Burden of irregular menstrual cycle and its predictors among reproductive-age women in Ethiopia: Systematic review and meta-analysis

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Abstract

Introduction: Irregular menstrual cycle has negative health and psychosocial repercussions for women of reproductive age worldwide. However, there is no national data for policymakers and health planners in Ethiopia. Therefore, this review aimed to determine the overall burden of irregular menstrual cycle and predictors among reproductive-age women in Ethiopia.
Methods: International databases (SCOPUS, CINAHL, CAB Abstract, EMBASE, PubMed, Web of Science, Google, and Google Scholar) and lists of references were employed to search literature in Ethiopia. The random-effects model was used to calculate the odds ratios of the outcome variable using STATA version 18. The heterogeneity of the studies was measured by computing I^2 and p-values. In addition, sensitivity analysis and funnel plots were performed to test the stability of pooled data in the presence of outliers and publication bias.
Results: The review includes 21 studies and 9109 populations. The overall burden of irregular menstrual cycles among reproductive-age women was 35% (95% CI: 30–41) with $I^2 = 96.96\%$. Sleeping for <5 h a day (AOR: 2.49; 95% CI: 1.49–3.49) and a stressful life (AOR: 3.15; 95% CI: 1.44–4.85) were predictors of irregular menstrual cycles.
Conclusion: More than one in every three reproductive-age women in Ethiopia experience irregular menstrual cycles. Sleeping for <5 h a day and stress increase the likelihood of an irregular menstrual cycle, which can be modified by improving sleeping hours and decreasing stress stimulators through psychotherapy.

Keywords

Irregular menstrual cycle, menstrual disorders, reproductive-age women, systematic review, meta-analysis, Ethiopia

Introduction

The menstrual cycle is monthly uterine bleeding in response to hormonal changes from menarche to menopause and has menstrual, proliferative, and secretory phases.[1] It is a physiological process caused by the withdrawal of estrogen and progesterone, which depletes the uterine lining, which is highly vascular and nutrient-rich.[2]

However, many women experience menstrual disorders such as irregular menses, dysmenorrhea, premenstrual syndrome, menstrual dysphoria, and abnormal uterine bleeding at some point during their reproductive lives.[3] Irregular menstruation occurs when menstruation occurs before 21 days or

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after 35 days, lasts more than 7 days, and results in more than 80 ml of blood loss.[4]

Irregular menstruation occurs due to disturbance of the hypothalamic-pituitary-ovarian axis.[5] It is common in adolescent girls and has a substantial impact on quality of life, amount of sleep, sleep quality, study time, concentration, group activities, and academic achievement.[6–9] It is a source of anxiety for them and their families.[10,11] Furthermore, studies have shown that monthly irregularity has long-term health consequences, including osteoporosis, infertility, diabetes mellitus, and cardiovascular disease.[12,13]

According to studies, the prevalence of irregular menstruation varies from 24% to 59% in different regions of Ethiopia.[10,14] Furthermore, anemia, stress, hereditary variables, age at menarche, weight loss, obesity, and dietary habits have been identified as key contributors to menstrual irregularity.[15,16]

However, the prevalence across different regions does not accurately reflect the national burden. In addition, contradictory factors of irregular menses were reported across the existing evidence. Hence, the burden of irregular menstruation and its predictors could not accurately represent national statistics. Therefore, this review would help policymakers and health managers to make evidence-based decisions and adopt suitable measures to promote the quality of life of women. Thus, we sought to ascertain the overall burden of irregular menstrual cycle and predictors among reproductive-age women in Ethiopia.

Materials and methods

Study protocol and registration

This systematic review and meta-analysis were conducted to determine the overall burden of the menstrual cycle and its predictors among reproductive-age females in Ethiopia. Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA 2020) guidelines were used to report the findings.[17] Furthermore, the Meta-analysis of Observational Studies in Epidemiology guidelines was utilized to conduct and report the meta-analysis.[18] The review was registered on the PROSPERO (CRD42024518353).

Eligibility criteria

Studies that had been conducted in Ethiopia and assessed the burden of the menstrual cycle and its predictors among reproductive-age females in Ethiopia were included. Observational studies (cross-sectional and cohort) that assessed the burden of the menstrual cycle and its predictors among reproductive-age females in Ethiopia were incorporated, but there was no case-control study found. Similarly, all articles conducted in Ethiopia and published until 01 July 2023, with full text written in English were included in the study. However, we excluded the studies that did not report our primary outcome of interest, not English language, studies that failed to fulfill the quality criteria, experimental studies, reviews, commentaries, editorials, and articles from outside Ethiopia were excluded.

Search strategy

Electronic databases (SCOPUS, CINAHL, EMBASE, PubMed, and Web of Science) were utilized to search the literature. In addition, Google, Google Scholar, and a university repository were carefully searched to discover literature that met our study objectives. Moreover, experts in the field were consulted to retrieve unpublished studies, and the bibliographies of chosen papers were searched for additional relevant studies.

Boolean logic operators (AND, OR, NOT) with MeSH terms, keywords, and word variants were used in the search strategy. Based on the specific requirements of the databases, search strings were modified. For instance, PubMed search: ((("irregular menses"[All Fields] OR "irregular menstrual"[All Fields] OR "irregular menstrual bleedings"[All Fields]) AND ("women"[All Fields])) OR ("females"[All Fields])) AND ("Ethiopia"[All Fields]). The other search strategies were outlined (Supplemental material File 1).

Study selection

All the articles obtained from the selected databases and other sources were exported to the EndNote X6 version library, and exact duplicates were removed. The EndNote library was then shared among five reviewers (IM, BB, FM, UJ, and DA) and the articles were screened separately using their title and abstract. Any differences between the first five reviewers were resolved through discussion with other reviewers (AD, AC, EM, AS, and LDR), and the full text was reviewed after a consensus was obtained. The overall study selection process was presented using the PRISMA statement flow diagram (Figure 1).

Data extraction

The data was extracted individually from the complete text of the included articles by the three reviewers (IM, BB, and UJ). Data from chosen studies were extracted using a predefined Microsoft Excel 2010 template under the following headings: author, publication year, setting, region, study design, NOS score, and primary outcomes of interest (Table 1). The accuracy of the data extraction was confirmed by comparing the outcomes of the independently extracted data.
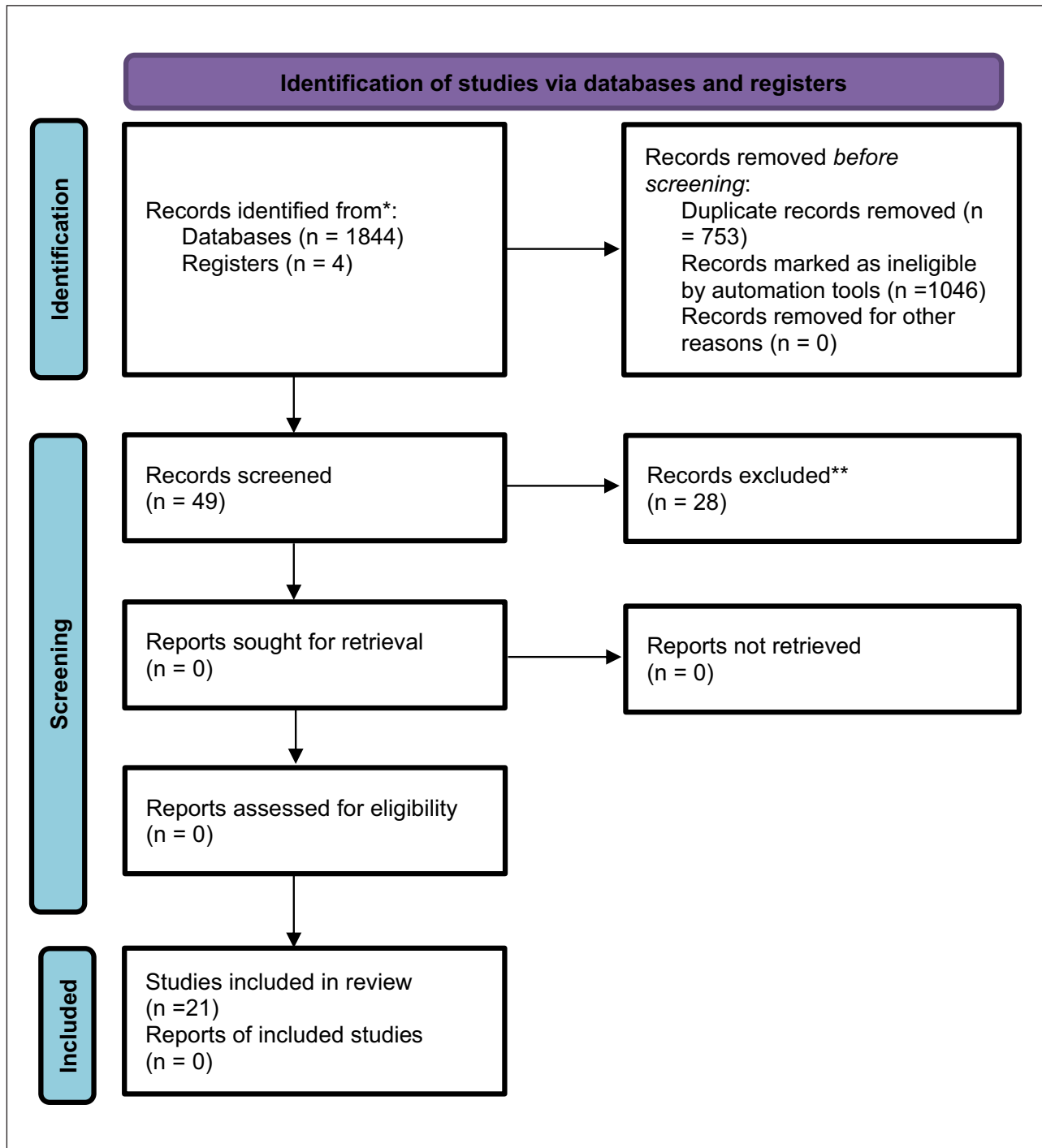
Figure 1. PRISMA presentation for irregular menstrual and its predictors among reproductive-age women in Ethiopia, 2023.
n: number of studies included at each level.

Quality and risk of bias assessment

The quality of the retained articles was assessed independently by the four reviewers (IM, BB, UJ, and LDR) using the Newcastle-Ottawa Scale (NOS) I^2 because all of the publications that met the inclusion criteria were observational studies (Supplemental material File 2). The mean score of the author's assessment was used to make a final conclusion, and any disagreements were resolved through consensus. The included studies were evaluated against each tool's indicator and classified as high quality

Table 1. General characteristics of studies included in the systematic reviews and meta-analysis in Ethiopia, 2023.

Authors (year)	Region	Sampling methods	Setting design	Sample size	Prevalence (%)	NOS result
Zeru et al. (2021)[15]	Amhara	Stratified sampling	IBCS	620	32.60	8
Demeke et al. (2023)[6]	Amhara	Simple random	IBCS	404	50.0	6
Metku et al. (2018)[19]	Oromia	Stratified sampling	IBCS	246	32.90	8
Negeso et al. (2021)[20]	Oromia	Stratified sampling	IBCS	344	26.50	8
Boshe et al. (2018)[21]	SNNPR	Systematic sampling	IBCS	613	18.30	7
Mammo et al. (2022)[22]	SNNPR	Simple random	IBCS	703	57.90	8
Tadese et al. (2021)[23]	SNNPR	Simple random	IBCS	615	33.30	8
Shiferaw et al. (2014)[24]	Amhara	Simple random	IBCS	470	46.20	8
Mittiku et al. (2022)[16]	Amhara	Systematic sampling	IBCS	395	33.40	8
Zegeye et al. (2009)[25]	Amhara	Systematic sampling	IBCS	565	42.83	7
Mesele et al. (2022)[26]	Oromia	Simple random	IBCS	540	49.23	8
Yesuf et al. (2018)[27]	Tigray	Stratified sampling	IBCS	242	32.60	8
Eshetu et al. (2022)[28]	SNNPR	Systematic sampling	IBCS	591	33.30	8
Muluneh et al. (2018)[29]	Amhara	Simple random	IBCS	511	25.00	8
Azagew et al. (2020)[30]	Amhara	Simple random	IBCS	442	26.50	6
Abeje and Berhanu (2019)[14]	Amhara	Simple random	IBCS	492	24.60	8
Minichil et al. (2020)[10]	Amhara	Simple random	IBCS	275	58.91	8
Giletew and Bekele (2019)[31]	Amhara	Simple random	IBCS	183	24.60	8
Yirsaw and Wale (2021)[32]	Oromia	Simple random	IBCS	713	45.02	8
Kebede et al. (2021)[33]	A/Ababa	Two-stage sampling	IBCS	400	49.30	7
Derseh et al. (2017)[34]	Amhara	Systematic sampling	IBCS	295	14.58	8

(>80%), moderate quality (60–80%), or low quality (<60%). Articles of high to moderate quality were included in the review. This critical appraisal was conducted to evaluate the internal validity (systematic error) and external validity (generalizability) and to reduce the risk of biases.

Outcome measures and statistical analysis

The primary outcome variable of this review was self-reported irregular menstrual cycle reproductive age among females. The overall burden of irregular menstrual cycle was computed from the reports of the included articles. To assess the study-specific true effects across the included studies, the random effect meta-analysis approach was used with STATA 18 software and Microsoft Excel spreadsheet software version 19. The pooled prevalence of irregular menstrual cycle and predictors was presented using a random-effects model for the reported proportion. Forest plots were used to show the overall burden of an irregular menstrual cycle among reproductive-age females. Also, subgroup analyses were conducted using the regions and publication years of the studies. Furthermore, sensitivity analyses were performed to examine the stability of pooled values in the presence of outliers.

The authors used a funnel plot and Egger's regression test to check for potential publication bias. In addition, the presence of heterogeneity was determined using a p-value of 0.05 for I^2 statistics. The review's findings were reported in accordance with PRISMA 2020 principles and presented in the form of a narrative synthesis.[35]

Results

Description of the studies

A total of 1848 articles were found by all searching methods. Exact duplicates (753 papers) were removed once all papers were exported to the Endnote library. In addition, after reviewing the titles and abstracts, 1046 unrelated papers were excluded. Then, 49 papers were retrieved for detailed examination. After a full-text review of those papers, 28 papers were excluded due to different populations and outcomes of interest not being reported. Finally, the full texts of the remaining 21 papers were selected for the methodological quality assessment using JBI critical appraisal tools. All appraised papers met the inclusion criteria and were included in the final review (Figure 1).

Characteristics of included studies

Twenty-one cross-sectional studies with a total of 9109 reproductive-age women were included to determine the overall burden of irregular menstrual cycle among reproductive-age women in Ethiopia. The prevalence of primary studies included in the reviews ranged from 14.58% to 58.91%.[10,34] Among the included studies, eleven were from Amhara, four were from Oromia and SNNPR, and others region (Addis Ababa and Tigray) (Table 1).

Overall burden of irregular menstrual cycle

The overall burden of irregular menstrual cycles among reproductive-age women was 35% (95% CI: 30–41) with $I^2 = 96.96\%$ and a p-value ≤0.001 (Figure 2).
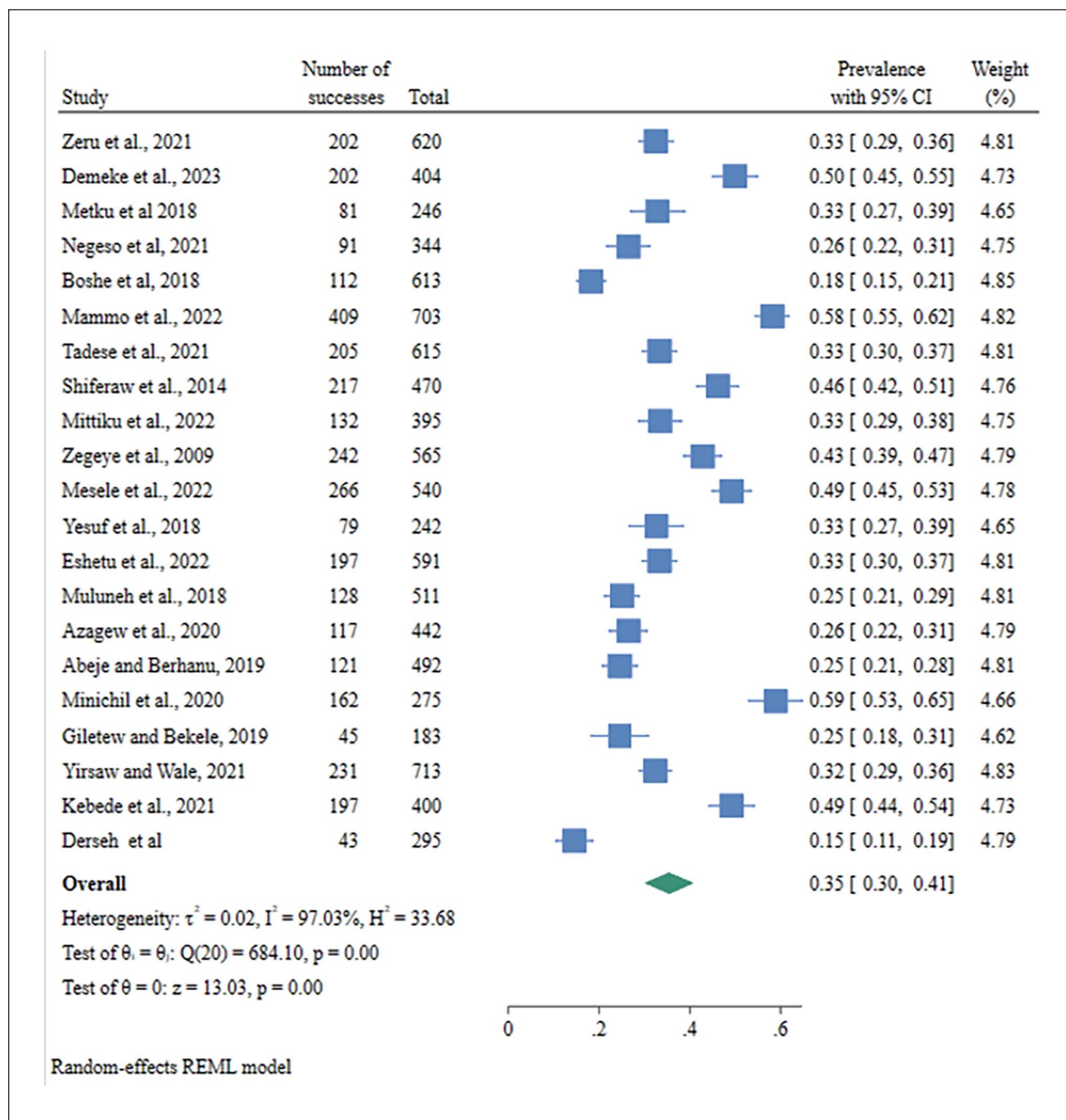
Figure 2. Forest plot for burden of irregular menstrual cycle among reproductive-age women in Ethiopia, 2023.

Publication bias

A visual inspection of the funnel plot revealed a serious publication bias (Figure 3). In addition, Egger regression test was conducted, and revealed that publication bias is not due to small study effect (*p*-value = 0.3151) (Figure 3).

Multivariate meta-regression

Both univariate and multivariate meta-regressions were conducted to identify the source of heterogeneity, as there was significant heterogeneity among studies. Accordingly, we found no significant variable that could explain the
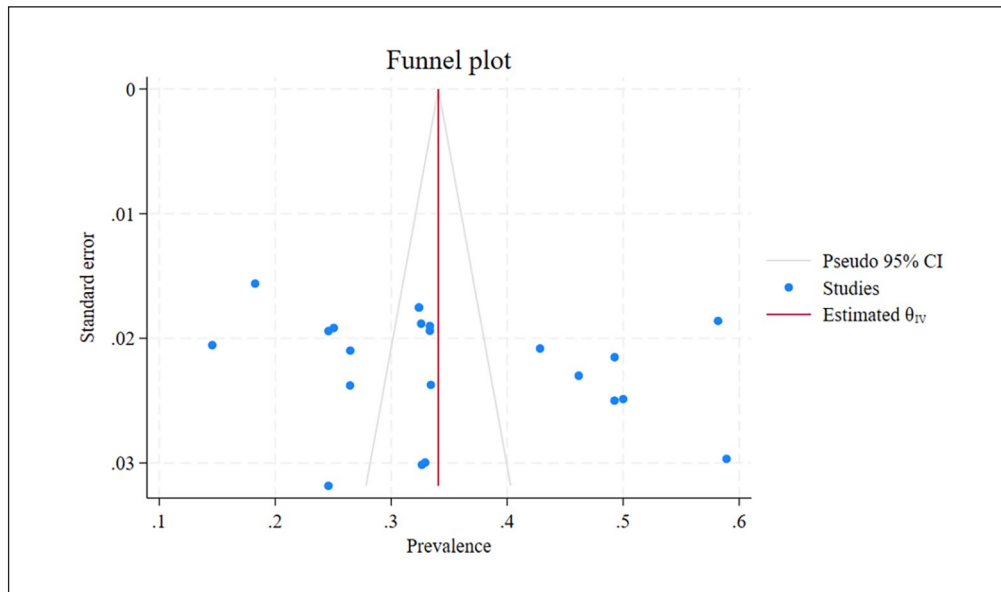
Figure 3. Funnel plot for burden of irregular menstrual cycle among reproductive-age women in Ethiopia, 2023.

Table 2. Meta-regression analysis to check heterogeneity of burden of irregular menstrual cycle among women by region in Ethiopia, 2023.

Variables	Coefficients	SE	p	[95% CI]
Publication year	0.0046128	0.0088411	0.52	[−0.0127154–0.021941]
Sample size	0.0000682	0.0001721	0.40	[−0.0002691–0.0004054]

heterogeneity. There was no statistically significant study level covariate: sample size or publication year of included studies. Therefore, the heterogeneity can be explained by other factors not included in this review (Table 2).

Subgroup analysis

Subgroup analysis was computed with evidence of heterogeneity. Hence, the Cochrane I^2 statistic (96.96%, $p = 0.001$) showed the presence of marked heterogeneity in this study. Therefore, subgroup analysis was implemented using the study area (region) and year of publications using random model-effect analysis. Regarding the study area (region), the burden of irregular menstrual cycle among reproductive-age women was highest in Addis Ababa, accounting for 49% (95% CI: 44–54), whereas the burden of irregular menstrual cycle among reproductive-age women in Ethiopia was highest among studies published between 2022 and 2023, accounting for 42% (95% CI: 32–52) (Figures 4 and 5).

Predictors of irregular menstrual cycle

In this review, predictors of irregular menstrual cycle among reproductive-age women were identified. The burden of

irregular menstrual cycle was increased by two times than reproductive-age women who sleep more than 5 h than those who sleeping less than 5 h (AOR: 2.49; 95% CI: 1.49–3.49). In addition, women with stress were three times more likely to have irregular menstrual cycle than their counterparts (AOR: 3.15; 95%CI: 1.44–4.85) (Figure 6).

Sensitivity analysis

A random-effects meta-analysis was conducted to assess the impacts of each study on the overall burden of the primary outcome using the DerSimonian-Liard model (Figure 7). Accordingly, there was no significant difference when the outliers or inliers were removed.

Discussion

This systematic review and meta-analysis attempted to determine the overall burden of irregular menstrual cycles among reproductive-age women in Ethiopia. Accordingly, the overall burden of irregular menstrual cycles was 35% (95% CI: 30–40). This was higher than a study finding conducted in South Korea (14.2%).[4] The observed differences might be related to high prevalence of ovarian and adrenal tumors, eating disorders, exercise-induced amenorrhea,
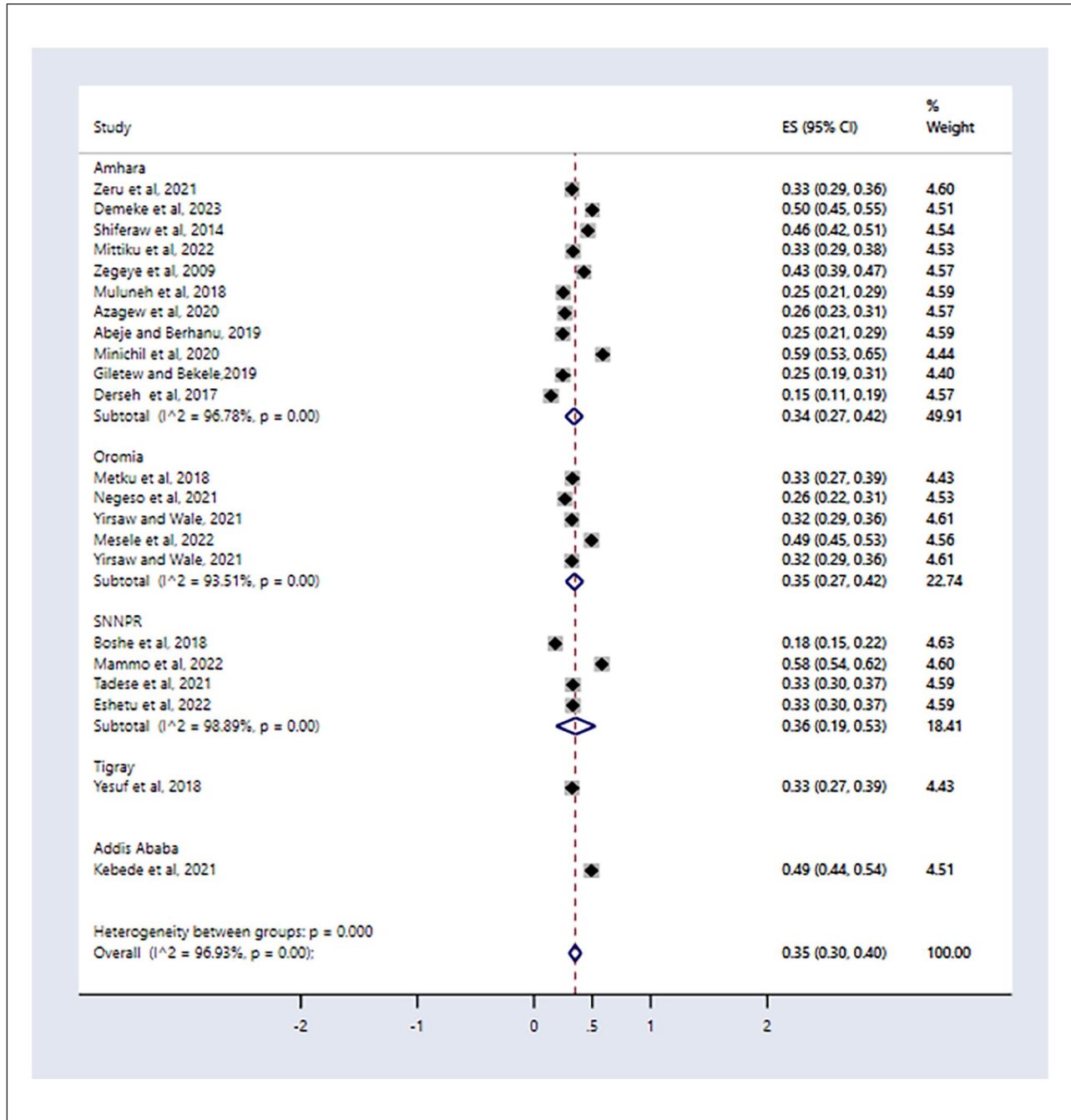
Figure 4. Forest plot for irregular menstrual cycle among women by region in Ethiopia, 2023.

polycystic ovary sydrome (PCOS), premature ovarian failure, and thyroid dysfunction in Ethiopia. Moreover, the discrepancy might be due to differences in socio-demographic and behavioral factors such as smoking status, stress status, and age at menarche. The complex interplay of health and socioeconomic variables necessitates the creation of individualized reproductive health education programs based on demographic and health-related characteristics.[4]

Sleeping for less than 5 h a day significantly affects the pattern of the menstrual cycle. According to Kennedy et al.,[36] sleeping for short hours has a significant effect on irregular menstrual cycles. In addition, Kang et al.,[37] and Kim et al.,[38] discovered that experiencing insomnia raised the probability of irregular menstrual cycle by more than 2 and 3 times in women compared to those who did not have the symptoms. Circadian rhythms may be influenced by sleep disruptions, which in turn may have an impact on irregular menstrual
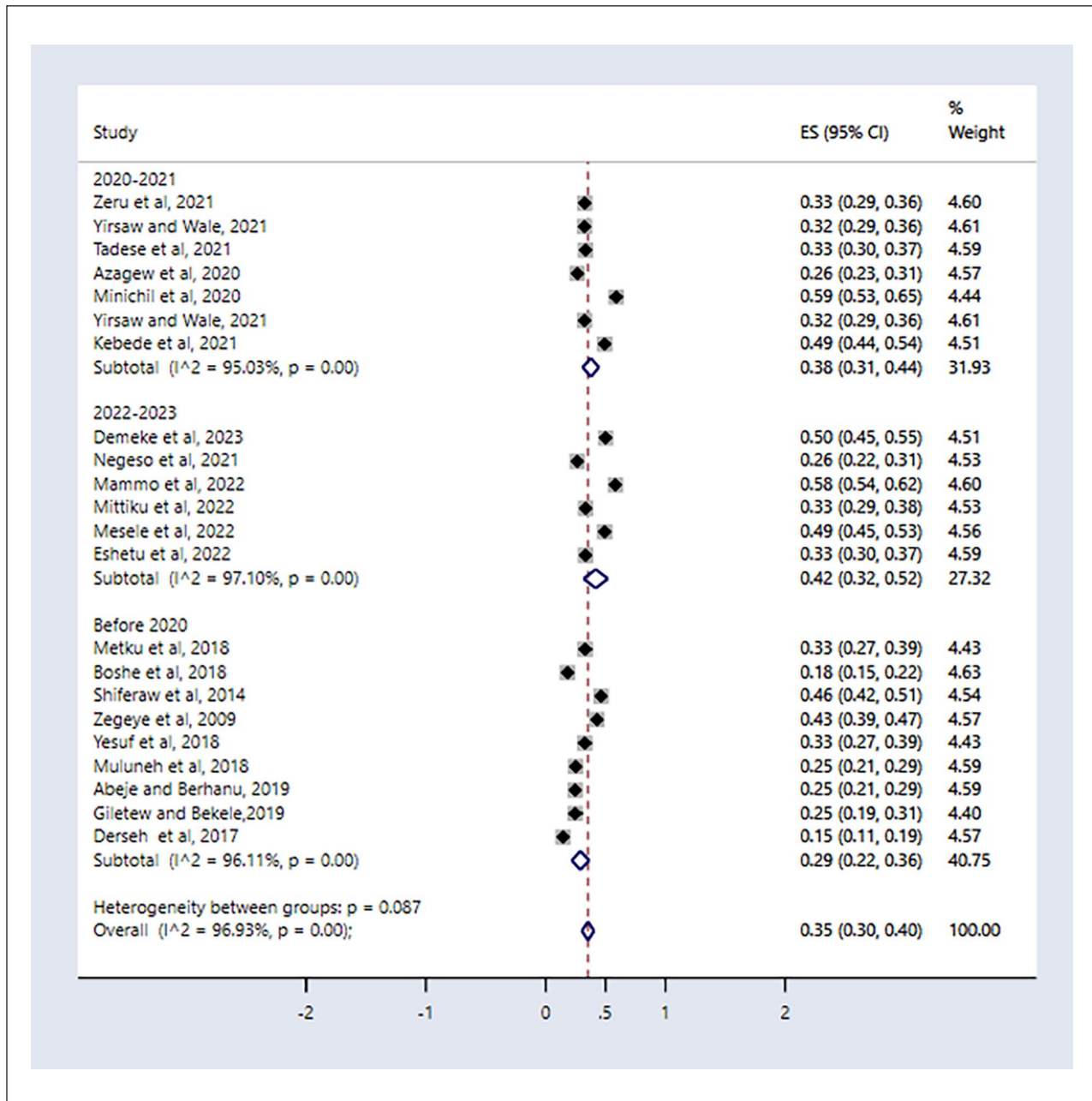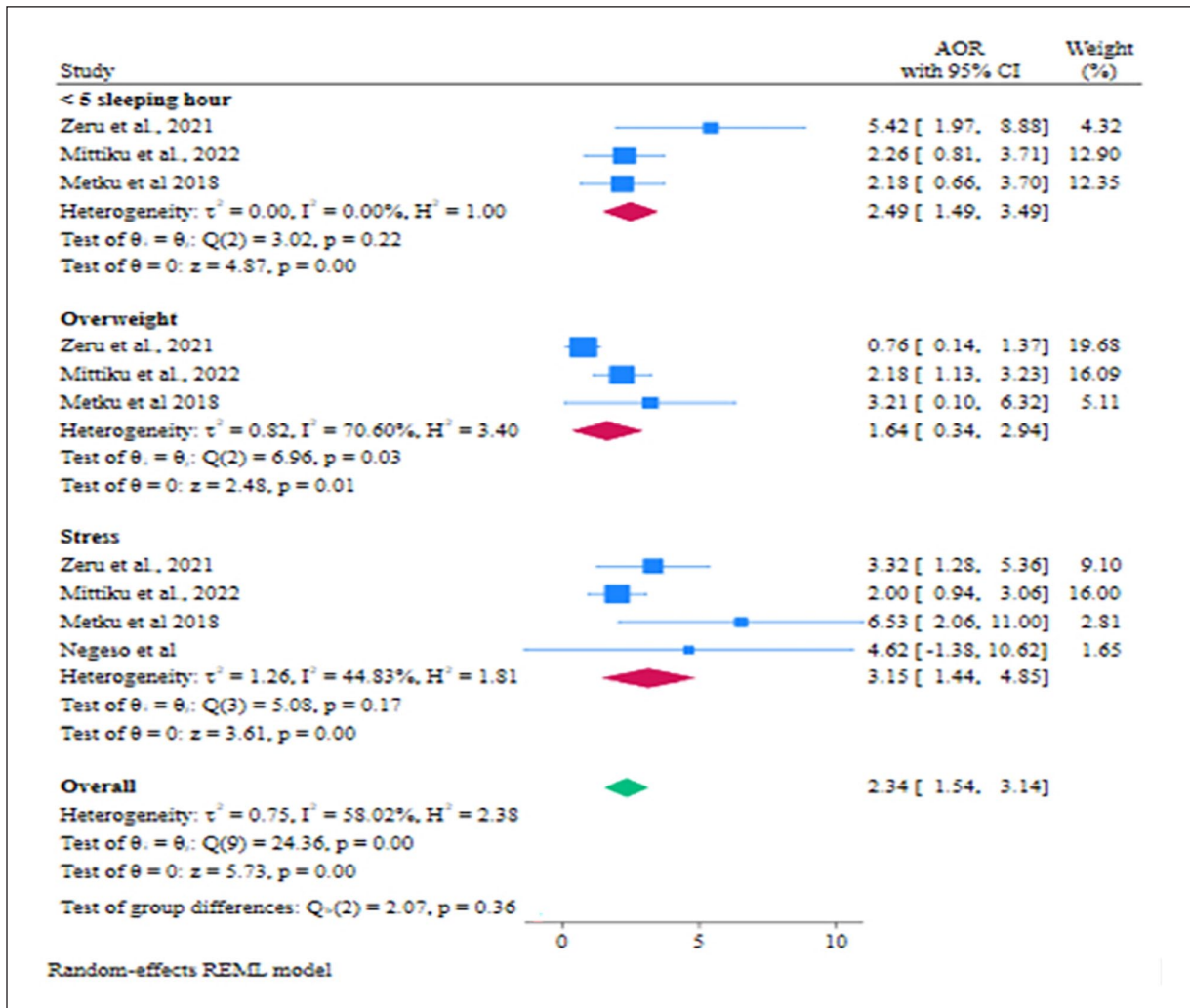
Figure 5. Forest plot for irregular menstrual cycle among women by publication year in Ethiopia, 2023

cycle[39] since both sleep and menstruation are vital rhythmic physiological events for women.[40,41] According to the evidence from previous studies, it was found that luteal phase progesterone and estradiol concentrations rose with increasing sleep duration.[42] Sleep disturbances limit the release of gonadal hormones by preventing the pituitary gland from secreting gonadotropin-releasing hormone.[43]

Women with stress were three times more likely to have irregular menstrual cycle than those who have no stress. This finding was supported by studies conducted in Korea[44]

and China.[45] Stress can increase level of endorphins and cortisol secretion which interrupt hormone production, and lead to an abnormal menstrual cycle. Mental stress also facilitates corticotrophin release, which activates the nervous system and can lead to menstrual problems. In addition, the effect of the hypothalamic-pituitary-adrenal (HPA) axis on gonadotropin-releasing hormone is a possible mechanism associating stress with menstrual cycle irregularity. The HPA axis is known to be dysregulated in response to stress. Consequently, gonadotropin-releasing hormone is

Figure 6. Forest plot for predictors of irregular menstrual cycle among women in Ethiopia, 2023.

inhibited by HPA axis dysfunction, delaying or preventing the luteinizing hormone (LH) surge.[46]

Premature ovarian failure and premature ovarian insufficiency also lead to abnormal menses. Moreover, eating disorders are other factors that may lead to abnormal menses. Amenorrhea occurs almost universally in anorexia nervosa and is thought to be a consequence of malnutrition-induced impairments in gonadotropin (particularly LH) secretory patterns.[47] Reproductive and sexual health services need to emphasize stress reduction methods, improving nutritional status from childhood to reproductive age among females.

The study provides a strong, more representative finding regarding the overall burden of irregular menstrual cycles and its predictors among reproductive-age women in Ethiopia. The limitation of this review was that it was not able to report the burden of irregular menstruation-based age and cases of women, which might have contributed to the high burden. Another limitation of the study was there is significant heterogeneity across included studies, which may affect the results.

Conclusion

More than one in every three, 35% (95% CI: 30–41) reproductive-age women in Ethiopia experience irregular menstrual cycles. Sleeping for <5 h a day and stress increase the likelihood of an irregular menstrual cycle, which can be modified by improving sleeping hours and decreasing stress stimulators through psychotherapy.
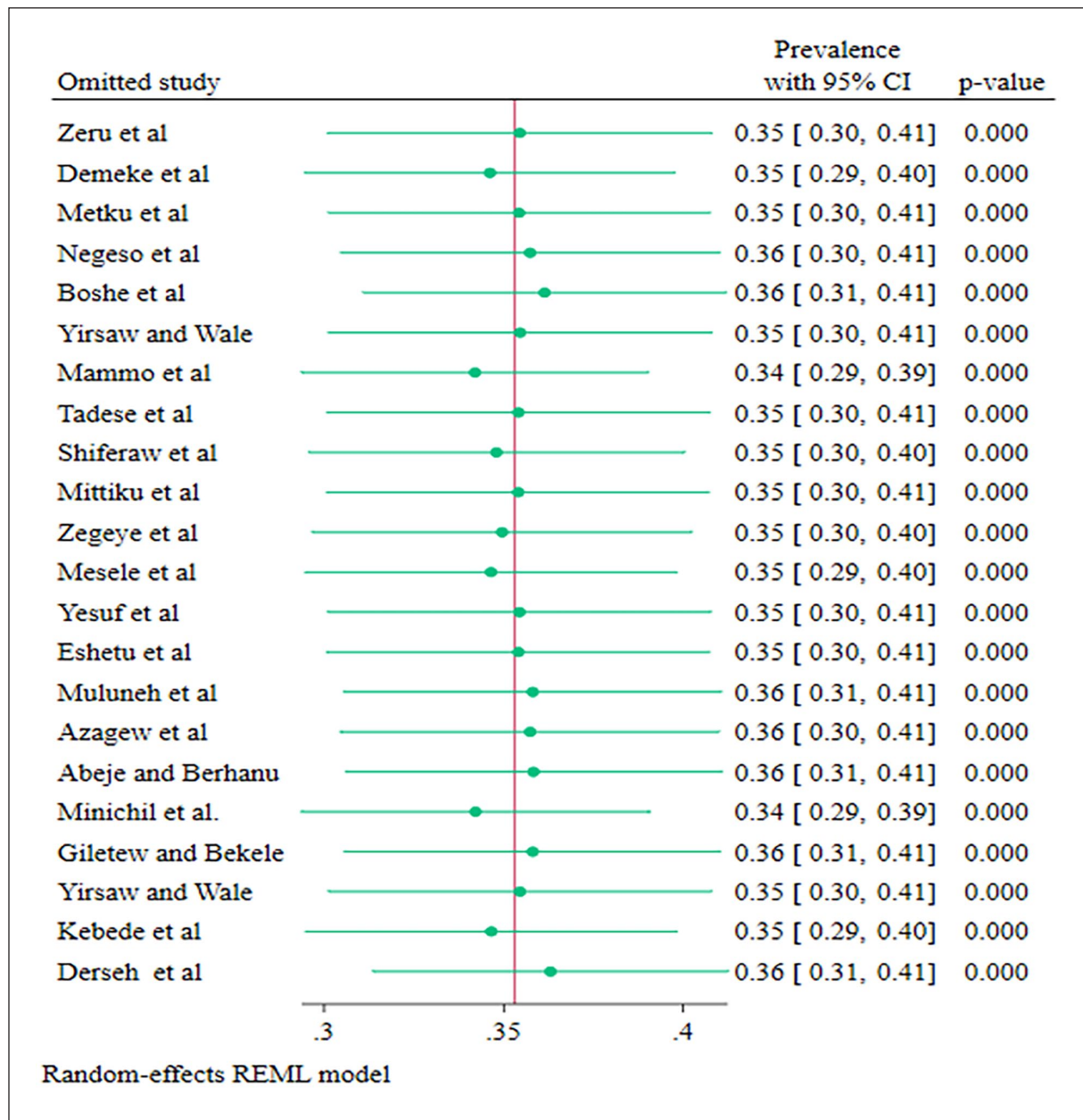
Figure 7. Sensitivity analysis of irregular menstrual cycle among women in Ethiopia, 2023.

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Author contributions

IM and BB conceived and designed the review. IM, BB, UJ, FM, AS, AC, DA, AD, EM, and LDR carried out the draft of the manuscript, and IM is the PI of the review. IM, BB, and LDR developed the search strings. The five reviewers (IM, BB, FM, UJ, and DA) screened and selected studies. Also, IM, BB, AS, UJ, LDR, and AC extracted the data and evaluated the quality of the studies. IM, BB, UJ, and LDR carried out the analysis and interpretation. All authors rigorously reviewed, read, and approved the final version of the manuscript.

Availability of data and materials

All related data has been presented within the manuscript. The dataset supporting the conclusions of this article is available from the corresponding author upon request.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Supplemental material

Supplemental material for this article is available online.

References

1. Thiyagarajan DK, Basit H and Jeanmonod R. Physiology, menstrual cycle. *StatPearls*. StatPearls Publishing, 2022.
2. Jain V, Chodankar RR, Maybin JA, et al. Uterine bleeding: how understanding endometrial physiology underpins menstrual health. *Nat Rev Endocrinol* 2022; 18: 290–308.
3. Amu EO and Bamidele JO. Prevalence of menstrual disorders among adolescent girls in Osogbo, South Western Nigeria. *Int J Adolesc Med Health* 2014; 26: 101–106.
4. Kwak Y, Kim Y and Baek KA. Prevalence of irregular menstruation according to socioeconomic status: a population-based nationwide cross-sectional study. *PloS One* 2019; 14: e0214071.
5. Mikhael S, Punjala-Patel A and Gavrilova-Jordan L. Hypothalamic-pituitary-ovarian axis disorders impacting female fertility. *Biomedicines* 2019; 7: 5.
6. Demeke E, Zeru AB, Tesfahun E, et al. Effect of menstrual irregularity on academic performance of undergraduate students of Debre Berhan University: a comparative cross sectional study. *PLoS One* 2023; 18: e0280356.
7. Mesele TT, Ayalew HG, Syoum AT, et al. Impact of dysmenorrhea on academic performance among Haramaya University undergraduate regular students, Eastern Ethiopia. *Front Reprod Health* 2022; 4: 939035.
8. Bogale B, Wolde A, Mohammed N, et al. Poor sleep quality and factors among reproductive-age women in Southwest Ethiopia. *Front Psychiatry* 2022; 13: 913821.
9. Adebimpe WO, Farinloye EO and Adeleke NA. Menstrual pattern and disorders and impact on quality of life among university students in South-Western Nigeria. *J Basic Clin Reprod Sci* 2016; 5: 27–32.
10. Minichil W, Eskindir E, Demilew D, et al. Magnitude of premenstrual dysphoric disorder and its correlation with academic performance among female medical and health science students at University of Gondar, Ethiopia, 2019: a cross-sectional study. *BMJ Open* 2020; 10: e034166.
11. Tsegaye D and Getachew Y. Premenstrual dysphoric disorder and associated factors among female health science students in Wollo University, Ethiopia, 2017/18. *Matern Health Neonatol Perinatol* 2019; 5: 8.
12. Alemu SM, Habtewold TD and Haile YG. Mental and reproductive health correlates of academic performance among Debre Berhan University female students, Ethiopia: the case of premenstrual dysphoric disorder. *Biomed Res Int* 2017; 2017: 9348159.
13. Gebeyehu MB, Mekuria AB, Tefera YG, et al. Prevalence, impact, and management practice of dysmenorrhea among University of Gondar students, Northwestern Ethiopia: a cross-sectional study. *Int J Reprod Med* 2017; 2017: 3208276.
14. Abeje A and Berhanu Z. Premenstrual syndrome and factors associated with it among secondary and preparatory school students in Debremarkos town, North-west Ethiopia, 2016. *BMC Res Notes* 2019; 12: 535.
15. Zeru AB, Gebeyaw ED and Ayele ET. Magnitude and associated factors of menstrual irregularity among undergraduate students of Debre Berhan University, Ethiopia. *Reproductive Health* 2021; 18: 101.
16. Mittiku YM, Mekonen H, Wogie G, et al. Menstrual irregularity and its associated factors among college students in Ethiopia, 2021. *Front Glob Women's Health* 2022; 3: 917643.
17. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Int J Surg* 2021; 88: 105906.
18. Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. *JAMA* 2000; 283: 2008–2012.
19. Metku K, Gobena T, Ibrahim M, et al. Prevalence of menstrual cycle irregularity and associated factors among medical students of Jimma University, Southwest Ethiopia, 2018. https://repository.ju.edu.Et/handle/123456789/5093. 2018.
20. Kemer N. Prevalence of menstrual irregularity and associated factors among preparatory school girls in Adama Town, Oromia Region, Ethiopia, http://213.55.95.56/handle/123456789/28617. 2021.
21. Boshe M, Mulu A, Zegeye DT, et al. *Assessment of age at menarche and menstrual cycle pattern among adolescent school girls in GamoGofa Zone, Southwest Ethiopia*, http://etd.aau.edu.et/handle/123456789/14697. 2018.
22. Mammo M, Alemayehu M and Ambaw G. Prevalence of primary dysmenorrhea, its intensity and associated factors among female students at high schools of Wolaita Zone, Southern Ethiopia: cross-sectional study design. *Int J Womens Health* 2022; 14: 1569–1577.
23. Tadese M, Kassa A, Muluneh AA, et al. Prevalence of dysmenorrhoea, associated risk factors and its relationship with academic performance among graduating female university

students in Ethiopia: a cross-sectional study. *BMJ Open* 2021; 11: e043814.

24. Shiferaw MT, Wubshet M and Tegabu D. Menstrual problems and associated factors among students of Bahir Dar University, Amhara National Regional State, Ethiopia: a cross-sectional survey. *Pan Afric Med J* 2014; 17: 246.

25. Zegeye DT, Megabiaw B and Mulu A. Age at menarche and the menstrual pattern of secondary school adolescents in northwest Ethiopia. *BMC Women's Health* 2009; 9: 1–8.

26. Mesele TT, Dheresa M, Oljira L, et al. Prevalence of dysmenorrhea and associated factors among Haramaya University students, Eastern Ethiopia. *Int J Womens Health* 2022; 14: 517–527.

27. Yesuf TA, Eshete NA and Sisay EA. Dysmenorrhea among University Health Science Students, Northern Ethiopia: impact and associated factors. *Int J Reprod Med* 2018; 2018: 9730328.

28. Eshetu N, Abebe H, Fikadu E, et al. Premenstrual syndrome, coping mechanisms and associated factors among Wolkite university female regular students, Ethiopia, 2021. *BMC Womens Health* 2022; 22: 88.

29. Muluneh AA, Nigussie TS, Gebreslasie KZ, et al. Prevalence and associated factors of dysmenorrhea among secondary and preparatory school students in Debremarkos town, North-West Ethiopia. *BMC Womens Health* 2018; 18: 57.

30. Azagew AW, Kassie DG and Walle TA. Prevalence of primary dysmenorrhea, its intensity, impact and associated factors among female students' at Gondar town preparatory school, Northwest Ethiopia. *BMC Womens Health* 2020; 20: 5.

31. Giletew A and Bekele W. Prevalence and associated factors of primary dysmenorrhea among Debre Tabor University students, north Central Ethiopia. *Int J Biomed Eng Clin Sci* 2019; 4: 70–74.

32. Yirsaw MT and Wale MZ. Menstrual related discomfort and associated factors among undergraduate students in Ambo University, Central Ethiopia. *SAGE Open Med* 2021; 9: 20503121211003361.

33. Kebede E, Mesfin E and Singh MR. Age at menarche; factors that influence it, and menstrual pattern of secondary school adolescents in Addis Ababa, Ethiopia. *Ethiop Med J* 2021; 59(4).

34. Derseh B, Afessa N, Temesgen M, et al. Prevalence of dysmenorrhea and its effects on school performance: a cross-sectional study. *Journal of Women's Health Care* 2017; 6: 361.

35. Salameh J-P, Bossuyt PM, McGrath TA, et al. Preferred reporting items for systematic review and meta-analysis of diagnostic test accuracy studies (PRISMA-DTA): explanation, elaboration, and checklist. *BMJ* 2020; 370: m2632.

36. Kennedy KE, Onyeonwu C, Nowakowski S, et al. Menstrual regularity and bleeding is associated with sleep duration, sleep quality and fatigue in a community sample. *J Sleep Res* 2022; 31: e13434.

37. Kang W, Jang K-H, Lim H-M, et al. The menstrual cycle associated with insomnia in newly employed nurses performing shift work: a 12-month follow-up study. *Int Arch Occup Environ Health* 2019; 92: 227–235.

38. Kim T, Nam GE, Han B, et al. Associations of mental health and sleep duration with menstrual cycle irregularity: a population-based study. *Arch Women's Ment Health* 2018; 21: 619–626.

39. Willis SK, Hatch EE and Wise LA. Sleep and female reproduction. *Curr Opin Obstetr Gynecol* 2019; 31: 222–227.

40. Xing X, Xue P, Li SX, et al. Sleep disturbance is associated with an increased risk of menstrual problems in female Chinese university students. *Sleep Breathing* 2020; 24: 1719–1727.

41. Baker FC and Lee KA. Menstrual cycle effects on sleep. *Sleep Med Clin* 2022; 17: 283–294.

42. Michels KA, Mendola P, Schliep KC, et al. The influences of sleep duration, chronotype, and nightwork on the ovarian cycle. *Chronobiol Int* 2020; 37: 260–271.

43. Chang W-P and Chang Y-P. Meta-analysis comparing menstrual regularity and dysmenorrhea of women working rotating shifts and fixed day shifts. *J Women's Health* 2021; 30: 722–730.

44. Jung E-K, Kim S-W, Ock S-M, et al. Prevalence and related factors of irregular menstrual cycles in Korean women: the 5th Korean National Health and Nutrition Examination Survey (KNHANES-V, 2010–2012). *J Psychosomatic Obstetr Gynecol* 2018; 39: 196–202.

45. Ansong E, Arhin SK, Cai Y, et al. Menstrual characteristics, disorders and associated risk factors among female international students in Zhejiang Province, China: a cross-sectional survey. *BMC Women's Health* 2019; 19: 1–10.

46. Maniam J, Antoniadis C and Morris M. Early-life stress, HPA axis adaptation, and mechanisms contributing to later health outcomes. *Front Endocrinol* 2014; 5: 73.

47. Pirke KM, Pahl J, Schweiger U, et al. Metabolic and endocrine indices of starvation in Bulimia: a comparison with anorexia nervosa. *Psychiatry Res* 1985; 15: 33–39.