine sleeping (n = 30): median 9, range 8 to 13. The two distributions do not overlap. Higher scores indicate poorer sleep quality.

Parity and sleeping position were strongly associated with each other: 27 of 30 nulliparous women (90.0%) reported supine sleeping and 33 of 36 parous women (91.7%) reported side sleeping ($\chi^2=44.018$, $df=1$, $p<0.001$; Fisher's exact $p<0.001$; Cramer's $V=0.817$). Only 6 of 66 participants (9.1%) therefore fell into the discordant cells. In all six, the PSQI score corresponded to sleeping position rather than parity: the three nulliparous side sleepers scored 4, 4, and 6, and the three parous supine sleepers scored 8, 10, and 13.

Multivariable model and sensitivity analyses

Table 4. Four-Factor Multiple Linear Regression for Global PSQI Score

Predictor	B	SE	β	p	BCa 95% CI	Bootstrap p
Parous vs nulliparous	1.140	0.543	0.253	0.040	-0.106 to 2.608	0.082

Supine vs side sleeping	4.249	0.580	0.944	<0.001	2.929 to 5.846	<0.001
HARS total score	0.026	0.025	0.086	0.297	−0.025 to 0.082	0.373
PPAQ MET-h/week	−0.026	0.017	−0.113	0.128	−0.057 to 0.010	0.124

The model was significant, $F(4,61)=36.496$, $p<0.001$, $R^2=0.705$ (Table 4). Supine sleeping was associated with a PSQI score 4.249 points higher, and its bootstrap interval excluded zero. Parity reached conventional significance ($p=0.040$), but its bootstrap interval crossed zero, and neither HARS nor PPAQ was independently associated with PSQI score. The reported R^2 is an apparent in-sample value obtained without cross-validation or optimism correction. Diagnostics were acceptable, with standardized residuals from -2.108 to 2.394 , maximum Cook's distance 0.288 , and all VIF values below 5 (Supplementary File 1).

Table 5. Sensitivity Analyses: Alternative Model Specifications

	Primary model	Parity excluded	Sleeping position excluded
Supine sleeping, B (95% CI)	4.249 (3.089–5.408)	3.324 (2.550–4.097)	—
BCa 95% CI	2.929 to 5.846	2.617 to 4.084	—
Standardised β	0.944	0.738	—
Parity, B (95% CI)	1.140 (0.054–2.227)	—	−1.887 (−2.847 to −0.927)
BCa 95% CI; bootstrap p	−0.106 to 2.608; 0.082	—	−3.047 to −0.667; 0.003
HARS, B; bootstrap p	0.026; 0.373	0.027; 0.343	0.086; 0.034
R^2	0.705	0.684	0.446
Maximum VIF	3.434	1.450	1.273
Valid bootstrap replications	4,988 / 5,000	5,000 / 5,000	5,000 / 5,000

The authors performed two estimations because both parity and sleeping position were almost completely overlapping (Table 5). The variable sleeping position was strongly linked to PSQI, with a significant increase in estimates after removing parity; the standard error of estimates changed from 0.580 to 0.387, maximum VIF decreased from 3.434 to 1.450. However, when parity is omitted, the sign of the coefficient for parity changes from $B=1.140$ to $B=-1.887$ and recovers an appropriate univariate direction; however, this estimate was determined as robust under the repeated samples. In the same model, the anxiety coefficient increased more than threefold, and it is significant and robust. All 5,000 replications of reduced models completed the estimation.

Discussion

Habitual sleeping position was the only correlate whose independent association with sleep quality was robust to bootstrap resampling. The magnitude requires caution. The standardized coefficient in the primary model ($\beta=0.944$) was inflated by overlap with parity, falling to $\beta=0.738$ when parity was excluded, and even that value is unusual in observational sleep research. The explained variance likewise exceeds that reported by comparable multivariable analyses of the continuous PSQI score, 22.6% among 424 Iranian women (Banaei et al., 2025) and 30.2% among 206 women in Jordan (Alasmer et al., 2025), but this reflects a sample containing a near-complete separation that those samples do not, rather than a better model.

The study measured neither hemodynamic variables nor symptoms of discomfort or orthopnoea, so mechanisms are drawn from previous literature rather than demonstrated here. Aortocaval compression in the supine position reduces caval and aortic flow and maternal cardiac output, making the position physiologically distinct from lateral sleeping (Rossiter et

al., 2021), and supine positioning may be associated with greater orthopnoea and discomfort (Alasmer et al., 2025). Direction cannot be established: women experiencing greater discomfort may adopt or revert to a supine position, just as supine sleeping may be less restful. Awareness of side-sleeping advice is also entangled with maternal affect, 22% of Australian women reporting anxiety about such advice (Warland et al., 2022), so position, discomfort, and worry may form an interconnected cluster.

Anxiety showed a moderate bivariate association, consistent in direction with Banaei et al. (2025) and Alasmer et al. (2025), but was attenuated after adjustment. The sensitivity analyses locate the source: anxiety correlated 0.518 with sleeping position, and removing the latter tripled the anxiety coefficient and made it bootstrap-robust ($B=0.086$, $p=0.009$; BCa 0.014 to 0.167). The association is therefore not absent but inseparable from that of sleeping position. Instrument differences may also contribute, since the comparison studies used pregnancy-specific and general screening measures. At the same time, the HARS was completed here as a self-report, and it did not include sleeping position as a predictor. Physical activity behaved similarly, its bivariate association not persisting in any specification; a non-monotonic relationship of the kind suggested by Ojelere and Adeoye (2024) would not have been detected by a single linear term, but no test for departure from linearity was performed.

Parity requires the most caution. The bivariate direction, higher PSQI scores among nulliparous women, is opposite to that reported elsewhere (Jemere et al., 2021; Awlachew et al., 2025; Mislu & Terefe, 2025), and the adjusted coefficient reversed sign when sleeping position was removed, while only the reversed estimate was robust to resampling. A pattern in which the adjusted estimate is unstable and reverses. In contrast, the unadjusted estimate is stable, which is the signature of statistical suppression rather than a distinct obstetric contribution, so the adjusted parity coefficient carries no interpretable meaning here. With just 6 out of 66 subjects in discordant clusters, these 6 account for almost all distinctions between the two coefficients, which is why VIF values under 5 did not prove that the coefficients were separately identifiable. Deleting parity cuts down explained variance by 2.1% compared to 25.9% for deleting sleeping position. The question of why sleeping position of the subjects is so much less evenly represented by parity in this population is one that needs to be pursued further.

In combination, the findings illustrate the superiority of joint modeling over bivariate screening. Of the four variables, three are only associated with PSQI scores. However, once the four are entered into the analysis together, only one remains significant statistically and the four are interdependent. This generally suggests that sleep quality in late pregnancy is a function of the totality of related maternal characteristics rather than independent factors and indicates the impossibility of identifying the affected women with a single question.

Limitations. It is not possible to draw temporal or causal conclusions using the cross-sectional design. In this study, no sample size calculation was done ahead of time, and the power analysis showed that the study could only detect medium to large effect sizes which greatly affects the obtained coefficients here. The explained variance can be considered as a mere number without proper internal validation. Using one health care center makes the study results non-generalizable, and the age range of subjects from 20 to 39 means that the results cannot be applied to either teenage pregnancies or late pregnancies. The fact that the number of people who were screened and those who refused to participate in the study is not given, as well as the information concerning the potentially overwhelming effect of the factors such as BMI, comorbidity, depressive symptoms, and socioeconomic standing, which were not measured, raises a lot of questions regarding the findings (Katz et al., 2024). All the measures were taken based on self-reports while self-reporting is not the perfect way to assess, for example, the sleeping position. Nevertheless, this possibility of misclassification is said to lead to underestimating the association of the variables.

Implications. Because habitual sleeping position was the correlate most consistently associated with sleep quality and is potentially modifiable even in low-resource settings (Rossiter et al., 2021), asking about sleeping position may be a reasonable component of antenatal assessment when a third-trimester woman reports poor sleep, and adds little burden, given that side-sleeping from 28 weeks is already recommended for fetal outcomes. These findings do not establish that changing position would improve sleep quality, which would require interventional evidence of the kind accumulating for other non-pharmacological approaches (Chen et al., 2025). Because 33 of 36 side sleepers reported sleeping left lateral, the comparison is, in practice, supine versus left lateral. Where such advice is given, it may be worth attending to how it is received (Warland et al., 2022). The high proportion scoring above the PSQI cut-off supports routine attention to sleep quality in antenatal care (Mislu & Terefe, 2025).

4. CONCLUSION

This study examined the associations of anxiety, physical activity, parity, and sleeping position with sleep quality among 66 third-trimester pregnant women in Palangka Raya, estimating all four factors simultaneously within a single multiple linear regression model on the continuous global PSQI score. In this particular case, habitual sleeping position was the only variable whose independent effect on sleep quality was found to be significant even after bootstrap resampling: it was shown that women who sleep in a supine position have considerably worse sleep quality than those sleeping on their side. This relation was very strong for sleep research and it needs confirmation in independent and larger studies in order to find out if such relation can be generalized. There was a two-dimensional connection between sleep quality and anxiety level and physical activity, but it disappeared after adjusting for both factors simultaneously. Sensitivity analysis did not prove that variables were independent but it showed that the direction of anxiety effect changes when the sleeping position variable is removed from the model, which indicates the suppression error. The results also endorse the proposal of including questions about sleeping position habits in prenatal sleep evaluations and of giving advice about the importance of sleeping on the side from week 28 of pregnancy to promote fetal well-being; they, however, do not show that modifying sleeping position would help improve sleep quality since this research used a cross-sectional approach that does not allow establishing the direction of causality between the factors studied. Future studies should be conducted in multiple centers and in a longitudinal design, while obtaining objective data on sleeping position instead of self-reports, stating the assumptions about confounding variables in advance, and taking into account that parity and sleeping position do not occur together in participants.

REFERENCES

- Aziz, H. A., Yahya, H. D. B., Ang, W. W., & Lau, Y. (2025). Global prevalence of depression, anxiety, and stress symptoms in different trimesters of pregnancy: A meta-analysis and meta-regression. *Journal of psychiatric research*, 181, 528–546. <https://doi.org/10.1016/j.jpsychires.2024.11.070>
- Alasmer, Z., Nazzal, M. S., Mohamed, Z., Al-Jaber, A., Ali, R., Alshar, F., Ababneh, E. M., Alshdaifat, E., & Kanaan, S. F. (2025). Sleep Quality and Its Predictors Among Pregnant Women in Jordan: A Cross-Sectional Study. *International journal of women's health*, 17, 1285–1296. <https://doi.org/10.2147/IJWH.S498204>
- Alomairah, S. A., Knudsen, S. P., Roland, C. B., Molsted, S., Clausen, T. D., Bendix, J. M., Løkkegaard, E., Jensen, A. K., Larsen, J. E., Jennum, P., & Stallknecht, B. (2023). Effects of Two Physical Activity Interventions on Sleep and Sedentary Time in Pregnant Women. *International journal of environmental research and public health*, 20(7), 5359. <https://doi.org/10.3390/ijerph20075359>

- Awlachew, S., Desalew, A., Jibro, U., & Tura, A. K. (2025). Pregnant women's sleep quality and its associated factors among antenatal care attendants in Bahir Dar City, *Northwest Ethiopia. Scientific reports*, 15(1), 15613. <https://doi.org/10.1038/s41598-025-00288-9>
- Banaei, M., Alizadeh, S., Roozbeh, N., Ghare-Naz, M. S., Taghvaei, E., Parviz, L., & Ghasemi, V. (2025). Sleep quality during pregnancy: the role of anxiety, fear of childbirth, and obstetric factors - a multicenter cross-sectional study. *BMC public health*, 25(1), 3797. <https://doi.org/10.1186/s12889-025-25142-5>
- Cannon, S. S., Lastella, M., Evenson, K. R., & Hayman, M. J. (2023). The association between physical activity and sleep during pregnancy: a systematic review. *Behavioral sleep medicine*, 21(4), 513–528. <https://doi.org/10.1080/15402002.2022.2124258>
- Chen, P., Wang, Y., Yuan, J., Bourjeily, G., Park, C. G., Zhu, B., & Izci-Balserak, B. (2025). Effectiveness of nonpharmacological sleep interventions in pregnancy: a systematic review and meta-analysis. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine*, 21(8), 1463–1476. <https://doi.org/10.5664/jcsm.11696>
- Christoper, D., Dewi, S., & Suyono, H. (2026). Correlation between sleep quality and anxiety levels among third-trimester pregnant women at Bulak Banteng Community Health Center. *Journal of Widya Medika Junior*, 8(2). <https://doi.org/10.33508/jwmj.v8i2.8138>
- Jemere, T., Getahun, B., Tadele, F., Kefale, B., & Walle, G. (2021). Poor sleep quality and its associated factors among pregnant women in Northern Ethiopia, 2020: A cross sectional study. *PloS one*, 16(5), e0250985. <https://doi.org/10.1371/journal.pone.0250985>
- Katz, J., Sanapo, L., Bublitiz, M. H., Guillen, M., Avalos, A., Aldana, A., Wilson, D., & Bourjeily, G. (2024). Longitudinally assessed maternal sleep position, measures of breathing during sleep, and fetal growth in high-risk pregnancies. *Sleep*, 47(2), zsad315. <https://doi.org/10.1093/sleep/zsad315>
- Lee, H., Kim, K. E., Kim, M. Y., & Park, C. G. (2022). Comparison of factor structures of the Pittsburgh sleep quality index between mid- and late pregnancy among Korean women: a cross-sectional study. *BMC pregnancy and childbirth*, 22(1), 694. <https://doi.org/10.1186/s12884-022-05024-z>
- Mislu, E., Kumsa, H., Tadesse, S., Arage, M. W., Susu, B., Ayele, M., & Chane, F. (2024). Sleep quality disparities in different pregnancy trimesters in low- and middle-income countries: a systematic review and meta-analysis. *BMC pregnancy and childbirth*, 24(1), 627. <https://doi.org/10.1186/s12884-024-06830-3>
- Mislu, E., & Terefe, A. (2025). Poor quality of sleep and associated factors among pregnant women attending antenatal clinic in Woldia Comprehensive Specialized Hospital, Ethiopia, 2023. *BMC pregnancy and childbirth*, 25(1), 1013. <https://doi.org/10.1186/s12884-025-08023-y>
- Ojelere, B. O., & Adeoye, I. A. (2024). Sleep pattern and disorders among pregnant women in Ibadan, Southwest Nigeria. *BMC women's health*, 24(1), 250. <https://doi.org/10.1186/s12905-024-03086-z>
- Rabiah, R., Yulastuti, E., Rafidah, R., & Isnaniah, I. (2025). Hubungan kualitas tidur dengan kecemasan pada ibu hamil di UPTD Puskesmas Bantuil. *Jurnal Penelitian Multidisiplin Bangsa*, 2(3), 549-559 <https://doi.org/10.59837/jpnmb.v2i3.559>
- Rossiter, S. K., Aziz, S., Wilson, A. N., Comrie-Thomson, L., Stacey, T., Homer, C. S. E., & Vogel, J. P. (2021). Women's sleep position during pregnancy in low- and middle-income countries: a systematic review. *Reproductive health*, 18(1), 53. <https://doi.org/10.1186/s12978-021-01106-x>
- Rovcanin, M., Jankovic, S., Mikovic, Z., Sipetic Grujicic, S., Ersk, I. R. B., Lackovic, M., Dimitrijevic, D., Simanic, S., & Vujcic, I. (2022). The Translation and Cross-Cultural Adaptation of the Pregnancy Physical Activity Questionnaire: Validity and Reliability of

- a Serbian Version (PPAQ-SRB). *Healthcare (Basel, Switzerland)*, 10(8), 1482. <https://doi.org/10.3390/healthcare10081482>
- Salari, N., Darvishi, N., Khaledi-Paveh, B., Vaisi-Raygani, A., Jalali, R., Daneshkhah, A., Bartina, Y., & Mohammadi, M. (2021). A systematic review and meta-analysis of prevalence of insomnia in the third trimester of pregnancy. *BMC pregnancy and childbirth*, 21(1), 284. <https://doi.org/10.1186/s12884-021-03755-z>
- Setyowati, A., & Chung, M. H. (2021). Validity and reliability of the Indonesian version of the Pittsburgh Sleep Quality Index in adolescents. *International journal of nursing practice*, 27(5), e12856. <https://doi.org/10.1111/ijn.12856>
- Warland, J., Footner, S., Beaufoy, G., Stocker, J., Agostini, A., & Dorrian, J. (2022). Giving sleep position advice in pregnancy: Will we make women anxious?. *The Australian & New Zealand journal of obstetrics & gynaecology*, 62(4), 536–541. <https://doi.org/10.1111/ajo.13507>