Poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia: systematic review and meta-analysis

Aragaw Asfaw Hasen[1], Abubeker Alebachew Seid[2] and Ahmed Adem Mohammed[2]

[1] Department of Statistics, College of Natural and Computational Sciences, Samara University, Semera, Afar, Ethiopia
[2] Department of Nursing, College of Medicine and Health Sciences, Samara University, Semera, Afar, Ethiopia

ABSTRACT

Introduction. COVID-19 has profoundly impacted the mental health and well-being of pregnant women worldwide. In Ethiopia, the poor sleep quality and suicidal ideation among pregnant women has increased due to the COVID-19 pandemic. This study aimed to provide comprehensive evidence on the prevalence and associated factors of poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia.

Materials and Methods. This study is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendation. Data were searched from PubMed, Google Scholar, and African Journals Online from the occurrence of the COVID-19 pandemic to February 2023. Two researchers extracted the data and performed the methodological quality assessment independently. Random-effect model was used to estimate the pooled effect size and I^2 was used to check heterogeneity. Stata 14.0 (StataCorp, Collage Station, Texas, USA) was used for statistical analysis.

Results. From six studies the pooled prevalence of poor sleep quality was 55% (95% CI [0.42–0.69], $I^2 = 98.1\%$, $p < 0.001$). Age ≥ 30 years pooled AOR = 1.95, 95% CI (0.85, 3.06), 3rd trimester pooled AOR = 3.20, 95% CI (1.82, 4.58), substance use pooled AOR = 2.51, 95% CI (0.99, 4.04), depression pooled AOR = 2.97, 95% CI (0.92, 5.02) and stress pooled AOR 2.14, 95% CI (0.24, 4.03) were associated factors of poor sleep quality. Three studies reported about suicidal ideation and pooled prevalence was 11% (95% CI: 0.09, 0.13, $I^2 = 48.2\%$, $p = 0.145$). Depression pooled AOR = 3.19, 95% CI (1.68, 4.71) was the only associated factor of suicidal ideation.

Conclusion. Due to COVID-19 pregnant women in Ethiopia were affected by poor sleep quality and suicidal ideation. Thus, suitable and well designed programs proposing awareness of COVID-19, mental health counseling and involvement should be designed to improve the general mental health of pregnant women.

Trial registration. PROSPERO registration number CRD42023389896.

Subjects Global Health, Psychiatry and Psychology, Women's Health, Mental Health, COVID-19
Keywords COVID-19, Mental health, Pregnancy, Women, Systematic review and meta analysis, Ethiopia, Poor sleep quality, Suicidal ideation

INTRODUCTION

Pregnancy is an event in a woman's life and can lead to psychological disorders. Several risk factors (such as disasters and pandemics) have been correlated with prevalence of mental disorders during pregnancy (*Keskin, Keskin & Bostan, 2022*). The COVID-19 pandemic has profoundly impacted mental health and well-being around the globe. Public health measures to control the virus's rapid spread, such as physical distancing, social isolation, lockdown, restricted movements, and quarantine, triggered fear in the general population (*Ajayi et al., 2021*). The COVID-19 pandemic has resulted in elevated mental health problems for pregnant women (*Khoury et al., 2021*; *Zeng et al., 2020*).

Pregnant women are vulnerable and suffered great psychological problems (*Wu et al., 2021*). Pregnant women's mental health is significantly impacted by their socioeconomic status, educational attainment, and social support (*Campos-garz, Riquelme-gallego & De Torre-luque, 2021*). Women who are pregnant, postpartum, miscarrying, or experiencing intimate partner violence are at high risk for developing mental health problems during the pandemic. Proactive outreach to these groups of women and enhancement of social supports could lead to prevention, early detection, and prompt treatment (*Almeida, 2020*).

Sleep is an important biological function in humans. Physical body dynamics during pregnancy lead to the deterioration of both sleep quality and sleep duration. According to the Pittsburgh Sleep Quality Index (PSQI) a score of above 5 is considered poor sleep quality (*Smyka et al., 2021*). On the other hand, suicide is a fatal action of terminating one's own life. Suicidal ideation (SI) is a thought about one's serving as an agent to kill him/herself and it is a predictor of suicide attempts and completions (*Jacobs et al., 2010*). During COVID-19 in Bangladesh about 8.2% of young adults reported having at least suicidal thoughts from the pandemic's inception to survey time (*Mamun et al., 2021*). Suicidal ideation (SI) is measured by the World Health Organization (WHO) composite international diagnostic interview (CIDI) (*Kessler & Üstün, 1981*).

The COVID-19 pandemic was expected to have terrible effects on mothers' mental health in Africa because of the continent's poor health systems, inadequate mental health policies, and unreliable maternal care (*Ajayi et al., 2021*; *Senkyire et al., 2023*). Studies showed that during the COVID-19 pandemic the prevalence of mental disorders among pregnant women was very high. For instance, of all participating pregnant women, 88% had poor sleep quality during the COVID-19 pandemic (*Alan et al., 2020*). Similarly, the prevalence of poor sleep quality among pregnant women during the pandemic was high. Maternal age, third trimester pregnancy, being multigravida, and having comorbidity were among associated factors of poor sleep quality of pregnant women during COVID-19 (*Amare, Chekol & Aemro, 2022*). The prevalence of poor sleep quality was 71.3% (*Bogale et al., 2022*) and 30.8% (*Anbesaw et al., 2021a*; *Anbesaw et al., 2021b*).

In addition, suicidal ideation is communal in the third trimester, particularly in pregnant women with poor marital satisfaction, high attachment anxiety, prenatal depression and prenatal anxiety (*Zhang et al., 2022*). The prevalence of suicidal ideation among pregnant women was 11.8% (*Belete et al., 2021*) and 13.3% of women who are on antenatal care were with suicidal ideation (*Anbesaw et al., 2021b*). Women who are on antenatal care developed

suicidal ideation due to different factors including, absence of cohabiting partners, history of abortion, depression, anxiety, intimate partner violence, poor sleep quality and stress (*Anbesaw et al., 2021b*). There are single level study findings in Ethiopia (*Amare, Chekol & Aemro, 2022*; *Anbesaw et al., 2021a*; *Bogale et al., 2022*; *Dule et al., 2021*; *Jemere et al., 2021*; *Belete et al., 2021*; *Molla, Nigussie & Girma, 2022*; *Takelle, Muluneh & Biresaw, 2022*; *Anbesaw et al., 2021a*) on the prevalence of poor sleep quality and suicidal ideation among pregnant women during COVID-19. The reports on prevalence of poor sleep quality and suicidal ideation in Ethiopia were high, and the results were inconsistent.

Therefore, a thorough investigation is necessary, as is the provision of thorough evidence regarding the prevalence and contributing variables of poor sleep quality and suicidal ideation among pregnant women in Ethiopia. No study reported in a summarized way. By measuring the combined prevalence of poor sleep quality, suicidal ideation, and their associated factors, this study intends to close this gap. This study offers proof of mental health issues in pregnant women to academics and decision-makers.

OBJECTIVES

General objective
• This study aimed to provide comprehensive evidence on the prevalence and associated factors of poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia.

Specific objectives
• To estimate the pooled prevalence of poor sleep quality and suicidal ideation during COVID-19 among pregnant women in Ethiopia.
• To review associated factors of poor sleep quality and suicidal ideation during the COVID-19 pandemic among pregnant women in Ethiopia.

MATERIALS AND METHODS

Protocol registration
The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 recommendation was used (*Moher et al., 2015*). The protocol for this systematic review and meta analysis was registered by International Prospective Register of Systematic Reviews with PROSPERO registration number: CRD42023389896.

Search strategy
Searching of literature was done by two authors (AAH and AAS) individually. Disagreement was handled by discussion with third author (AAM). Databases PubMed, African Journals Online and Google Scholar, and papers published from the occurrence of the COVID-19 pandemic to February 2023 were searched. Observational studies that evaluated sleep quality and suicidal ideation during COVID-19 among pregnant women in Ethiopia were considered. Systematic searches were carried out by combining every possible predefined search term determined by Medical Subject Headings (MeSH) and keywords. The following key words were used: "COVID-19", "2019 novel coronavirus disease", "2019 novel

coronavirus infection", "2019 ncov disease", "2019 ncov infection", "covid 19 pandemic", "covid 19 pandemics", "covid 19 virus disease", "covid 19 virus infection", "COVID19", "coronavirus disease 2019", "coronavirus disease 19", "sars coronavirus 2 infection", "sars cov 2 infection", "severe acute respiratory syndrome coronavirus 2 infection", "SARS-CoV-2", "2019 novel coronavirus", "2019 novel coronavirus", "2019- nCoV", "covid 19 virus", "covid19 virus", "Coronavirus disease 2019 virus", "SARS coronavirus 2", "SARS cov 2 virus", "severe acute respiratory syndrome coronavirus 2", "Wuhan coronavirus", "Wuhan seafood market pneumonia virus", "mental illness", "psychiatric problem", "psychology problem", "mental health effect", "psychological disturbance", "mental disorder", "psychiatric illness", "psychiatric diseases", "psychiatric disorders", "behavior disorders", "severe mental disorder", "sleeping quality", "poor sleep quality", "insomnia", "suicide", "suicidal ideations", "pregnant women", "prenatal", " perinatal", "postpartum", "antenatal", "postnatal", "puerperal", "lactating women", "reproductive age women", "child bearing women" and "Ethiopia".

Reference lists of full text articles included in the review were checked to identify any potentially eligible study for this review. Systematic procedure confirmed that the literature search encompasses all published studies on the prevalence and associated factors of poor sleep quality and suicidal ideation during COVID-19 among pregnant women in Ethiopia. From the searched results duplicates were detached by using Mendeley (*Kwon et al., 2015*). The search strategy for finding suitable studies from databases is presented in Supplemental File S1.

Eligibility criteria
Inclusion criteria
For this systematic review and meta-analysis, observational studies that focused on the prevalence and associated factors of poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia were considered. Moreover, the inclusion criteria is stated as:

Setting: Studies in Ethiopia were the main emphasis of this review.

Population: All pregnant women in Ethiopia.

Study design: Observational studies on prevalence of poor sleep quality and suicidal ideation and their associated factors.

Language: Only English.

Exclusion criteria
The following types of studies were excluded: studies focusing on the whole population, studies that do not report prevalence and associated factors of poor sleep quality and suicidal ideation among pregnant women, systematic reviews and meta-analyses, randomized controlled trials, editorials, and conference abstracts and opinions.

Outcome measures
The primary outcomes were the pooled prevalence of prevalence of poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia. The secondary

outcomes were factors associated with poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia.

Selection of studies

Two researchers (AAH and AAS) reviewed studies based on eligibility criteria. Firstly, the authors evaluated titles and abstracts of the studies from the searched databases. Then, full-text screening was done to screen the full texts. We have provided a reasoning for inclusion and exclusion of studies in the PRISMA diagram. The list of suitable studies for this systematic review and meta-analysis were arranged.

Data extraction

The data were collected by two researchers (AAH and AAS) individually. Pretest on the data extraction form by using two pilot surveyed studies was done. This helps ensure the collection of all necessary data for this systematic review and meta-analysis is accurate. Disagreements were handled by deep discussion among the investigators. All relevant data were collected from the original studies. Specifically, author's last name, year of publication, region, study design, number of cases, sample size, sampling design, instrument, study population, average age and prevalence of poor sleep quality and suicidal ideation with their associated factors were extracted.

Methodological quality assessment

Two researchers (AAH and AAM) separately evaluated the quality of the included studies by the Newcastle-Ottawa Scale (NOS) (*Peterson, Welch & Losos, 2011*). According to this scale, three parameters named selection, comparability, and assessment of exposure/outcome were considered. Studies with less than 5 scores were considered low quality, 5-7 scores of moderate quality, and more than 7 scores of high quality (*Ssentongo et al., 2020*). Studies with moderate and above quality score were considered for this study. Disagreements on scores between reviewers were resolved by discussion. The final quality score was presented in Table 1.

Data synthesis

The statistical data analysis was done by Stata 14.0 (StataCorp, Collage Station, Texas, USA). The pooled prevalence with 95% confidence interval (CI) by using random-effect model with the generic inverse variance method was computed. Evaluation of heterogeneity was checked by I^2 and Cochran's Q-statistics (*Bowden et al., 2011*; *Zhu et al., 2020*). Subgroup analyses was performed by regions, year of publication and sampling methods used in individual studies to decide the source of heterogeneity. Publication bias was checked by Doi plot and the Luis Furuya Kanamori (LFK) index was applicable when the number of studies was small and used to assess asymmetry (*Furuya-Kanamori, Barendregt & Doi, 2018*) (*Furuya-Kanamori & Doi, 2021*). The LFK index value out of the interval -1 and 1 were considered asymmetry (existence of publication bias) (*Furuya-Kanamori & Doi, 2021*).

Table 1 Study characteristics and quality of the included studies for poor sleep quality and suicidal ideation among pregnant women during the COVID-19 pandemic in Ethiopia.

No	Authors	Year	Region	Mental disorders	Population	Study design	Sampling method	Sample size (n)	Cases	P (%)	Instrument	Age (average)	Quality
1	Dule et al. (2021)	2021	Oromiya	Poor sleep quality	All PW	CS	Census/consecutive	228	130	57	PSQI	30.79	7
2	Jemere et al. (2021)	2021	Amhara	Poor sleep quality	All PW	CS	Systematic	411	281	68.4	PSQI	25.7	8
3	Bogale et al. (2022)	2022	SWE	Poor sleep quality	RAW	CS	Multistage	606	432	71.3	PSQI	25	8
4	Anbesaw et al. (2021b)	2021	Oromiya	Poor sleep quality	All PW	CS	Systematic	415	128	30.8	PSQI	25.22	8
5	Takelle, Muluneh & Biresaw (2022)	2022	Amhara	Poor sleep quality	All PW ≥18 years	CS	Systematic	415	175	42.2	PSQI	28	8
6	Amare, Chekol & Aemro (2022)	2022	Amhara	Poor sleep quality	All PW	CS	Systematic	423	265	62.8	PSQI	28	8
7	Molla, Nigussie & Girma (2022)	2022	SNNP	Suicidal ideation	All PW	CS	Multistage	504	47	9.3	SBQ-R	27.56	8
8	Anbesaw et al. (2021a)	2021	Oromiya	Suicidal ideation	All PW	CS	Systematic	415	55	13.3	CIDI	25.22	8
9	Belete et al. (2021)	2021	SNNP	Suicidal ideation	All PW	CS	Systematic	738	87	11.3	CIDI	25.54	8

Notes.

CIDI, Composit International Diagnostic Interview; SBQ-R, *Suicide Behaviors Questionnaire-Revised*; PSQI, Pittsburgh Sleep Quality Index; SNNP, Southern Nations Nationalities and People; SWE, South West Ethiopia; CS, Cross-sectional; PW, Pregnant women; P, Prevalence; RAW, Reproductive Age Women; AOR, adjusted odds ratio; CI, Confidence Interval; IPV, Intimate Partner Violence.

RESULTS

A PRISMA diagram demonstrating steps of the database search and the refining process for the study on poor sleep quality and suicidal ideation among pregnant women during the COVID-19 pandemic was shown in Fig. 1. From our databases search primarily 22 studies were identified. Due to duplication four studies were removed. About 18 full text studies were examined and nine studies were removed by reasons that did not encountered inclusion criteria. Finally, we recognized nine studies appropriate to this systematic review and meta-analysis.

Study characteristics

In this systematic review and meta-analysis, we included nine cross sectional studies (*Amare, Chekol & Aemro, 2022*; *Anbesaw et al., 2021a*; *Anbesaw et al., 2021b*; *Bogale et al., 2022*; *Dule et al., 2021*; *Jemere et al., 2021*; *Belete et al., 2021*; *Molla, Nigussie & Girma, 2022*; *Takelle, Muluneh & Biresaw, 2022*; *Anbesaw et al., 2021b*) on the prevalence and associated factors of poor sleep quality and suicidal ideation among pregnant women during the COVID-19 pandemic in Ethiopia. Based on the types of mental disorders; six studies (*Amare, Chekol & Aemro, 2022*; *Bogale et al., 2022*; *Anbesaw et al., 2021a*; *Anbesaw et al., 2021b*; *Jemere et al., 2021*; *Takelle, Muluneh & Biresaw, 2022*; *Dule et al., 2021*) were reported about poor sleep quality; three studies (*Belete et al., 2021*; *Anbesaw et al., 2021b*; *Molla, Nigussie & Girma, 2022*) were reported about suicidal ideation. Furthermore, the summarized data of the key characteristics of the included studies for this review were showed in Table 1.

Quality of included studies

The quality of included studies using the modified Newcastle Ottawa scale (NOS) for cross-sectional studies quality assessment was presented in Table 1. We considered moderate quality, and high-quality studies for this review. Thus, one study (*Dule et al., 2021*) that was appraised as moderate quality and eight studies (*Amare, Chekol & Aemro, 2022*; *Bogale et al., 2022*; *Anbesaw et al., 2021b*; *Belete et al., 2021*; *Jemere et al., 2021*; *Molla, Nigussie &*
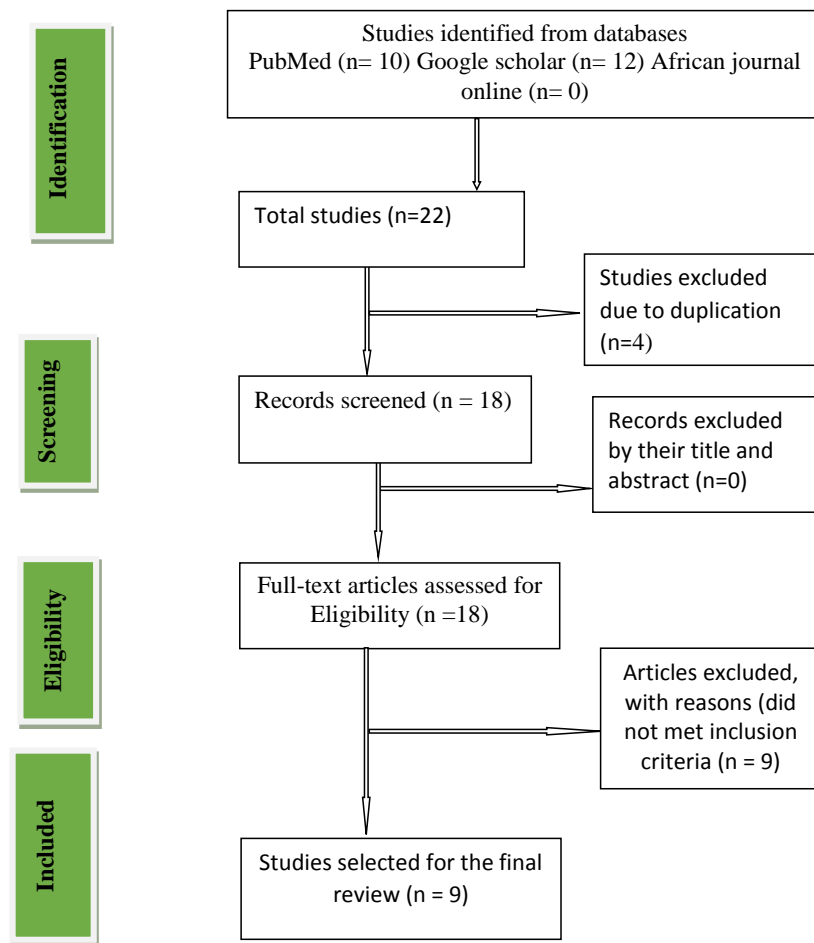
Figure 1 **Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow chart.**
Full-size ☒ DOI: 10.7717/peerj.16038/fig-1

Girma, 2022; *Takelle, Muluneh & Biresaw, 2022*) that were appraised as high quality were
considered for final systematic review and meta analysis.

Publication bias

Publication bias was evaluated by using Doi plot (*Furuya-Kanamori, Barendregt & Doi,
2018*), a method used to see asymmetry and by the LFK index (*Furuya-Kanamori & Doi,
2021*), used to detect and quantify asymmetry of study effects. For poor sleep quality studies
(LFK index $= -1.49$, Egger's test p-value $=0.531$), *i.e.,* there is minor asymmetry, but the
Egger's test result is not statistically significant with p-value $=0.531$, indicating that no
significant influence was found on the pooled result and therefore no publication bias. For
suicidal ideation studies (LFK index $= -0.05$, Egger's test p-value $= 0.674$). *i.e*, both LFK
index and Egger's test supports no publication bias (Fig. 2).

Pooled prevalence of poor sleep quality

Six studies reported the prevalence of anxiety, and the pooled prevalence of poor sleep
quality was found to be 55% (95% CI [0.42–0.69], $I^2 = 98.1\%$, $p < 0.001$). As shown in

A.

B.
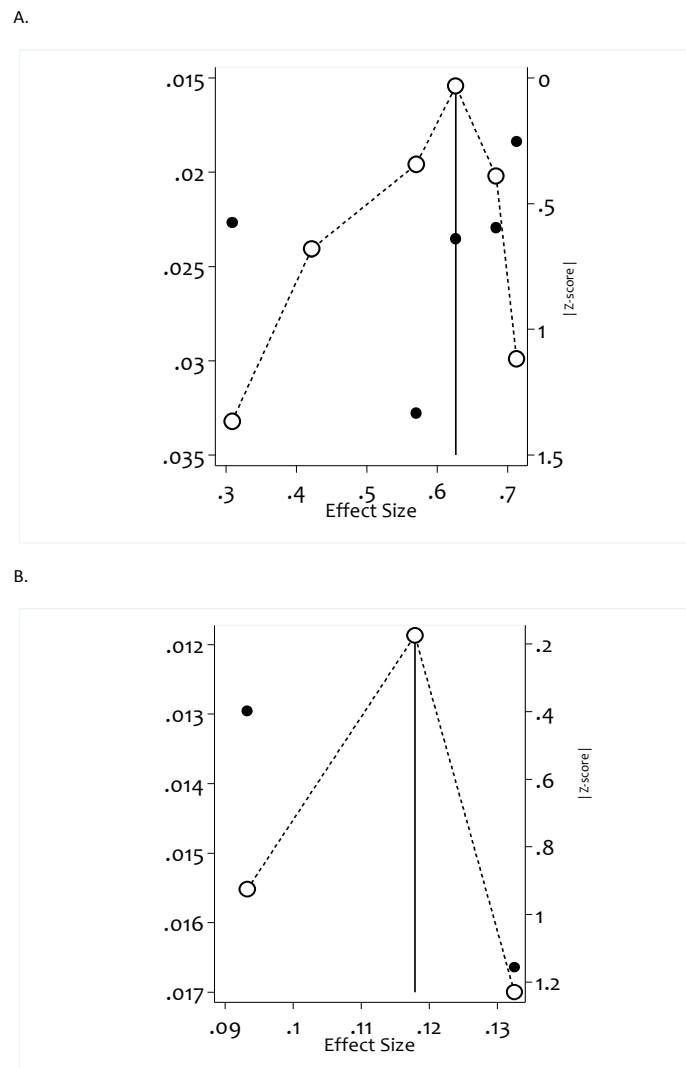
Figure 2 **Assessment of publication bias of included studies using Doi plot, LFK index and Egger's test for included studies.** (A) Doi plot and LFK index for poor sleep quality studies, LFK index $= -1.49$; Egger's test (p_value) $= .531$. (B) Doi plot and LFK index for suicidal ideation studies; LFK index $= -.05$; Egger's test (p_value) $= .674$.

Full-size 🖾 DOI: 10.7717/peerj.16038/fig-2

Fig. 3 there is substantial heterogeneity among study findings on prevalence of poor sleep quality among pregnant women during the COVID-19 pandemic.

Subgroup analysis of poor sleep quality by region

From the subgroup analysis of prevalence of poor sleep quality by region, the pooled prevalence of poor sleep quality in Oromiya, Amhara and South West Ethiopia was 44%, 58% and 71% respectively (Fig. 4). The prevalence was higher in the South West Ethiopia region compared to the others. There was statistically significant heterogeneity among regions ($Q = 6.39$, $df = 2$, $p = 0.032$).

		%
Authors (year)	Effect (95% CI)	Weight
Dule et al (2021)	0.57 (0.51, 0.63)	16.39
Jemere et al (2021)	0.68 (0.64, 0.73)	16.71
Bogale et al (2022)	0.71 (0.68, 0.75)	16.82
Anbesaw et al B (2021)	0.31 (0.26, 0.35)	16.72
Takelle et al (2022)	0.42 (0.37, 0.47)	16.67
Amare et al (2022)	0.63 (0.58, 0.67)	16.69
Overall, DL (I^2 = 98.1%, p = 0.000)	0.55 (0.42, 0.69)	100.00
with estimated 95% predictive interval	(0.05, 1.06)	
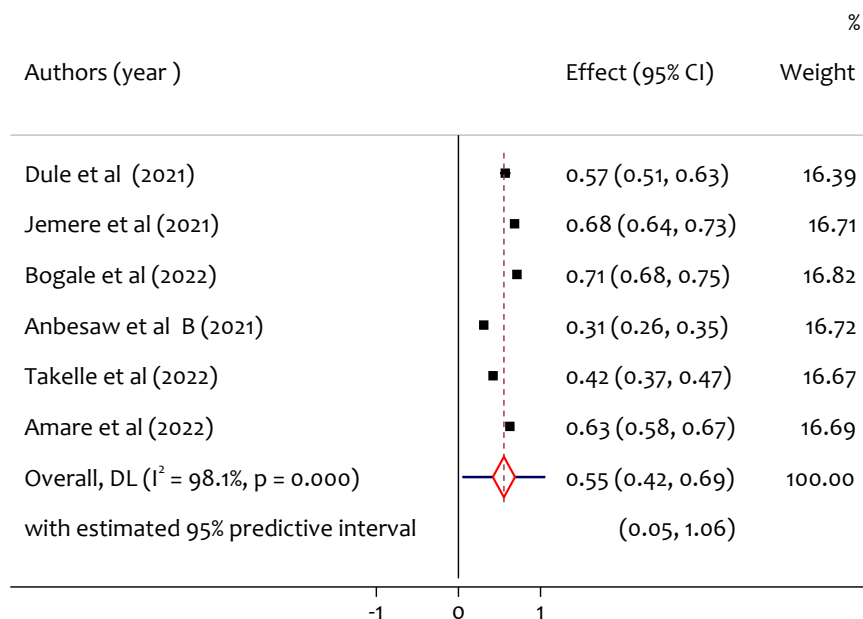
NOTE: Weights are from random-effects model

Figure 3 A forest plot for the prevalence of poor sleep quality among pregnant women during the COVID-19 pandemic.

Full-size 🖼 DOI: 10.7717/peerj.16038/fig-3

Subgroup analysis of poor sleep quality by year of publication

From the subgroup analysis by publication year (Fig. 5), the pooled prevalence of poor sleep quality in 2021 and 2022 was 52% and 59%, respectively. The prevalence of poor sleep quality among pregnant women was high in studies published in 2022. The heterogeneity test between group result ($Q = 0.2$, $df = 1$, $p = 0.657$) implies that there was no significant heterogeneity in years of publication on the prevalence of poor sleep quality.

Subgroup analysis of poor sleep quality by sampling method

From the subgroup analysis by sampling method (Fig. 6) the pooled prevalence of poor sleep quality in study using sampling methods census was 57%, systematic sampling was 63% and multistage sampling was 71%. The heterogeneity test between group ($Q = 20.60$, $df = 3$, $p = 0.000$) implies that there is statistically significant heterogeneity among sampling methods.

Pooled prevalence of suicidal ideation

From three studies, the pooled prevalence of suicidal ideation was 11% (95% CI [0.09–0.13], $I^2 = 48.2\%$, $p = 0.145$) as shown in Fig. 7. No significant heterogeneity was observed. We did not do subgroup analysis to assess the source of heterogeneity.

Associated factors and pooled effect size

As shown in Table 2, the pooled adjusted odds ratio of age >= 30 years pregnant women was 1.95, 95% CI (0.85, 3.06), suggesting that the odds of developing poor sleep quality

| | | % |
| Region and Authors (year) | Effect (95% CI) | Weight |

Oromiya		
Dule et al (2021)	0.57 (0.51, 0.63)	16.39
Anbesaw et al B (2021)	0.31 (0.26, 0.35)	16.72
Subgroup, DL (I^2 = 97.7%, p = 0.000)	0.44 (0.18, 0.69)	33.11
Amhara		
Jemere et al (2021)	0.68 (0.64, 0.73)	16.71
Takelle et al (2022)	0.42 (0.37, 0.47)	16.67
Amare et al (2022)	0.63 (0.58, 0.67)	16.69
Subgroup, DL (I^2 = 97.0%, p = 0.000)	0.58 (0.42, 0.73)	50.07
with estimated 95% predictive interval	(-1.40, 2.56)	
South West Ethiopia		
Bogale et al (2022)	0.71 (0.68, 0.75)	16.82
Subgroup, DL (I^2 = 0.0%, p = .)	0.71 (0.68, 0.75)	16.82
Heterogeneity between groups: p = 0.032		
Overall, DL (I^2 = 98.1%, p = 0.000)	0.55 (0.42, 0.69)	100.00
with estimated 95% predictive interval	(0.05, 1.06)	

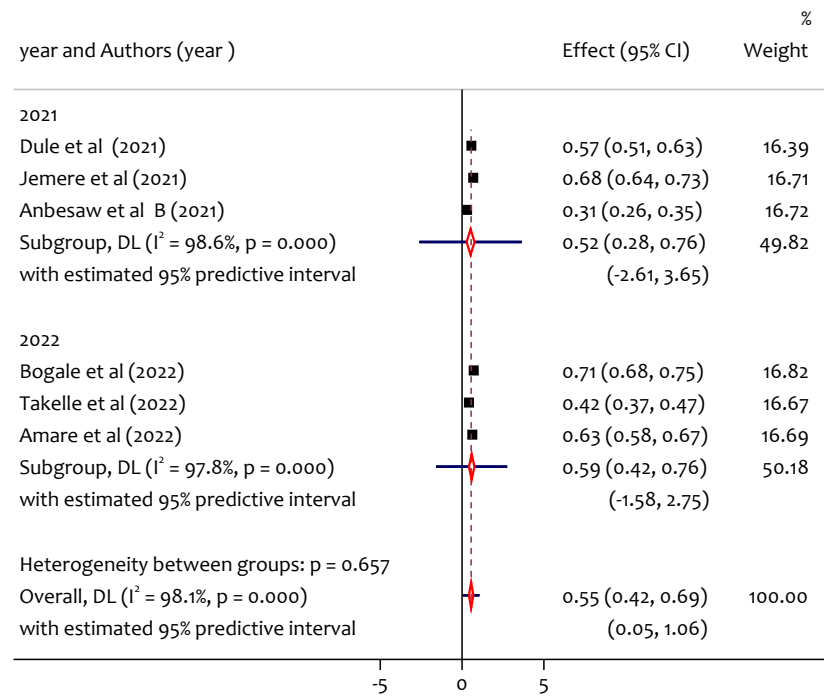NOTE: Weights and between-subgroup heterogeneity test are from random-effects model

Figure 4 Subgroup analysis of prevalence of poor sleep quality among pregnant women during the COVID-19 pandemic by region.

Full-size 🖼 DOI: 10.7717/peerj.16038/fig-4

among pregnant women was 1.95 times more with age >= 30 years pregnant women than women with age <30 years. The pooled adjusted odds ratio of 3rd trimester pregnant women was 3.20, 95% CI (1.82, 4.58), implying that the odds of developing poor sleep quality among pregnant women on 3rd trimester gestational age was 3.20 times more than women in the 2nd or 1st trimester.

The pooled adjusted odds ratio of substance use among pregnant women was 2.51, 95% CI (0.99, 4.04), suggesting that the odds of developing poor sleep quality among pregnant women with substance use was 2.51 times more than women without substance use. The pooled adjusted odds ratio of pregnant women with depression was 2.97, 95% CI (0.92, 5.02) suggests that the odds of developing poor sleep quality among pregnant women with depression was 2.97 times more than women with out depression. Likewise, the pooled adjusted odds ratio of pregnant women with stress was 2.14, 95% CI (0.24, 4.03) suggests that the odds of developing poor sleep quality among pregnant women with stress was 2.14 times more than women without stress.

We also reported pooled effect size of associated factors of suicidal ideation among pregnant women. The pooled adjusted odds ratio of pregnant women with depression was 3.19, 95% CI (1.68, 4.71) suggesting that the odds of developing suicidal ideation among pregnant women with depression was 3.19 times more than women that do not

year and Authors (year)	Effect (95% CI)	% Weight
2021		
Dule et al (2021)	0.57 (0.51, 0.63)	16.39
Jemere et al (2021)	0.68 (0.64, 0.73)	16.71
Anbesaw et al B (2021)	0.31 (0.26, 0.35)	16.72
Subgroup, DL (I^2 = 98.6%, p = 0.000)	0.52 (0.28, 0.76)	49.82
with estimated 95% predictive interval	(-2.61, 3.65)	
2022		
Bogale et al (2022)	0.71 (0.68, 0.75)	16.82
Takelle et al (2022)	0.42 (0.37, 0.47)	16.67
Amare et al (2022)	0.63 (0.58, 0.67)	16.69
Subgroup, DL (I^2 = 97.8%, p = 0.000)	0.59 (0.42, 0.76)	50.18
with estimated 95% predictive interval	(-1.58, 2.75)	
Heterogeneity between groups: p = 0.657		
Overall, DL (I^2 = 98.1%, p = 0.000)	0.55 (0.42, 0.69)	100.00
with estimated 95% predictive interval	(0.05, 1.06)	

NOTE: Weights and between-subgroup heterogeneity test are from random-effects model

Figure 5 **Subgroup analysis of prevalence of poor sleep quality among pregnant women during the COVID-19 pandemic by year of publication.**
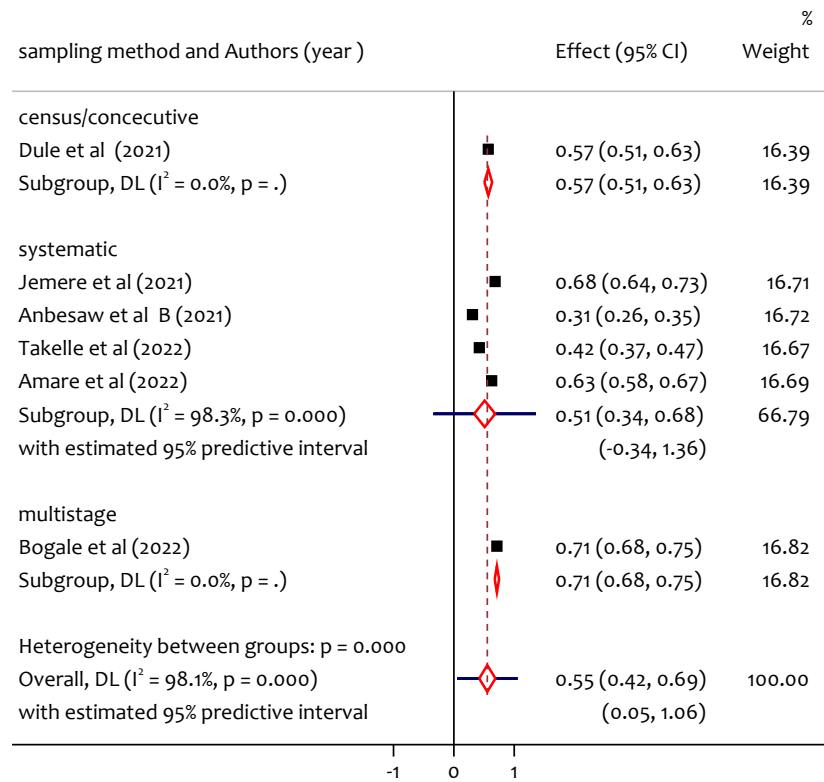
Full-size ☑ DOI: 10.7717/peerj.16038/fig-5

have depression. The pooled adjusted odds ratio of pregnant women with intimate partner violence was 3.83, 95% CI (−0.67, 8.34) suggesting that the odds of developing suicidal ideation among pregnant women with intimate partner violence was 3.83 times more than women without intimate partner violence. Due to the limited number of studies available, pooling the adjusted odds ratio for the associated factors of poor sleep quality and suicidal ideation is not possible. Hence, we summarized the collected findings in Table 3.

DISCUSSION

In this comprehensive study we have shown that due to the COVID-19 pandemic poor sleep quality and suicidal ideation increased among pregnant women in Ethiopia. This study is the first of its kind that assessed the pooled prevalence and associated factors of poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia. This study includes nine papers. We supposed that all of the included studies are conducted with in ethical guidelines. The pooled prevalence of poor sleep quality and suicidal ideation with their associated factors were discussed.
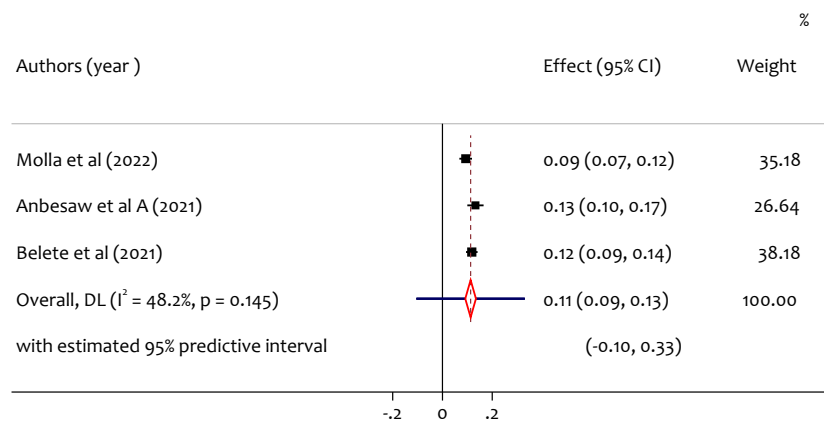
The pooled prevalence of poor sleep quality was found to be 55%. This is higher than the study in Changsha, China where the prevalence was 37.65% (*Cai et al., 2022*), the study in Wuhan, China where the prevalence was 37.6% (*Xu et al., 2021*), the study in Bangladesh where the prevalence was 38.88% (*Shaun et al., 2022*) and lower than worldwide meta analysis result where the prevalence was 49% (*Yan, Ding & Guo, 2020*). From the subgroup

sampling method and Authors (year)		Effect (95% CI)	% Weight
census/concecutive			
Dule et al (2021)		0.57 (0.51, 0.63)	16.39
Subgroup, DL (I^2 = 0.0%, p = .)		0.57 (0.51, 0.63)	16.39
systematic			
Jemere et al (2021)		0.68 (0.64, 0.73)	16.71
Anbesaw et al B (2021)		0.31 (0.26, 0.35)	16.72
Takelle et al (2022)		0.42 (0.37, 0.47)	16.67
Amare et al (2022)		0.63 (0.58, 0.67)	16.69
Subgroup, DL (I^2 = 98.3%, p = 0.000)		0.51 (0.34, 0.68)	66.79
with estimated 95% predictive interval		(-0.34, 1.36)	
multistage			
Bogale et al (2022)		0.71 (0.68, 0.75)	16.82
Subgroup, DL (I^2 = 0.0%, p = .)		0.71 (0.68, 0.75)	16.82
Heterogeneity between groups: p = 0.000			
Overall, DL (I^2 = 98.1%, p = 0.000)		0.55 (0.42, 0.69)	100.00
with estimated 95% predictive interval		(0.05, 1.06)	

-1   0   1

NOTE: Weights and between-subgroup heterogeneity test are from random-effects model

Figure 6 Subgroup analysis of prevalence of poor sleep quality among pregnant women during the COVID-19 pandemic by sampling method.

Full-size ☒ DOI: 10.7717/peerj.16038/fig-6

Authors (year)		Effect (95% CI)	% Weight
Molla et al (2022)		0.09 (0.07, 0.12)	35.18
Anbesaw et al A (2021)		0.13 (0.10, 0.17)	26.64
Belete et al (2021)		0.12 (0.09, 0.14)	38.18
Overall, DL (I^2 = 48.2%, p = 0.145)		0.11 (0.09, 0.13)	100.00
with estimated 95% predictive interval		(-0.10, 0.33)	

-.2   0   .2

NOTE: Weights are from random-effects model

Figure 7 A forest plot for the prevalence of suicidal ideation among pregnant women during the COVID-19 pandemic.

Full-size ☒ DOI: 10.7717/peerj.16038/fig-7

Table 2 Pooled AOR for associated factors of poor sleep quality and suicidal ideation among pregnant women during the COVID-19 pandemic in Ethiopia.

Mental illness	Numbers of studies	Variables	Reference category	Pooled AOR ((95% CI)	Heterogeneity	
					I²(%)	p-value
Poor sleep quality	4	Age ≥ 30	<30	1.95 (0.85, 3.06)	0.00	0.616
>>	3	Gestational age in 3rd trimester	2nd or 1st trimester	3.20 (1.82, 4.58)	0.00	0.405
>>	2	Substanse use	Not	2.51(0.99, 4.04)	0.00	0.455
>>	2	Depression	Not	2.97(0.92, 5.02)	60.50	0.110
>>	2	Stress	Not	2.14(0.24, 4.03)	12.8	0.284
Suicidal ideation	2	Depression	Not	3.19(1.68, 4.71)	0.00	0.619
>>	2	IPV	Not	3.83(−0.67, 8.34)	44.8	0.178

analysis among regions, we found significant heterogeneity and prevalence of poor sleep quality by region, the pooled prevalence in Oromiya, Amhara and South West Ethiopia was 44%, 58% and 71% respectively, the prevalence was higher in the South West Ethiopia region. This might be due to the lack of awareness and poor health system in the new emerging region which requires special attention to improve maternal mental health during the pandemic. From the subgroup analysis by publication year the pooled prevalence of poor sleep quality in 2021 and 2022 was 52% and 59% respectively. The heterogeneity test between groups implies that there was no significant heterogeneity on the prevalence of poor sleep quality in publication years. On the other hand, we also observed heterogeneity on findings based on sampling methods on the prevalence of poor sleep quality among pregnant women during COVID-19 in Ethiopia. From this the prevalence of poor sleep quality in the study using sampling methods census was 57%, systematic sampling was 63% and multistage sampling was 71%. The heterogeneity might be due to the difference in the nature of the sampling methods to select samples (representatives) for making inferences in a given study.

The pooled prevalence of suicidal ideation was 11%. The result is consistent with a systematic review result prevalence worldwide that was between 2.73% to 18% (*Carolina et al., 2022*). The result is higher than the Brazilian pregnant women prevalence of suicidal ideation which was 3.9%. This might be due to the differences in the quality of maternal health service between countries. The result is in line with study findings on the general population pooled prevalence of suicidal ideation during COVID-19 which was 12.1% (*Farooq et al., 2021*) and is lower than study in Australian adults prevalence of suicidal ideation which was 17.5% (*Wiley et al., 2021*).

Our study also demonstrated the associated risk factor for poor sleep quality and suicidal ideation among pregnant women during COVID-19 in Ethiopia. For pregnant women age >= 30, the odds of developing poor sleep quality are more than with age <30 years. Gestational age in the 3rd trimester increases the odds of developing poor sleep quality among pregnant women more so women in the 2nd or 1st trimester. This finding is supported by study results from *Jelly et al. (2021)* which outlined that gestational age

Table 3 A summary review of significant associated factors of poor sleep quality and suicidal ideation among pregnant women during COVID-19 pandemic in Ethiopia.

Authors (year)	Mental disorders	Associated factors	AOR (95% CI)
Jemere et al. (2021)	Poor sleep quality	Age of the mother age 20–30 years	4.3 (1.8, 9.9)
>>	>>	Gestational age second trimester	2.46 (1.2, 4.9)
>>	>>	Multiparous women	2.1(1.24, 3.6)
Bogale et al. (2022)	Poor sleep quality	Palpable /visible thyroid gland	2. 12 (1.08,3.82)
>>	>>	Having premenstrual syndrome	1.86 (1.38, 3.12)
Takelle, Muluneh & Biresaw (2022)	Poor sleep quality	Being first trimesters	2.31(1.16, 4.61)
>>	>>	Intimate Partner Violence	5.57(2.19, 14.68)
Amare, Chekol & Aemro (2022)	Poor sleep quality	Having co-morbidity	3.57(1.45, 8.78)
>>	>>	Being multigravida	2.72(1.34, 5.50)
Molla, Nigussie & Girma (2022)	Suicidal ideation	Being unmarried	5.69 (1.19, 27.23)
>>	>>	Gestation age greater than 27 weeks	4.92 (1.67, 14.53)
>>	>>	History of having chronic medical illness	4.47 (1.35, 14.85)
Anbesaw et al. (2021a)	Suicidal ideation	Marital status with lack of cohabiting partners	2.80 (1.23, 6.37)
>>	>>	History of abortion	2.45(1.03, 5.93)
>>	>>	Anxiety	2.99 (1.24, 7.20)
>>	>>	Poor sleep quality	2.85 (1.19, 6.79)
>>	>>	Stress	2.50 (1.01, 5.67)

Notes.

AOR, Adjusted Odds Ratio; CI, Confidence Interval.

has direct association with psychological impact scores. We also found that depression and stress increases the odds of developing poor sleep quality among pregnant women during COVID-19. Similarly, depression and stress increase the odds of developing suicidal ideation among pregnant women. Intimate partner violence also maximizes the odds of developing suicidal ideation among pregnant women during COVID-19 in Ethiopia. This is supported by study findings (*Carolina et al., 2022*).

However, this study has both strengths and weaknesses. Two researchers (AAH and AAS) independently conducted the searching, screening, data extraction, and methodological quality assessment. The quality of the included studies was evaluated using the Newcastle-Ottawa Scale. Lack of adequate number of studies on the psychological effects of COVID-19 across all regions of Ethiopia was the limitation of this study.

CONCLUSION

Due to the COVID-19 pandemic pregnant women in Ethiopia were affected by poor sleep quality and suicidal ideation. The prevalence of poor sleep quality and suicidal ideation among pregnant women were high. Providing pregnant women with appropriate and well-designed programs that promote awareness of COVID-19, mental health counseling, and involvement to improve their general mental health is crucial. This review has helped to highlight the need of interventions that can be taken during COVID-19. Further studies could be conducted on the mental health effects of COVID-19 among pregnant women in Ethiopia.

Abbreviations

AOR	Adjusted odds ratio
CI	Confidence Interval
MeSH	Medical Subject Headings
NOS	Newcastle Ottawa Quality Assessment Scale
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis
SI	Suicidal Ideation

ADDITIONAL INFORMATION AND DECLARATIONS

Author Contributions

- Aragaw Asfaw Hasen conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, authored or reviewed drafts of the article, and approved the final draft.
- Abubeker Alebachew Seid conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, authored or reviewed drafts of the article, and approved the final draft.
- Ahmed Adem Mohammed conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, authored or reviewed drafts of the article, and approved the final draft.

Data Availability

The following information was supplied regarding data availability:

The data for this research is available in the Supplemental File.

Supplemental Information

Supplemental information for this article can be found online at http://dx.doi.org/10.7717/peerj.16038#supplemental-information.

REFERENCES

Ajayi KV, Wachira E, Bolarinwa OA, Suleman BD. 2021. Maternal mental health in Africa during the COVID-19 pandemic: a neglected global health issue. *Epidemiolgy and Health* **43**:1–6 DOI 10.4178/epih.e2021078.

Alan S, Vurgec BA, Cevik A, Gozuyesil E, Surucu SG. 2020. The effects of COVID-19 pandemic on pregnant women: perceived stress, social support and sleep quality. *Yonago Acta Medica* **63(4)**:360–367 DOI 10.33160/yam.2020.11.016.

Almeida M. 2020. The impact of the COVID-19 pandemic on women's mental health. *Archives of Women's Mental Health* **23**:741–748 DOI 10.1007/s00737-020-01092-2.

Amare NS, Chekol B, Aemro A. 2022. Determinants of poor sleep quality during the COVID-19 pandemic among women attending antenatal care services at the health facilities of Debre Berhan Town, Ethiopia: an study. *Frontiers in Psychology* **13**(March):1–7 DOI 10.3389/fpsyt.2022.841097.

Anbesaw T, Abebe H, Kassaw C, Bete T, Molla A. 2021a. Sleep quality and associated factors among pregnant women attending antenatal care at Jimma Medical Center, Jimma, Southwest Ethiopia, 2020: cross-sectional study. *BMC Psychiatry* **21**:469 DOI 10.1186/s12888-021-03483-w.

Anbesaw T, Negash A, Mamaru A, Abebe H, Belete A, Getinet A. 2021b. Suicidal ideation and associated factors among pregnant women attending antenatal care in Jimma medical center, Ethiopia. *PLOS ONE* **16**(8):e0255746 DOI 10.1371/journal.pone.0255746.

Belete K, Kassew T, Demilew D, Zeleke TA. 2021. Prevalence and correlates of suicide ideation and attempt among pregnant women attending antenatal care services at public hospitals in prevalence and correlates of suicide ideation and attempt among pregnant women attending antenatal care services at pub. *Neuropsychiatric Disease and Treatment* **2021**:1517–1529 DOI 10.2147/NDT.S309702.

Bogale B, Wolde A, Mohammed N, Midaksa G. 2022. Poor sleep quality and factors among reproductive-age women in Southwest Ethiopia. *Frontiers in Psychiatry* **13**(July):1–8 DOI 10.3389/fpsyt.2022.913821.

Bowden J, Tierney JF, Copas AJ, Burdett S. 2011. Quantifying, displaying and accounting for heterogeneity in the meta-analysis of RCTs using standard and generalised Q statistics. *BMC Medical Research Methodology* **11**:41 DOI 10.1186/1471-2288-11-41.

Cai YM, Zheng XL, Shen ZM, Zhou BF, Liu YM, Yang JY, Xie N. 2022. Study on the sleep quality of women pregnant with a second child and the influencing factors. *European Journal of Medical Research* **27**(1):1–6 DOI 10.1186/s40001-022-00848-z.

Campos-garz C, Riquelme-gallego B, De Torre-luque A. 2021. Behavioral sciences psychological impact of the COVID-19 pandemic on pregnant women: a scoping review. *Behavioral Sciences* **11**(12):181 DOI 10.3390/bs11120181.

Carolina P, Legazpi C, Muñoz MFR, Eugenia M, Crespo O. 2022. Review of suicidal ideation during pregnancy: risk factors, prevalence, assessment instruments and consequences. *Psicologia: Reflexão e Crítica* **35**:13 DOI 10.1186/s41155-022-00220-4.

Dule A, Abdu Z, Hajure M, Mohammedhussein M. 2021. Sleep quality among pregnant women Amidst COVID-19: Association with mental wellbeing and self-efficacy. *American Journal of Health Research* **9**(6):238–245 DOI 10.11648/j.ajhr.20210906.14.

Farooq S, Tunmore J, Ali W, Ayub M. 2021. Suicide, self-harm and suicidal ideation during COVID-19: a systematic review. *Psychiatry Research* **306**:114228 DOI 10.1016/j.psychres.2021.114228.

Furuya-Kanamori L, Barendregt JJ, Doi SAR. 2018. A new improved graphical and quantitative method for detecting bias in meta-analysis. *International Journal of Evidence-Based Healthcare* **16**(4):195–203 DOI 10.1097/XEB.0000000000000141.

Furuya-Kanamori L, Doi SAR. 2021. LFK: stata module to compute LFK index and Doi plot for detection of publication bias in meta-analysis. *Available at https://econpapers. repec.org/RePEc:boc:bocode:s458762*.

Jacobs DG, Baldessarini RJ, Horton L, Pfeffer CR. 2010. Practice guideline for the assessment and treatment of patients with suicidal behaviors APA practice guidelines for the treatment of psychiatric disorders: comprehensive guidelines DOI 10.1176/appi.books.9780890423363.56008.

Jelly P, Chadha L, Kaur N, Sharma S, Sharma R, Stephen S, Rohilla J. 2021. Impact of COVID-19 pandemic on the psychological status of pregnant women. *Cureus* **13(1)**:1–10 DOI 10.7759/cureus.12875.

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)**:1–9 DOI 10.1371/journal.pone.0250985.

Keskin DD, Keskin S, Bostan S. 2022. Mental disorders among pregnant women during the COVID-19 pandemic. A cross-sectional study. *Sao Paulo Medical Journal* **140(1)**:87–93 DOI 10.1590/1516-3180.2021.0356.27052021.

Kessler RC, Üstün TB. 1981. The world mental health (WMH) survey initiative version of the world health organization (WHO) composite international diagnostic inter-view (CIDI). *International Journal of Methods in Psychiatric Research* **13(2)**:93–121 DOI 10.1002/mpr.168.

Khoury JE, Atkinson L, Bennett T, Jack SM, Gonzalez A, Khoury JE. 2021. Coping strategies mediate the associations between COVID-19 experiences and mental health outcomes in pregnancy. *Archives of Women's Mental Health* **24(6)**:1007–1017 DOI 10.1007/s00737-021-01135-2.

Kwon Y, Lemieux M, McTavish J, Wathen N. 2015. Identifying and removing duplicate records from systematic review searches. *Journal of the Medical Library Association* **103(4)**:184–188 DOI 10.3163/1536-5050.103.4.004.

Mamun F, Hosen I, Hasan M, Rahman A, Abdullah AH, Sarker A, Kabir H, Jyoti AS, Kaggwa MM. 2021. Suicidality in Bangladeshi young adults during the COVID-19 pandemic: the role of behavioral factors, COVID-19 risk and fear, and mental health problems. *Risk Management and Healthcare Policy* **29(14)**:4051–4061 DOI 10.2147/RMHP.S330282.

Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Lesley A Stewart; PRISMA-P Group. 2015. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* **4**:1 DOI 10.1186/2046-4053-4-1.

Molla A, Nigussie J, Girma B. 2022. Prevalence and associated factors of suicidal behav-ior among pregnant mothers in southern Ethiopia: a cross-sectional study. *BMC Public Health* **22**:490 DOI 10.1186/s12889-022-12957-9.

Peterson J, Welch V, Losos MTP. 2011. *The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses.* Ottawa, ON, Canada: Ottawa Hospital Research Institute. *Available at https://www.ohri.ca/programs/clinical_ epidemiology/oxford.asp* (accessed on May 14, 2023).

Hasen et al. (2023), *PeerJ*, DOI 10.7717/peerj.16038

17/19

Senkyire EK, Ewetan O, Azuh D, Asiedua E, White R, Dunlea M, Barger M, Ohaja M. 2023. An integrative literature review on the impact of COVID-19 on maternal and child health in Africa. *BMC Pregnancy and Childbirth* **23**:6 DOI 10.1186/s12884-022-05339-x.

Shaun MMA, Nizum MWR, Shuvo MA, Fayeza F, Faruk MO, Alam MF, Ahmed MS, Zaman S, Mali SK, Hawlader MDH. 2022. Association between depressive symptoms and poor sleep quality among pregnant women in Northern Rural Bangladesh: a community-based cross-sectional study. *BMC Psychiatry* **22(1)**:1–10 DOI 10.1186/s12888-022-03839-w.

Smyka M, Kosińska-Kaczyńska K, Sochacki-Wójcicka N, Zgliczyńska M, Wielgoś M. 2021. Sleep quality according to the Pittsburgh sleep quality index in over 7000 pregnant women in Poland. *Sleep and Biological Rhythms* **19(4)**:353–360 DOI 10.1007/s41105-021-00324-x.

Ssentongo P, Ssentongo AE, Heilbrunn ES, Ba DM, Chinchilli VM. 2020. Association of cardiovascular disease and 10 other pre-existing comorbidities with COVID-19 mortality: a systematic review and meta-analysis. *PLOS ONE* **15(8)**:e0238215 DOI 10.1371/journal.pone.0238215.

Takelle GM, Muluneh NY, Biresaw MS. 2022. Sleep quality and associated factors among pregnant women attending antenatal care unit at Gondar, Ethiopia: a cross-sectional study. *BMJ Open* **12**:e056564 DOI 10.1136/bmjopen-2021-056564.

Wiley JF, Facer-childs ER, Robbins R, Mark E, Weaver MD, Barger LK, Czeisler CA, Howard ME, Rajaratnam SMW. 2021. Mental health, substance use, and suicidal ideation during a prolonged COVID-19-related lockdown in a region with low SARS-CoV-2 prevalence. *Journal of Psychiatric Research* **140(June)**:533–544 DOI 10.1016/j.jpsychires.2021.05.080.

Wu F, Lin W, Liu P, Zhang M, Huang S, Chen C, Li Q, Huang W, Zhong C, Wang Y, Chen Q. 2021. Prevalence and contributory factors of anxiety and depression among pregnant women in the post-pandemic era of COVID-19 in Shenzhen, China. *Journal of Affective Disorders* **291(May)**:243–251 DOI 10.1016/j.jad.2021.05.014.

Xu K, Zhang Y, Zhang Y, Xu Q, Lv L, Zhang J. 2021. Mental health among pregnant women under public health interventions during COVID-19 outbreak in Wuhan, China. *Psychiatry Research* **301**:113977 DOI 10.1016/j.psychres.2021.113977.

Yan H, Ding Y, Guo W. 2020. Mental health of pregnant and postpartum women during the coronavirus disease 2019 pandemic: a systematic review and meta-analysis. *Frontiers in Psychology* **11(November)**:1–12 DOI 10.3389/fpsyg.2020.617001.

Zeng L-N, Chen L-G, Yang C-M, Zhang L-Y. 2020. Mental health care for pregnant women in the COVID-19 outbreak is urgently needed. *Women and Birth Journal* **January**:2020–2022.

Zhang L, Yang Y, Li M, Zhou X, Zhang K, Yin X, Liu H. 2022. The prevalence of suicide ideation and predictive factors among pregnant women in the third trimester. *BMC Pregnancy and Childbirth* **22**:266 DOI 10.1186/s12884-022-04590-6.

Zhu F, Zhang M, Gao M, Zeng C, Wang D, Hong Q, Chen W. 2020. Effects of respiratory rehabilitation on patients with novel coronavirus (COVID-19) pneumonia in the

rehabilitation phase: protocol for a systematic review and meta-analysis. *BMJ Open* **10**:e039771 DOI 10.1136/bmjopen-2020-039771.