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Sleep quality disparities in different pregnancy trimesters in low- and middle-income countries: a systematic review and meta-analysis

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Abstract

Introduction Sleep is a crucial determinant of maternal and fetal health, significantly impacting the well-being of both the mother and her developing fetus. Poor sleep quality, characterized by difficulties in falling asleep or staying asleep, can cause poor pregnancy outcome. Conversely, studies came with inconsistent result in the prevalence of poor sleep quality in different trimester of pregnancy. Therefore, this systematic review and meta-analysis study aimed to compare the prevalence of poor sleep quality in different trimesters.

Method A systematic review and meta-analysis were done on published studies. Electronic data base search was done from PubMed, Hinari, Medline and Google Scholar. Data were extracted with Excel and the analysis were done using STATA version 17. Publication bias was assessed both graphically and statistically. I-square test was used to identify heterogeneity.

Result In this meta-analysis, 38 studies that measured poor sleep quality using the Pittsburg Sleep Quality Index (PSQI ≥ 5) were included. The pooled prevalence of poor sleep quality was identified as 37.46% (95% CI: 29.26, 45.67) in the first trimester, 47.62% (95% CI: 42.23, 53.02) in the second trimester, and 60.05% (95% CI: 51.32, 68.78) in the third trimester.

Conclusion This study identified a significant discrepancy in the prevalence of poor sleep quality, which increases as gestational age advances. Therefore, this discrepancy should be addressed, and additional support should be provided to pregnant women to help them achieve adequate sleep, especially as gestational age advances.

Keywords Sleep quality, Poor sleep quality, Pittsburg sleep quality index, Different trimesters, Systematic review

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Introduction

Sleep is crucial for the growth and development of the fetus and is integral to a positive pregnancy experience [1]. Adequate sleep ensures the baby receives necessary resources for optimal growth [1, 2]. However, many pregnant women face challenges with sleep quality, including difficulty falling asleep, staying asleep, or achieving restful sleep [3].

Several factors can affect sleep quality during pregnancy, such as hormonal changes, physical discomfort (e.g., nausea, breast tenderness), increased urination frequency, and emotional factors like anxiety, and worries about the baby's health [4, 5]. Poor sleep quality during pregnancy has been linked to adverse outcomes such as a higher risk of gestational diabetes, preeclampsia, preterm birth, low birth weight, and postpartum depression [6–8]. It also negatively impacts overall well-being, leading to daytime fatigue, reduced cognitive function, and difficulty coping with the physical and emotional demands of pregnancy [3, 6, 9].

The quality of sleep varies significantly across trimesters. In the first trimester, hormonal changes and physical discomfort can hinder restful sleep [10]. Moving in to the second trimester, challenges include increased urination and difficulty finding a comfortable sleeping position due to the growing abdomen, alongside emotional factors like anxiety [11]. By the third trimester, physical discomfort intensifies with symptoms such as back pain and difficulty breathing, compounded by concerns about labor, delivery, and preparing for the baby's arrival [4, 5].

Addressing poor sleep quality is crucial, and it requires awareness from pregnant women, healthcare providers, and support systems [6, 12, 13]. Strategies like maintaining good sleep hygiene, practicing relaxation techniques before bed, creating a comfortable sleep environment, and seeking medical advice for sleep disturbances can help improve sleep quality and mitigate its negative consequences during pregnancy [14–16].

Despite recognizing the issue, studies have shown a wide range in the reported prevalence of poor sleep quality in different trimester of pregnancy. Therefore, this systematic review and meta-analysis was conducted to compare the prevalence of poor sleep quality in different trimester of pregnancy in low- and middle-income countries which is crucial better understand these variations.

Methods

This systematic review and meta-analysis was conducted to determine the prevalence of poor quality of sleep and compare it among different trimester pregnancy in low- and middle-income countries. The review strictly followed the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA 2020) guidelines [17].

Search strategy

Electronic search of online databases was done from PubMed, Medline, Google Scholar, and Hinari databases to retrieve published articles conducted on the prevalence of poor quality of sleep among pregnant women. In addition, we extended our search by retrieving and extracting potential articles from reference lists of eligible articles. The searching was conducted using free text and Medical Subject Heading (MeSH) terms such as: sleep, sleep quality, poor sleep quality, prevalence, magnitude, Pittsburgh Sleep Quality Index, PSQI, and pregnancy.

Inclusion criteria

All articles of a cross-sectional, retrospective cohort, and prospective cohort studies that assess the prevalence of poor quality of sleep among different trimester of pregnancy in low and middle-income countries and written in English were included. Agreements on the inclusion and exclusion of the articles were done through extensive discussion of all authors.

Exclusion criteria

Studies were excluded if they were case reports, case series, conference papers, reviews, or published only as abstracts. We also excluded studies that did not use the PSQI score to measure sleep quality, those that did not report prevalence data on poor sleep quality, and studies involving non-pregnant women. Duplicate publications were also excluded.

Outcome measurement

The included studies measured poor sleep quality by the Pittsburgh Sleep Quality Index (PSQI), a PSQI score ≥ 5 .

Data extraction and quality assessment

The Joanna Brigg's Institute (JBI) tool for prevalence and determinant studies was used as a guideline for data extraction from the final selected articles. The data were extracted in Microsoft excel form, checked and evaluated by all authors. The extraction sheet contains name of authors, study year, publication year, country and region of study, study design, study population, sample size, prevalence with the upper and lower boundary confidence intervals. The quality of included studies was evaluated using the Joanna Briggs Institute (JBI) critical appraisal checklist [18]. The quality scores of included studies were assessed and presented using the mean scores to designate them as high- or low-quality. Articles with a score of 5 or more out of 8 were considered to be of good quality and were included in the review. Low- and middle-income countries list were identified from World Bank official website (countries with 2022 GNI per capita was less than \$13,845) [19].

Data processing and analysis

The extracted data were analyzed using STATA 17. The results were presented in evidence tables, figures and descriptive statistics form. The estimates for prevalence from each study were pooled and determined as a single estimate with its corresponding 95% CI for each trimester of pregnancy. The random effect regression model was used for analysis [20]. Forest plots were used to estimate the pooled prevalence and effect size of each study with their 95% confidence interval. The size of each box indicated the weight of the study, while each crossed line refers to the 95% confidence interval. Subgroup analysis was done by sub-region and income level of country's the study were from, which enables the assessment of poor sleep quality varies in different low- and middle-income countries.

Heterogeneity and publication biases assessment

The magnitudes of heterogeneity between studies were assessed using I^2 statistics and values of 25%, 50%, and 75% were graded as low, medium, and high quality respectively. A P-value of less than 0.1 was considered to suggest statistically significant heterogeneity [21]. For further clarification on the source of heterogeneity, the pooled prevalence was reported on the base of income level by subgroup analysis. Publication bias was assessed subjectively by observing the funnel plot and objectively by considering Egger's test estimates at a 5% level of significance [22, 23]. Leave-one-out sensitivity analysis was performed to confirm potentially biased direction of pooled estimates on Egger's test [24].

Registration and protocol

This review has been previously registered on PROSPERO (ID: CRD42024496841).

Result

Study selection

This systematic review and meta-analysis included published studies on the prevalence of poor sleep quality among pregnant women in different trimester in low and middle-income countries. More than 1,821 articles were identified through electronic database searching, and 38 studies were included to estimate and compare the pooled prevalence of poor sleep quality in different trimester of pregnancy (Fig. 1).

Characteristics of included studies

This systematic review and meta-analysis included 38 studies from 13 different low- and middle-income countries without restriction based on the year of publication. Eleven studies from China [13, 25–34], six studies from Indonesia [35–40], five studies from Ethiopia [41–45], two studies from Peru [46, 47], three studies from Iran

[48–50], two studies from Pakistan [51, 52], two studies from India [53, 54], two studies from Turkey [55, 56], and five studies from Malaysia [12], Russia [57], Sri Lanka [58], Brazil [59], and Thailand [60], one from each countries. In this meta-analysis, 11,610, 7168 and 9265 women were included in the first, second and third trimester of pregnancy, respectively.

Based on income categories of countries, as World Bank categorized them based on their income, five studies were from low-income countries [41–45], eight studies from lower middle-income countries [48–54, 58], and twenty-five studies from upper middle-income countries [12, 13, 25–40, 46, 47, 55–57, 59, 60] (Supplementary Table 1).

Risk of bias assessment

Publication bias was comprehensively assessed through both graphical and statistical methods in this review. Funnel plots were presented for the first (Supplementary Fig. 1), second (Supplementary Fig. 2), and third trimesters (Supplementary Fig. 3), visually inspecting the distribution of study outcomes. Additionally, Egger's tests were conducted, yielding p-values of 1.00 for the first trimester and second trimester, and 0.9148 for the third trimester, indicating no significant evidence of publication bias across these trimesters in the meta-analysis.

Prevalence of poor quality of sleep in the first trimester of pregnancy

There were 17 studies reporting on the prevalence of poor sleep quality during the first trimester of pregnancy. The pooled prevalence of poor sleep quality among pregnant women during this period was 37.46% (95% CI: 29.26, 45.67). However, the I-square statistic ($I^2 = 98.8\%$) showed a significant heterogeneity among the included studies.

Subgroup analysis was conducted based on income categories. The result revealed a prevalence of 35.59% (95% CI: 17.83, 35.35) in low-income countries, 33.15% (95% CI: 21.98, 44.32) in lower-middle-income countries, and 39.48% (95% CI: 28.69, 50.31) in upper-middle-income countries (Fig. 2).

Prevalence of poor sleep quality in the second trimester of pregnancy

There were 18 studies reported the prevalence of poor sleep quality among pregnant women during the second trimester of pregnancy. The pooled prevalence of poor sleep quality during the second trimester of pregnancy were 47.623% (95% CI: 42.230, 53.016). However, there was high degree of heterogeneity among the studies identified from the I^2 ($I^2 = 95.0\%$), for which sub group analysis was done based on income categories. The pooled prevalence were 47.90% (95% CI: 34.88, 60.93) in low income

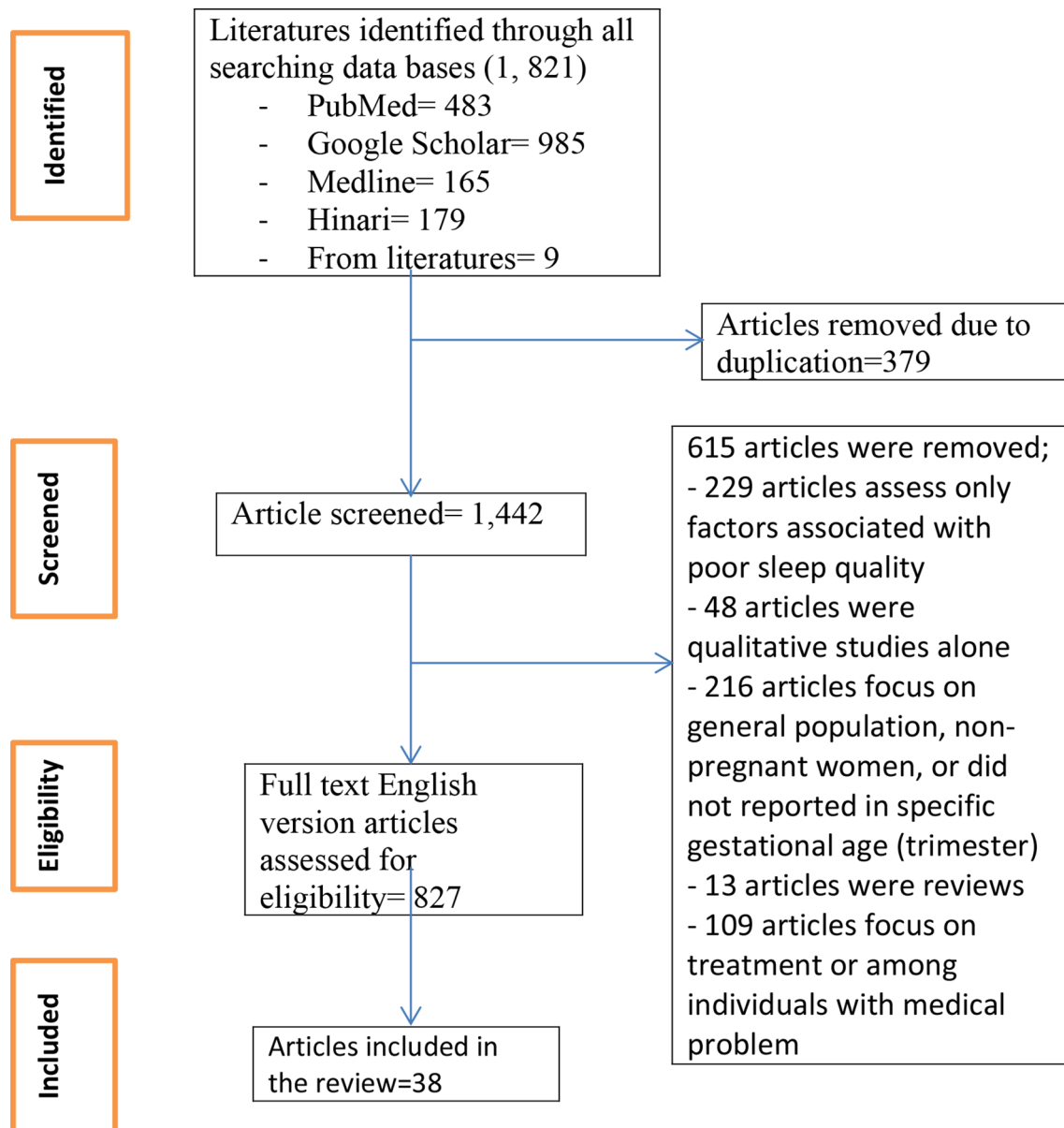


Fig. 1 Flow chart for studies selection to compare the pooled prevalence of poor sleep quality in different trimester of pregnancy in low- and middle-income countries

countries, 47.29% (95% CI: 42.26, 52.32) in lower middle-income countries, and 47.02% (95% CI: 39.72, 54.32) in upper middle-income countries (Fig. 3).

Prevalence of poor quality of sleep during the third trimester of pregnancy

There were 28 studies reported the prevalence of poor sleep quality during the third trimester of pregnancy. The pooled prevalence was identified as 60.05% (95% CI: 48.700, 66.623). I-square result (I^2 (%): 98.9%) showed a significant heterogeneity among the included studies. The pooled prevalence were 53.78% (95% CI: 35.46, 72.11) in low income countries, 59.52% (95% CI: 48.71,

70.34) in lower middle-income countries, and 62.41% (95% CI: 49.00, 75.82) in upper middle-income countries (Fig. 4). Summary of the statistics and meta-analysis is shown on Table 1.

Discussion

This systematic review and meta-analysis highlights a marked increase in the prevalence of poor sleep quality among pregnant women as pregnancy progresses, with rates escalating from 37.46% in the first trimester to 47.62% in the second trimester, and reaching 60.05% in the third trimester. This escalation is consistent with previous reviews conducted by Salari Nader et al. [11]

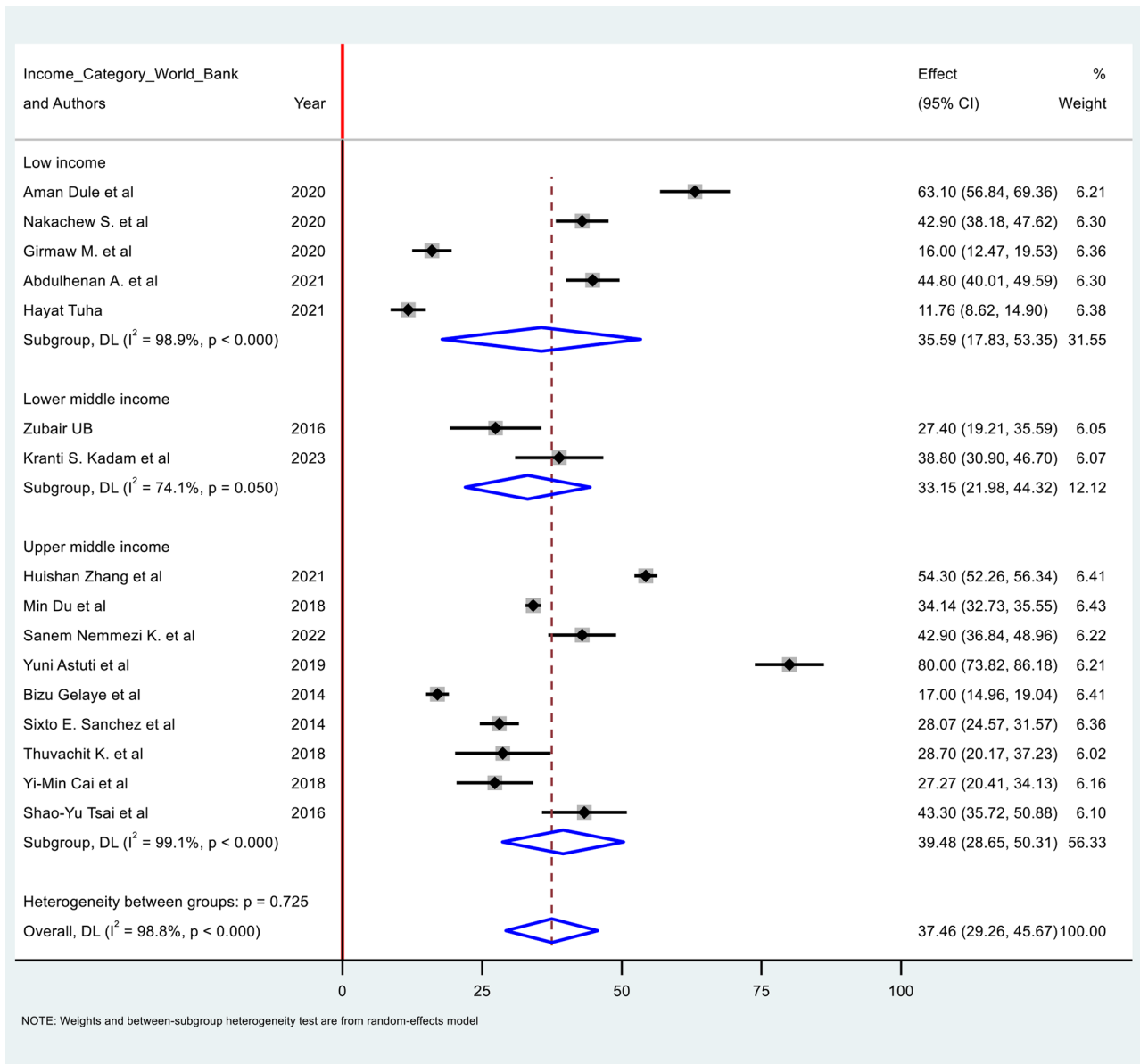


Fig. 2 Forest plot for poor sleep quality among first trimester pregnant women in low- and middle-income countries

and Ivan D. Sedov et al. [61], which also reported an increasing prevalence of poor sleep quality during the latter stages of pregnancy. Moreover, studies conducted in upper-income countries, including the USA [62], Poland [63], and Saudi Arabia [64] supports this finding, suggesting that the observed escalation is a widespread phenomenon. The main cause of this significant deterioration of sleep quality is the physiological, social and psychological changes accompanying pregnancy [65].

The marked increase in poor sleep quality across trimesters suggests that pregnant women encounter progressively more complex and distinct challenges to their sleep as their pregnancy advances. Several factors might contribute to these discrepancies: hormonal changes,

particularly the fluctuations in progesterone and estrogen, disrupt sleep patterns by affecting thermoregulation and increasing nighttime awakenings [63, 66, 67]. Physical discomfort also intensifies, with the growing uterus applying pressure on internal organs and the bladder, leading to frequent urination and discomfort that interrupts sleep. Additionally, increased fetal movement, especially in the third trimester, can be disruptive, making it harder for women to fall and stay asleep [63, 67, 68].

Gastrointestinal issues, such as acid reflux, heartburn, indigestion, and constipation, become more prevalent as the pregnancy advances due to the expanding uterus exerting pressure on the stomach and intestines [11, 69, 70]. The progressively increasing leg cramps and

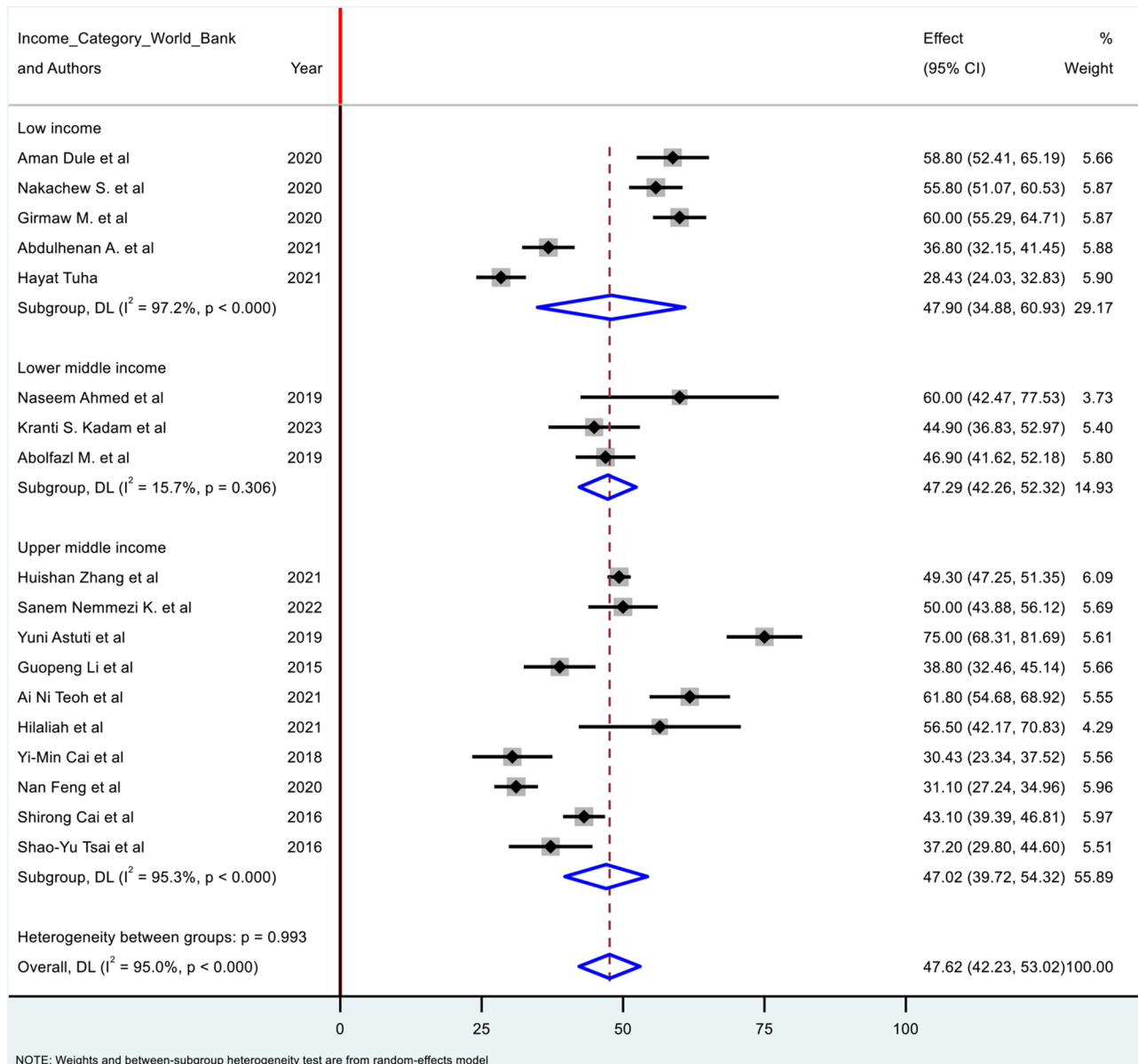


Fig. 3 Forest plot for poor quality of sleep among pregnant women during the second trimester of pregnancy in low and middle-income countries

restless legs syndrome is another common issue in the later stages of pregnancy, contributing to nocturnal discomfort [71]. Psychological factors, including heightened anxiety and stress related to labor, delivery, and parenting responsibilities, further exacerbate increase as pregnancy advances. These concerns can exacerbate sleep disturbances, as women worry about potential complications or the health of their baby [72, 73].

The review also included a subgroup analysis based on the income level of the countries where studies were conducted, examining low-income, lower-middle-income, and upper-middle-income settings. The results indicated no statistically significant differences in the prevalence of poor sleep quality across these income levels, suggesting

that poor sleep quality during pregnancy is a universal issue affecting women regardless of economic status [72, 74].

The findings indicate that poor sleep quality among pregnant women worsens as gestational age progresses, underscoring the need for increased support from healthcare providers and family members. This decline in sleep quality, particularly during late pregnancy, may exacerbate stress, anxiety, and mood disorders, highlighting the necessity for targeted interventions [72]. Healthcare providers should implement comprehensive care strategies, including education on sleep hygiene, routine screening for sleep disorders, and psychological support, to enhance sleep quality and overall well-being

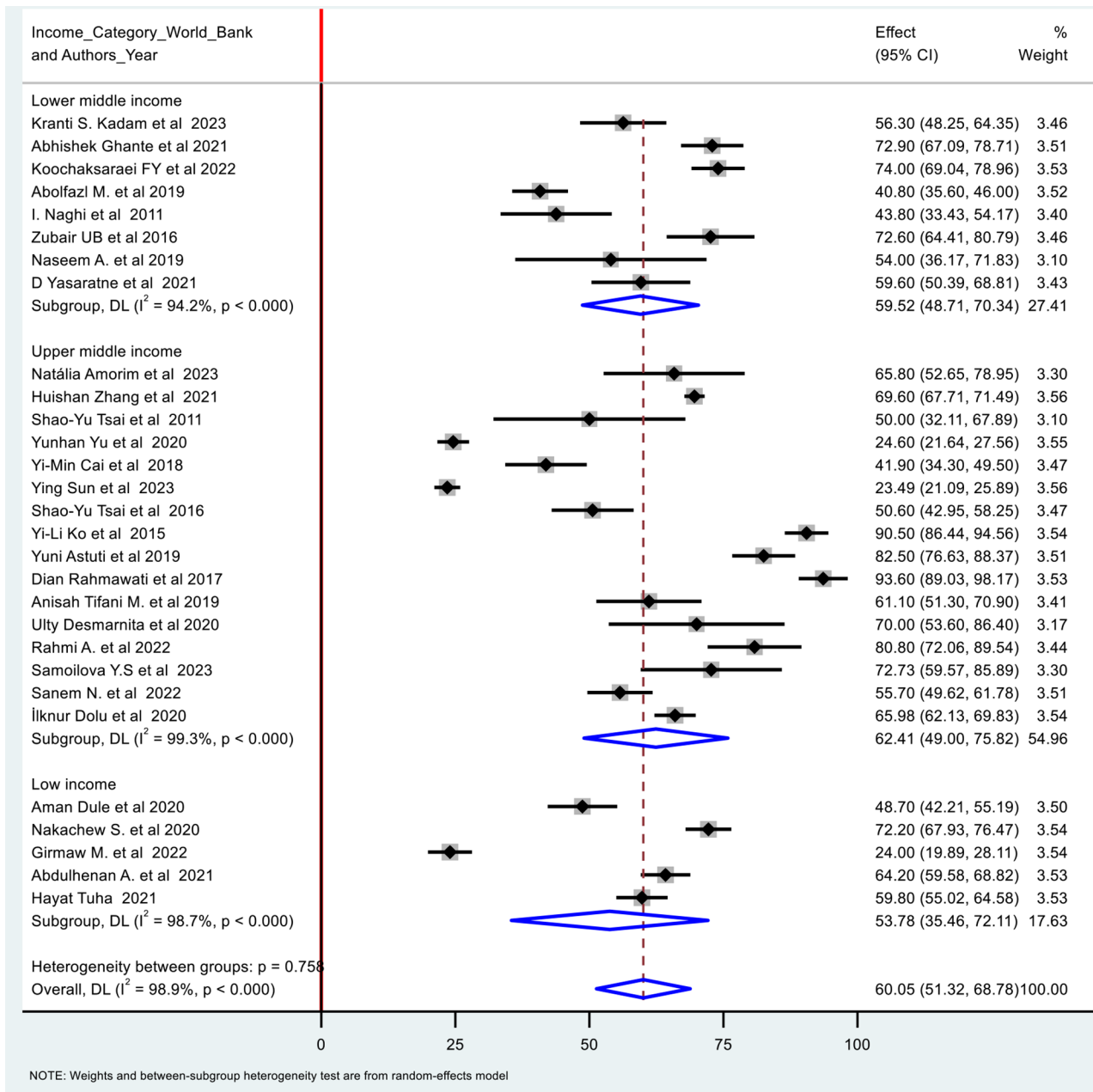


Fig. 4 Forest plot for poor quality of sleep during the third trimester of pregnancy in low and middle-income countries

throughout pregnancy [75]. Addressing these issues proactively is essential for improving outcomes for pregnant women as they advance through their pregnancy [65].

While interpreting the findings of this review, it is better to consider the following strengths and limitations. As a strength, this review included only studies that measure the quality of sleep using similar measurement tool (the Pittsburgh Sleep Quality Index). As a limitation, this study only included published studies and those written in the English language, and there was significant heterogeneity among the included studies.

Conclusion

This review identified a considerable heterogeneity among the included studies and a significant discrepancy in the prevalence of poor sleep quality across different trimesters of pregnancy, with a trend showing an increase in poor sleep quality as gestational age advances. This observation suggests that the sleep quality of pregnant women deteriorate as their pregnancies progress. Interventions aimed at improving sleep hygiene, providing supportive prenatal care, and addressing specific physical discomforts associated with pregnancy could

Table 1 Summary table to compare the prevalence of poor sleep quality in different trimester of pregnancy in low- and middle-income countries

Women's characteristics	Included studies	Number of participant	Pooled prevalence (%)	95% CI	I-square (%)	Publication bias tests
First trimester	17	11,610	37.46	29.26, 45.67	98.8	Egger test ($p = 1.0000$)
<i>Subgroup analysis based on income level</i>						
LIC	5	1884	35.59	17.83, 35.35	98.9	
LMIC	2	260	33.15	21.98, 44.32	74.1	
UMIC	10	9466	39.48	28.69, 50.31	99.1	
Second trimester	18	7168	47.62	42.23, 53.02	95.0	Egger test ($p = 1.0000$)
<i>Subgroup analysis based on income level</i>						
LIC	5	1884	47.90	34.88, 60.93	97.2	
LMIC	3	519	47.29	42.26, 52.32	15.7*	
UMIC	10	4538	47.02	39.72, 54.32	95.3	
Third trimester	28	9265	60.05	51.32, 68.78	98.9	Egger test ($p = 0.9148$)
<i>Subgroup analysis based on income level</i>						
LIC	5	1884	53.78	35.46, 72.11	98.7	
LMIC	7	1129	59.52	48.71, 70.34	94.2	
UMIC	16	6252	62.41	49.00, 75.82	99.3	

LIC: low income countries; LMIC: lower middle-income countries; UMIC: upper middle income countries; * low heterogeneity

potentially mitigate these challenges and improve maternal and fetal health outcomes.

Further meta-analysis studies also needed to explore factors contributing to poor sleep quality among pregnant women, and interventions to improve sleep quality for pregnant women.

Abbreviations

CI Confidence interval
PSQI Pittsburgh Sleep Quality Index

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12884-024-06830-3>.

Supplementary Material 1

Supplementary Material 2

Author contributions

EM, HK, MWA, ST, MA, BS, and FC conducted the search, quality assessment, and data extraction. Additionally, EM, MWA, HK, MA, and FC wrote the first draft of the manuscript. Lastly, EM, HK, ST, BS, and MWA conducted the statistical analyses, data interpretation and wrote the final draft. All authors read and approved the final manuscript.

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Data availability

The datasets used in this study are available from the authors upon reasonable request.

Declarations

Ethical approval

Not required. This study was on published articles.

Consent to Publish

Not applicable.

Competing interests

The authors declare no competing interests.

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