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Burden and determinants of anemia among pregnant women in Africa: An umbrella review

Alemken Eyayu Abuhay

alexeyayu6@gmail.com

Department of Clinical Midwifery, College of Medicine and Health Sciences, University of Gondar Comprehensive Specialized Hospital, Gondar, Ethiopia

Tadele Amare Zeleke

Department of Psychiatry, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Demiss Mulatu Geberu

Department of Health Systems and Policy, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Serku Abate Mihret

Department of Clinical Midwifery, College of Medicine and Health Sciences, University of Gondar Comprehensive Specialized Hospital, Gondar, Ethiopia

Mesafint Yihalem Belie

Department of Internal Medicine, Neurosurgery, Clinical general practitioner, University of Gondar, Gondar, Ethiopia

Kassa Kefale Defersha

Department of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Techilo Asmare Alayehu

Department of Internal Medicine, Nephrologist, Clinical general practitioner, University of Gondar, Gondar, Ethiopia

Danil Assefa Bayayebegn

Department of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Degsew Ewunetie Anteneh

Department of Midwifery, College of Medicine and Health Sciences, Woldia University, Woldia, Ethiopia

Berihun Agegn Mengistie

Department of General Midwifery, School of Midwifery, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

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Burden and determinants of anemia among pregnant women in Africa: An umbrella review

Alemken Eyayu Abuhay[1*] , Tadele Amare Zeleke[2], Demiss Mulatu Geberu[3], Serku Abate Mihret[1], Mesafint Yihalem Belie[4], Kassa Kefale Defersha[5], Techilo Asmare Alayehu[6], Danil Assefa Bayayebegn[5], Degsew Ewunetie Anteneh[7], Berihun Agegn Mengistie[8]

[1]Department of Clinical Midwifery, College of Medicine and Health Sciences, University of Gondar Comprehensive Specialized Hospital, Gondar, Ethiopia, [2]Department of Psychiatry, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia, [3]Department of Health Systems and Policy, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia,[4]Department of Internal Medicine, Neurosurgery, Clinical general practitioner, University of Gondar, Gondar, Ethiopia, [5]Department of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia, [6]Department of Internal Medicine, Nephrologist, Clinical general practitioner, University of Gondar, Gondar, Ethiopia, [7]Department of Midwifery, College of Medicine and Health Sciences, Woldia University, Woldia, Ethiopia,[8]Department of General Midwifery, School of Midwifery, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

*Correspondence author: Alemken Eyayu Abuhay

Email address: alexeyayu6@gmail.com

ORCID ID: https://orcid.org/0009-0000-7504-4102

Abstract

Background: Anemia during pregnancy remains a major public health challenge in Africa. Although numerous studies have been conducted, the evidence remains fragmented and inconsistently reported, limiting its usefulness for policy and practice. This umbrella review aimed to synthesize existing systematic reviews and meta-analyses on the burden and determinants of anemia among pregnant women in Africa.

Methods: A comprehensive search of PubMed, Hinari, ScienceDirect, and Google Scholar was conducted to identify systematic reviews and meta-analyses published up to February 20, 2026. Methodological quality was assessed using AMSTAR-2. A random-effects model was used to estimate pooled prevalence. Heterogeneity and publication bias were evaluated using I^2 statistics, funnel plots, and Egger's test. The protocol was registered in PROSPERO (CRD420251133890).

Results: Ten articles with 229,310 pregnant women across Africa were included. The pooled prevalence of anemia among pregnant women was 37.68% (95% CI: 30.44, 44.88%). Key determinants were low dietary diversity (AOR: 3.02, 95% CI: 2.21, 4.13), inadequate iron and folic acid supplementation (AOR: 1.62, 95% CI: 1.36, 1.92), intestinal parasitic infections (AOR: 2.16, 95% CI: 1.28, 3.65), malaria infection (AOR: 1.95, 95% CI: 1.64, 2.33), and short interpregnancy intervals (AOR: 1.83, 95% CI: 1.42, 2.34).

Conclusion: Anemia during pregnancy was high and was driven by different factors. Strengthening antenatal micronutrient supplementation, improving dietary diversity, and integrating infection prevention into maternal health programs are essential. These findings support policymakers and program planners in prioritizing targeted, context-specific interventions and accelerating progress toward the World Health Organization's global nutrition targets and the sustainable development goals.

Key word: Anemia, Burden, Pregnant women, prevalence, Africa, Umbrella review

Contributions to the Literature

- This umbrella review provides the first comprehensive synthesis of systematic reviews and meta-analyses on anemia among pregnant women in Africa.
- The study highlights that anemia during pregnancy remains a major public health challenge across African countries.
- The review identifies important modifiable factors, including poor dietary diversity, inadequate iron and folic acid supplementation, malaria, parasitic infections, and short birth intervals.
- The findings support policymakers and maternal health programs in prioritizing context-specific interventions to improve maternal and neonatal health outcomes.

List of abbreviations

ANC**:** Antenatal care, AMSTAR: A Measurement Tool to assess systematic Reviews, AOR: Adjusted odds ratio, CI: Confidence interval, CS: Cross-sectional study, JBI: Joanna Briggs Institute's, SSA: Sub-Saharan Africa, SRM: Systematic review and Meta-analysis, SDG: Sustainable development goal, LMIC: Low- and middle-income countries, WHO: World health organization

Introduction

Anemia is a major global health issue, affecting roughly 500 million women of reproductive age (15–49 years); in 2019, it impacted an estimated 37% of pregnant women and 30% of non-pregnant women worldwide [1]. Anemia in pregnancy is a significant public health issue and remains one of the leading contributors to maternal and neonatal mortality and morbidity in low- and middle-income countries [2]. The World Health Organization (WHO) classifies anemia in pregnant women based on its magnitude: less than 5% is considered insignificant, 5–19% is mild, 20–39% is moderate, and 40% or higher is severe [3]. According to WHO, anemia prevalence of ≥40% among pregnant women represents a severe public health problem [4].

Studies show a high burden of anemia, with prevalence estimates of 53% in Sudan [5], 57% in Tanzania [6], and about 51% across Africa overall, indicating that more than half of pregnant women are affected [7]. These rates exceed the WHO threshold for severe public health concern and underscore critical nutritional and health challenges. Anemia is more common during pregnancy due to factors such as infections, malaria, helminth infestations, and iron and folic acid deficiencies, which can impair red blood cell production, a process vital for maternal and fetal health [8]. Addressing these issues through adequate nutrition and medical care is essential to reducing anemia risk during pregnancy [9]. Maternal anemia increases the risk of complications such as hemorrhage, preeclampsia, sepsis, and maternal mortality [10]. It also contributes to adverse fetal outcomes, including preterm birth, low birth weight, and intrauterine growth restriction, affecting both maternal and neonatal health [11].

Moreover, children born to anemic mothers are more likely to experience anemia during early childhood, which can lead to long-term cognitive and academic challenges [12]. Effective anemia control strategies in Africa and worldwide include nutritional counseling, dietary diversification, deworming programs, treatment of parasitic infections, routine iron and folic acid supplementation during pregnancy, antenatal care services, insecticide-treated nets, intermittent preventive treatment for malaria, and strengthening maternal health programs. These interventions improve maternal health and significantly contribute to better neonatal outcomes [13].

Despite these interventions, previous studies have primarily focused on prevalence and specific determinants of anemia, with limited data on severity and intervention effectiveness. Additionally, systematic reviews and meta-analyses often do not comprehensively assess evidence quality, which leads to complicated policy decisions [14]. The WHO and Sustainable Development Goals (SDG) target reductions in anemia among pregnant women and women of reproductive age by 2030, which are 15% and 50%, respectively [15]. However, existing systematic reviews and meta-analyses on anemia among pregnant women in Africa mainly

report prevalence and associated factors, with limited assessment of anemia severity and certainty of evidence. In addition, findings across reviews remain fragmented and inconsistent, with potential overlap of primary studies and no comprehensive synthesis of evidence across reviews. To date, no umbrella review has systematically synthesized the burden and determinants of anemia among pregnant women in Africa. Therefore, this umbrella review aimed to provide combined evidence on the burden and associated factors of anemia among pregnant women to inform future research, policy, and intervention strategies in African countries.

Method

Study design and reporting guideline

This umbrella review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. A preliminary search of the PROSPERO database was performed to identify existing umbrella reviews on anemia among pregnant women in Africa, and none were found. The review protocol was prospectively registered in PROSPERO (Registration ID: CRD420251133890) (Supplementary file 1).

Search strategy

This review aimed to synthesize evidence from published systematic reviews and meta-analyses reporting the prevalence of anemia and its associated factors among pregnant women in Africa. The search strategy was developed using the Condition, Context, and Population (CoCoPop) framework and conducted across electronic databases, including PubMed, Hinari, and ScienceDirect, and through the Google Scholar search engine. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords using Boolean operators ("AND," “OR”). Reference lists of included articles were also screened to identify

additional relevant studies. Only systematic reviews and meta-analyses published between 17 October 2015 and 20 February 2026 were eligible for inclusion. The detailed search strategy was as follows: ("systematic review" OR "meta-analysis" OR "review") AND ("anemia" OR "anemia of pregnancy" OR "pregnancy anemia") AND ("prevalence" OR "magnitude" OR "incidence") AND ("pregnant women" OR "antenatal women" OR "pregnant mothers" OR "maternal") AND ("associated factors" OR "determinants" OR "risk factors" OR "predictors") AND ("Africa" OR "Sub-Saharan Africa" OR "East Africa" OR "West Africa" OR "North Africa" OR "Southern Africa") (Supplementary file 2).

Eligibility criteria

Inclusion criteria

This umbrella review included systematic reviews and meta-analyses, published in the English language, that reported the prevalence of anemia among pregnant women and/or its factors associated with anemia among pregnant women in Africa. Only studies with complete and extractable data relevant to the review objectives were considered eligible. Publications released between 17 October 2015 and 20 February 2026 were included in the analysis.

Exclusion criteria

Studies were excluded if anemia among pregnant women was not assessed as an outcome variable. In addition, primary studies; narrative reviews; qualitative studies lacking quantitative data suitable for umbrella review; expert opinions; case reports; editorials; commentaries; conference abstracts; correspondence; and methodological papers were excluded from the review.

Study selection process

All retrieved records were imported into EndNote X8 reference management software, and duplicate records were automatically removed. Two reviewers (AEA and BAM) independently screened titles and abstracts to identify potentially eligible studies. Full-text reviews for the remaining articles were then assessed for

eligibility based on the predefined inclusion and exclusion criteria. Disagreements between reviewers were resolved through discussion with third reviewers (TAZ) until agreement was reached.

Measurement of the outcomes

The primary outcome was the pooled prevalence of anemia among pregnant women in Africa as reported in systematic reviews and meta-analyses. Anemia definitions used in included reviews were based on WHO hemoglobin thresholds (<11 g/dL), and variations across studies were considered during interpretation.

The secondary outcome was to identify factors associated with anemia, expressed as adjusted odds ratios (AORs) with 95% confidence intervals (CIs), as reported in the included systematic reviews and meta-analyses. Results were presented using forest plots for pooled prevalence estimates and adjusted odds ratios (AORs) with corresponding 95% confidence intervals (CIs). Findings were summarized narratively and statistically where appropriate.

Data extraction and management

Two reviewers (AEA and BAM) independently extracted data using a standardized Microsoft Excel-based form. Articles were initially screened by title and abstract before full-text review. Any disagreements were resolved through discussion with third reviewers (TAZ). Extracted information included the first author and year of publication; reported magnitude of anemia; factors associated with anemia (such as low dietary diversity, lack of iron/folic acid supplementation, intestinal parasitic infections, malaria infection, and short inter-pregnancy intervals) and their corresponding adjusted odds ratios (AORs) with 95% confidence intervals (CIs); number of systematic reviews or meta-analyses included within each umbrella review; study area; total sample size; and quality assessment (Supplementary file 3).

Operational definitions

Anemia among pregnant women was defined according to World Health Organization (WHO) criteria as hemoglobin concentration < 11 g/dL during pregnancy. Associated factors were defined as exposures or

determinants reported in the included systematic reviews that showed statistically significant associations with anemia, expressed as adjusted odds ratios (AORs) with 95% confidence intervals. Systematic reviews and meta-analyses were defined as studies that systematically identified, appraised, and statistically synthesized findings from primary studies.

Quality assessment of included studies

The methodological quality of the included systematic reviews and meta-analyses was evaluated using the A Measurement Tool to Assess Systematic Reviews 2 (AMSTAR 2) checklist, an updated version of the original AMSTAR tool. Each review was assessed based on 16 criteria and categorized as critically low, low, moderate, or high quality. Systematic reviews or meta-analyses rated as critically low quality were excluded from the synthesis of this umbrella review [16] (Table 1).

Assessment of overlap

Assessment of overlap using the Corrected Covered Area (CCA) method demonstrated slight/moderate/high overlap among the included systematic reviews and meta-analyses, indicating a low/moderate risk of duplication of primary studies across reviews.

Unit of analysis

The unit of analysis was systematic reviews and meta-analyses rather than primary studies. This approach was used to avoid double counting of primary studies, and overlap assessment was applied to minimize bias in pooled estimates.

Missing data handling

Missing or incomplete data were handled based on the type of unavailable information. Reviews with insufficient data for the outcomes of interest were excluded from quantitative synthesis.

Data synthesis and statistical analysis

Extracted data from the included systematic reviews and meta-analyses were entered into Microsoft Excel and analyzed using STATA version 17. Standard errors of the prevalence estimates reported in the included reviews were computed assuming a binomial distribution. Statistical heterogeneity across reviews was evaluated using the I^2 statistic, categorized as low (<25%), moderate (50–75%), or high (>75%) [17]. A random-effects meta-analysis using the DerSimonian and Laird method was performed to estimate the pooled prevalence of anemia. Subgroup analyses were conducted by country, region, and study population to explore sources of heterogeneity. Sensitivity analysis was performed using a leave-one-out approach to assess the influence of each review on the pooled estimate. Publication bias was evaluated through funnel plot symmetry and Egger's regression test ($p < 0.05$). When bias was detected, trim-and-fill analysis was applied to adjust for missing reviews [18]. Results were presented using forest plots, odds ratios (ORs), and 95% confidence intervals (CIs).

Assessment of confidence in evidence

The certainty of evidence for pooled prevalence estimates and associated factors was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. The quality of evidence was evaluated based on risk of bias, inconsistency, indirectness, imprecision, and publication bias. The certainty of evidence was categorized as high, moderate, low, or very low, and was considered during interpretation of the findings.

Results

Study selection process

Overall, 1,500 records were identified from all databases, including the Google Scholar search engine. After removing 650 duplicates, 850 records remained for screening. Titles and abstracts were reviewed, resulting in 80 potentially eligible systematic reviews and meta-analyses. Following full-text assessment, 70 studies were excluded for different reasons, such as varying in the study settings, not being directly related to the outcome

of interest, qualitative reviews, scoping reviews, or methodological reviews. Ultimately, ten systematic reviews and meta-analyses met the eligibility criteria and were included in the final quantitative umbrella review [3, 5, 8, 19-25] (figure 1).

Figure 1: PRISMA flow diagram showing the study selection process of prevalence of anemia among pregnant women in Africa.

Characteristics of the included systematic review and meta-analysis studies

The ten eligible systematic reviews and meta-analyses (SRM) collectively included data from 229,310 participants across 270 primary studies. These SRMs were conducted in different regions of Africa: two in Ethiopia, two in Sub-Saharan Africa (SSA), and the remaining six studies were conducted in South Africa, Uganda, Sudan, Somalia, and Egypt. The methodological quality of the included SRMs, as assessed using AMSTAR 2, ranged from 15 to 16, indicating moderate to high quality (Table 2)

Burden and determinants of anemia among pregnant women in Africa

In this umbrella review, the pooled prevalence of anemia among pregnant women in Africa was 37.68% (95% CI: 30.49–44.88), indicating a substantial public health burden across the region. A high level of heterogeneity was observed among the included reviews ($I^2 = 99.92\%$, $p < 0.001$), suggesting considerable variability in study populations, settings, and methodologies. Accordingly, a random-effects meta-analysis model was applied to account for between-study differences (Figure 2).

Figure 2: A forest plot that shows the pooled prevalence of anemia among pregnant women in Africa.

Publication bias

Publication bias was assessed using funnel-plot symmetry and Egger's regression test. The funnel plot showed a symmetrical distribution, suggesting no apparent publication bias. Consequently, Egger's regression test showed no statistically significant evidence of publication bias among the included systematic reviews and meta-analyses ($p = 0.7520$) (Figure 3).

Figure 3: Funnel plot assessing publication bias anemia among pregnant women in Africa.

Heterogeneity and subgroup analysis

Subgroup analyses were conducted to explore potential sources of heterogeneity based on the number of included systematic reviews and meta-analyses (SRMs), country, and regional classification within Africa. The results demonstrated marked regional variation in the prevalence of anemia among pregnant women in Africa. The highest pooled prevalence was observed in North Africa (49%; 95% CI: 48.19–49.81) and Sub-Saharan Africa (38.69%; 95% CI: 23.42–53.96), while Southern Africa showed the lowest prevalence (31%; 95% CI: 29.66–32.34). Overall, the pooled prevalence of anemia among pregnant women in Africa was estimated at 37.68% (95% CI: 30.49–44.88). Despite conducting subgroup analyses, heterogeneity remained extremely high (I^2 = 99.92%), indicating substantial unexplained variability across the included reviews. Additional subgroup analyses based on study quality, study design, and year of publication were considered; however, these analyses were not feasible due to limited reporting, inconsistent methodological descriptions, and variability in data availability across the included SRMs.

The persistence of extreme heterogeneity suggests that the observed differences in prevalence are likely determined by a complex interplay of factors beyond geographic classification alone. These may include variations in population characteristics (such as maternal age, parity, nutritional status, and comorbid infections), differences in diagnostic criteria and hemoglobin cut-off values used to define anemia, disparities in access to antenatal care services, differences in iron and micronutrient supplementation coverage, and broader socioeconomic and health system factors across regions. In addition, regional differences in malaria burden, helminth infections, food insecurity, and maternal health policies may further contribute to the wide variability observed across studies. Given the extent of heterogeneity, the pooled prevalence estimate should be interpreted with attention. Rather than representing a precise continental prevalence, the summary estimate should be viewed as a broad approximation that reflects substantial variation across regions and study

contexts. These findings underscore the need for context-specific strategies and attention against overgeneralization of prevalence estimates in the presence of extreme between-study heterogeneity (Figure 4).

Figure 4: A forest plot showing the sub-group analysis of anemia among pregnant women by study area.

Sensitivity analysis

A leave-one-out sensitivity analysis was performed using a random-effects model to assess the influence of individual SRMs on the overall pooled prevalence estimate. The results indicated that sequential omission of any single SRM did not result in substantial changes in the pooled prevalence, with all estimates remaining within the confidence interval of the combined analysis.

These findings suggest that no single SRM disproportionately influenced the overall pooled estimate. However, despite the apparent numerical stability of the pooled prevalence, substantial heterogeneity persisted across all confirmations of the sensitivity analysis. Therefore, the strength observed reflects consistency in the direction of the pooled estimate rather than homogeneity across studies. Accordingly, while the sensitivity analysis supports the internal stability of the pooled estimate, the results should still be interpreted carefully due to the extremely high between-study heterogeneity. The pooled estimate should be regarded as a broad summary measure rather than a precise estimate of anemia prevalence among pregnant women across Africa (Figure 5).

Figure 5 : Leave-one-out sensitivity analysis for pooled prevalence estimates of anemia among pregnant women in Africa.

Meta-regression analysis

A meta-regression analysis was conducted alongside subgroup and sensitivity analyses to explore potential sources of between-study heterogeneity. Study-level characteristics, including year of publication and sample size of the included systematic reviews and meta-analyses, were entered as covariates in the random-effects meta-regression model. The results indicated that none of the examined moderators significantly explained the

observed heterogeneity across studies. This suggests that the extreme variability in prevalence estimates could not be explained by these study-level characteristics alone. However, the ability of meta-regression to detect meaningful associations may have been limited by the small number of available systematic reviews and meta-analyses, residual confounding, and the use of aggregated data from included reviews rather than primary-level data.

Consequently, the unexplained heterogeneity likely reflects the influence of unmeasured factors, such as differences in population characteristics, anemia diagnostic thresholds, antenatal care coverage, nutritional and infection profiles, and health system contexts across regions. These findings reinforce the need for careful interpretation of pooled estimates. They also highlight the inherent challenges of synthesizing highly heterogeneous secondary evidence in umbrella reviews (Table 3).

Meta-analysis for factors associated with anemia among pregnant women in Africa

Among the ten included systematic reviews and meta-analyses, five reported statistically significant factors that could be pooled quantitatively [3, 5, 8, 19, 24]. The random-effects model identified several key predictors. Pregnant women with low dietary diversity were more than three times as likely to develop anemia compared to those with adequate dietary diversity [AOR = 3.02; 95% CI: 2.20, 4.13]. Similarly, women who did not take iron/folic acid supplementation had 1.6 times higher odds of anemia than those who adhered to supplementation [AOR = 1.62; 95% CI: 1.36, 1.92]. Intestinal parasitic infections were also a significant risk factor, with affected women more than twice as likely to develop anemia compared to uninfected women [AOR = 2.16; 95% CI: 1.28, 3.65]. Malaria infection further increased the likelihood of anemia, as women infected with malaria had approximately two-fold higher odds compared with uninfected women [AOR = 1.95; 95% CI: 1.64, 2.33]. Lastly, short inter-pregnancy intervals were associated with higher risk, with women experiencing short intervals approximately twice as likely to develop anemia compared with those with longer intervals [AOR = 1.83; 95% CI: 1.42, 2.34] (Figure 6, Table 4).

Figure 6: Forest plot showing factors associated with anemia among pregnant women in Africa.

Discussion

Anemia during pregnancy remains a major public health concern, particularly in low- and middle-income countries (LMICs). Globally, approximately 41.8% of pregnant women are affected by anemia, with previous estimates suggesting that Africa bears one of the highest burdens, affecting up to 57.1% of pregnant women [26]. These figures underscore the heightened vulnerability of pregnant women to anemia and its associated maternal and neonatal consequences. Evidence-based interventions including iron and folic acid supplementation, improved dietary practices, routine antenatal care (ANC) utilization, and optimal birth spacing remain central to prevention efforts [27]. In line with this, the World Health Organization has set a global target to reduce anemia among women of reproductive age by 50% and to lower its prevalence among pregnant women to 15% by 2030 [28].

This umbrella review synthesized findings from systematic reviews and meta-analyses to estimate the pooled prevalence of anemia among pregnant women in Africa, which was 37.68%. This finding indicates that anemia remains a major public health problem among pregnant women in Africa, with serious implications for maternal and neonatal health outcomes. The high burden suggests gaps in maternal nutrition, antenatal care, and preventive health services, including iron supplementation and infection prevention. It also highlights the need for strengthened and integrated interventions to improve maternal nutrition, early screening, and access to quality maternal health care services across Africa. This estimate is consistent with previous reports from China (30.7%), low- and middle-income countries (36.8%), and global populations (41.7%) [29-31]. However, it remains considerably higher than the WHO global target of less than 15% by 2030 [32]. Additionally, the pooled prevalence of anemia among pregnant women in Africa (37.68%) is higher than reported estimates from Iran (15%) and Brazil (23%) and falls within the range reported in Malaysia (19.3–57.4%) [33-35].

The observed differences might be explained by variations in health-seeking behaviors, socioeconomic status, and healthcare system capacity. Most studies included in this review were conducted in African LMICs, whereas other studies originated from countries with better healthcare systems, higher access to prenatal care services, trained healthcare professionals, and greater awareness of maternal nutrition and anemia prevention. This review identified several factors significantly associated with anemia: low dietary diversity, lack of iron/folic acid supplementation, intestinal parasitic infection, malaria infection, and short inter-pregnancy intervals.

Pregnant women with low dietary diversity were more likely to develop anemia, consistent with studies from China, Brazil, Iran, and global LMIC contexts [29, 30, 34, 36]. A diverse diet reduces anemia risk by ensuring adequate micronutrient intake, enhancing iron absorption, and improving overall nutritional status.

Women who did not take iron/folic acid supplementation were also at higher risk of anemia, supported by evidence from LMICs, Iran, China, Malaysia, and Indonesia [29, 30, 35-37]. Iron and folic acid supplements enhance hemoglobin production and replenish iron stores, whereas inadequate supplementation fails to meet the increased physiological demand during pregnancy.

Intestinal parasitic infections were significantly associated with anemia, consistent with findings from LMICs, Iran, Indonesia, and multi-country systematic reviews [30, 36-38]. Parasitic infestations lead to lower hemoglobin levels, blood loss, and impaired nutrient absorption, increasing anemia risk.

Similarly, malaria infection was a major risk factor, supported by studies from LMICs and Indonesia [30, 37]. Malaria induces hemolysis and reduces hemoglobin synthesis, contributing to anemia; however, regular ANC contacts, intermittent preventive treatment, and effective vector control can substantially alleviate this risk.

Lastly, short inter-pregnancy intervals were another important determinant, supported by evidence from China and Indonesia [37, 39]. Short intervals do not allow sufficient time for maternal iron and folic acid stores to recover, while longer intervals support nutritional restoration and improve overall maternal health.

Despite these findings, significant challenges persist in reducing anemia among pregnant women in Africa. These include low dietary intake of iron and other micronutrients due to poverty and food insecurity, limited knowledge about nutrition, restricted access to high-quality ANC services, cultural misconceptions about supplementation, weak health systems, and logistical barriers in supplement distribution [39-41].

By synthesizing evidence across multiple reviews, this umbrella review addressed inconsistencies in pooled estimates, fragmentation of evidence, and overlap among previous systematic reviews and meta-analyses.

According to the WHO severity classification and the SDGs, anemia among pregnant women in Africa remains a major public health concern. Despite variation in prevalence estimates across regions and studies, the overall burden observed in this umbrella review underscores the persistent challenges facing maternal nutrition and antenatal care systems across the region. Given the extremely high heterogeneity observed, the pooled estimate should be interpreted as a broad regional approximation rather than an accurate prevalence. Nonetheless, the consistently high prevalence reported across multiple reviews indicates that anemia in pregnancy remains unacceptably common in many African settings.

Addressing this burden requires context-specific and equity-focused interventions. Priority should be given to improving access to quality antenatal care services, particularly among socioeconomically disadvantaged and underserved populations. Strengthening routine antenatal screening for anemia, expanding coverage of iron and folic acid supplementation, and integrating comprehensive nutrition education into maternal health services are critical components of effective prevention strategies. In addition, interventions targeting infection prevention and control, food insecurity, and micronutrient deficiencies should be tailored to local epidemiological and health system contexts.

At the policy level, these findings support the need for sustained investment in maternal nutrition programs, improved supply chains for essential supplements, and enhanced monitoring and evaluation frameworks to track progress toward national and global targets. Community engagement, advocacy, and long-term financial

commitment are essential to ensure the uptake and sustainability of interventions. While the confidence in secondary evidence and the presence of substantial heterogeneity limit definitive conclusions, this umbrella review provides valuable synthesized evidence to inform maternal health policy, guide program prioritization, and highlight areas where high-quality, context-specific primary research is urgently needed. Coordinated efforts among governments, healthcare providers, development partners, and communities will be crucial to achieving meaningful reductions in anemia and improving maternal and neonatal health outcomes across Africa.

Strengths and limitations of the study

This umbrella review is, to our knowledge, the first comprehensive synthesis conducted in Africa to estimate the prevalence of anemia and associated factors among pregnant women using evidence derived from multiple systematic reviews and meta-analyses. By integrating findings across a wide range of reviews, this study provides a higher level of evidence than individual primary studies and allows for broader geographic representation across the continent. The use of rigorous quantitative synthesis methods, including subgroup, sensitivity, and meta-regression analyses, strengthens the analytical approach and offers valuable insights into regional patterns and variability. The findings have important implications for maternal health policy and practice, particularly in informing the prioritization of antenatal nutrition and anemia prevention strategies in African settings.

Despite these strengths, several important limitations should be acknowledged. First, the pooled prevalence estimates were characterized by extremely high heterogeneity ($I^2 = 99.92\%$), indicating substantial variability across the included reviews. This heterogeneity likely reflects differences in population characteristics, anemia diagnostic thresholds, study designs, antenatal care coverage, nutritional status, infection burden, and broader health system and socioeconomic contexts. As a result, the pooled estimate should be interpreted carefully and regarded as a broad approximation rather than a precise continental prevalence.

Second, although overlap assessment using the Corrected Covered Area (CCA) method was conducted to minimize duplication of primary studies across included systematic reviews and meta-analyses, some degree of overlap may still remain unavoidable in umbrella reviews. Therefore, the possibility of residual double counting of primary studies should be considered when interpreting the pooled estimates.

Third, language bias may have been introduced, as only studies published in English were included. Articles in other languages were excluded due to resource constraints related to translation and language editing.

Finally, the validity of the conclusions depends on the methodological quality of the included systematic reviews and meta-analyses. Variations in review quality, reporting standards, and analytical approaches may have affected the strength of the synthesized evidence. Collectively, these limitations highlight the need for careful interpretation of the results and underscore the importance of future high-quality, context-specific primary studies and systematic reviews to refine estimates of anemia prevalence among pregnant women in Africa.

Conclusions and recommendations

This umbrella review indicates that anemia remains a substantial public health challenge among pregnant women in Africa. Although this estimate provides a continent-wide overview, it should be interpreted carefully due to the extremely high heterogeneity observed across included reviews. These factors suggest that the pooled estimate represents a broad regional approximation rather than a precise measure applicable to all African settings.

Across the synthesized evidence, anemia in pregnancy was consistently associated with low dietary diversity, inadequate iron and folic acid supplementation, intestinal parasitic infections, malaria infections, and short inter-pregnancy intervals. However, the certainty of evidence for several associated factors is limited by trust on secondary data and variability in study designs and contexts. Therefore, the findings should be interpreted with attention.

Addressing anemia among pregnant women in Africa requires a comprehensive and context-specific approach. Priority actions were to improve the coverage and adherence to iron and folic acid supplementation programs, enhance maternal nutrition through dietary diversification initiatives, and integrate effective infection prevention and control strategies, particularly for malaria and parasitic diseases, within routine maternal health services. In addition, interventions that support birth spacing, women's education, and socioeconomic empowerment are essential to addressing the underlying determinants of anemia.

From a policy perspective, the findings underscore the need for sustained investment in maternal nutrition and anemia prevention programs, improved monitoring systems, and region-specific strategies aligned with local epidemiological and health system realities. Future research should focus on generating high-quality, primary evidence and conducting standardized, methodologically robust systematic reviews to reduce uncertainty and refine estimates. Collectively, these efforts will be critical to achieving meaningful reductions in anemia and improving maternal and neonatal health outcomes across Africa.

Implication of the study

This umbrella review provides a comprehensive synthesis of existing systematic reviews and meta-analyses on the burden and determinants of anemia among pregnant women in Africa, addressing inconsistencies and fragmentation in the current evidence base. By integrating findings across multiple high-level studies, this review offers a clearer and more reliable estimate of the magnitude and key drivers of anemia in this population.

The findings confirm that anemia remains a significant public health problem in Africa, with a disproportionately high burden among pregnant women. This underscores the need for strengthened, context-specific interventions targeting the major identified determinants, including nutritional deficiencies, infections, and socioeconomic factors.

In relation to global priorities such as the World Health Organization targets and the Sustainable Development Goals, this study provides consolidated evidence that can support progress monitoring and policy evaluation. The results highlight the urgency of accelerating efforts to reduce anemia among pregnant women to meet the 2030 targets.

Furthermore, this study offers practical value for policymakers, program planners, and healthcare providers by identifying priority areas for intervention and resource allocation. It also emphasizes the need for improved quality of primary studies and future systematic reviews, particularly in underrepresented regions within Africa.

Ethical approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

All relevant data are available within the manuscript or supplementary materials.

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Competing interests

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Authors' contributions

Alemken Eyayu Abuhay and Berihun Agegn Mengistie conceptualized the topic. Alemken Eyayu Abuhay, Mesafint Yihalem Belie, Kassa Kefale Defersha, Tadele Amare Zeleke, and Berihun Agegn Mengistie developed the search strategy, conducted the review, extracted and analyzed the data, and drafted the manuscript. Demiss Mulatu Geberu, Serku Abate Mihret, Techilo Asmare Alayehu, Danil Assefa Bayayebegn, and Degsew Ewunetie Anteneh conducted a second review, provided input on data analysis, and critically revised the manuscript. All authors read and approved the final manuscript.

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582 sub-Saharan Africa: a systematic review and Meta-analysis. Archives of public health = Archives belges de
583 sante publique 2021, 79(1):219.

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585

586

587 ## List of tables

588 Table 1 : Methodological quality assessment of the included systematic review and meta-analysis studies
589 using AMSTAR 2.

Authors	Q	Q	Q	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q1	Q1	Q1	Q1	Q1	Score

	1	2	3									2	3	4	5	6	
Geta TG et al [42]	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	15
Kassa GM et al [14]	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	15.5
Adam I et al [43]	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	15
Azzam A et al [44]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	16
Mude ASA et al [20]	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	15

590

591 *AMSTAR is a measurement tool to assess systematic reviews.

592 Y=Yes

593 PY = partially yes

594 N=No

595 Q1: a priori design

596 Q2: duplicate study selection and data extraction

597 Q3: search comprehensiveness

598 Q4: inclusion of grey literature

599 Q5: included and excluded studies provided

600 Q6: characteristics of the included studies provided

601 Q7: scientific quality of the primary studies assessed and documented

602 Q8: scientific quality of the included studies used appropriately in formulating conclusions

603 Q9: appropriateness of methods used to combine studies' findings

604 Q10: likelihood of publication bias was assessed

605 Q11: assess the potential impact of individual studies

606 Q12: account for risk of bias in individual studies when interpreting the result

607 Q13: satisfactory explanation for discussion

608 Q14: assessing adequate investigation of publication bias

609 Q15: did the authors report any potential sources of conflict of interest

610 Q16: conflict of interest potential sources of support were clearly acknowledged in both the systematic review

611 and the included studies.

612 Table 2 : Descriptive summaries of the included systematic review and meta-analysis studies on anemia

613 among pregnant women in Africa.

Authors' name	Study area	Study population	No. of_ studies	Sample size	Prevalence (%)	AMSTAR score
Geta TG et al.,2022 [42]	Ethiopia	Pregnant women	16	28542	26.4	High
Kassa GM et al .,2017 [14]	Ethiopia	Pregnant women	31	10281	31.66	High
Adam I et al .,2018 [43]	Sudan	Pregnant women	16	15688	53	High
Azzam A et al .,2025 [44]	Egypt	Pregnant women	18	14548	49	High
Mude ASA et	Africa	Pregnant women	101	79572	29.2	High

al.,2025 [20]						
Dorsamy V et al.,2022 [45]	South Africa	Pregnant women	26	4584	31	High
Bongomin F et al .,2021 [46]	Uganda	Pregnant women	16	5113	30%	High
Nageye YA et al.,2024 [23]	Somalia	Pregnant women	13	3998	39.7	High
Belete NK et al.,2025 [47]	SSA	Pregnant women	21	51923	51.26	High
Fite MB et al.,2021 [48]	SSA	Pregnant women	25	15061	35.6	High

614

615 Table 3 : Meta-regression for factors associated anemia among women in Africa.

616 Variables	Coefficient	Std. errs.	P=value	95% CI
617 Publication year	0.61	1.76	0.728	-2.84, 4.06
618 Sample size	-0.0001	0.0002	0.834	-0.0005, 0.0004
619 Constant	-1197.662	3553.59	0.736	-8162.57, 5767.25

620

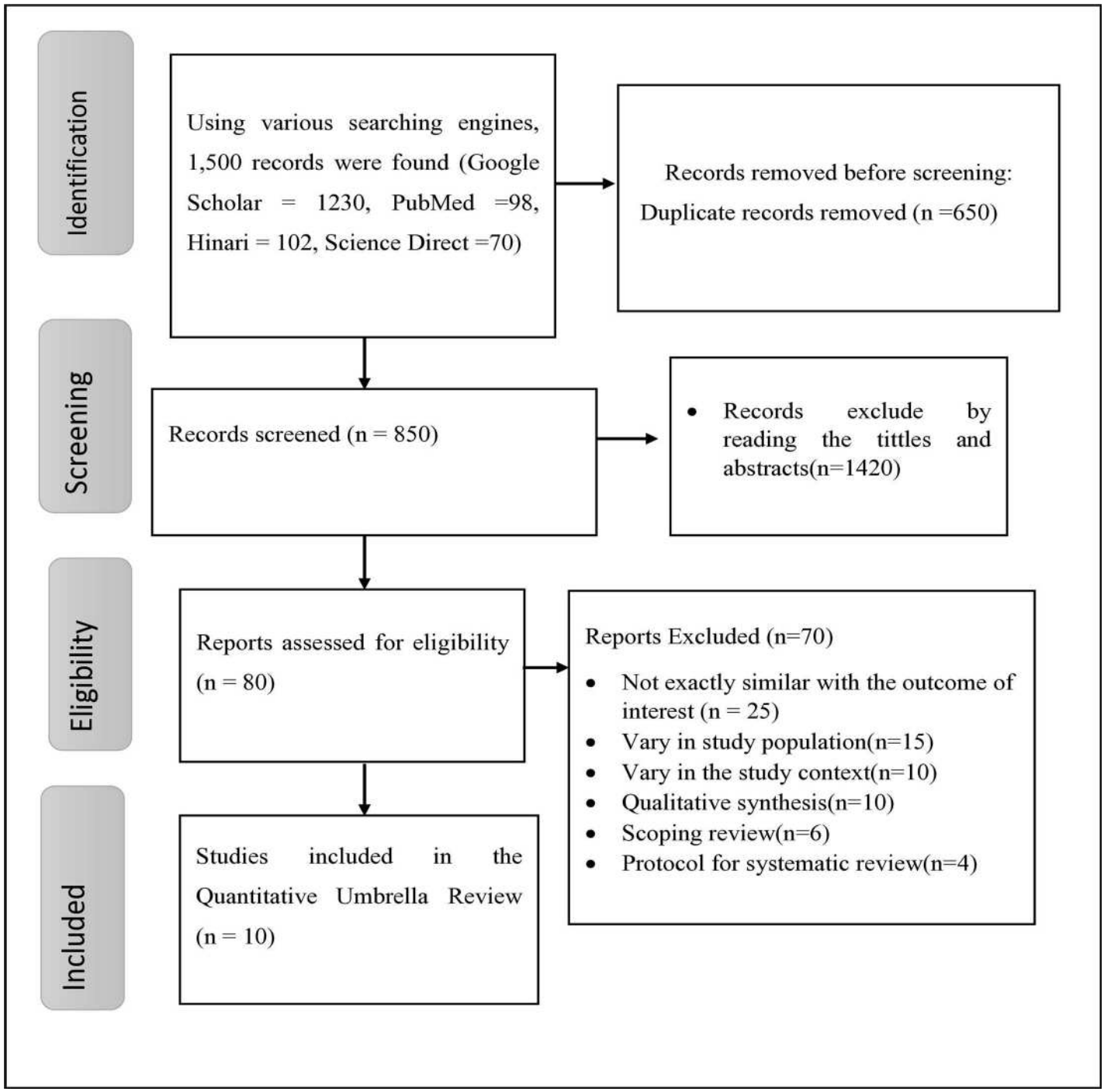
621 Table 4 : Factors associated with anemia among pregnant women in Africa.

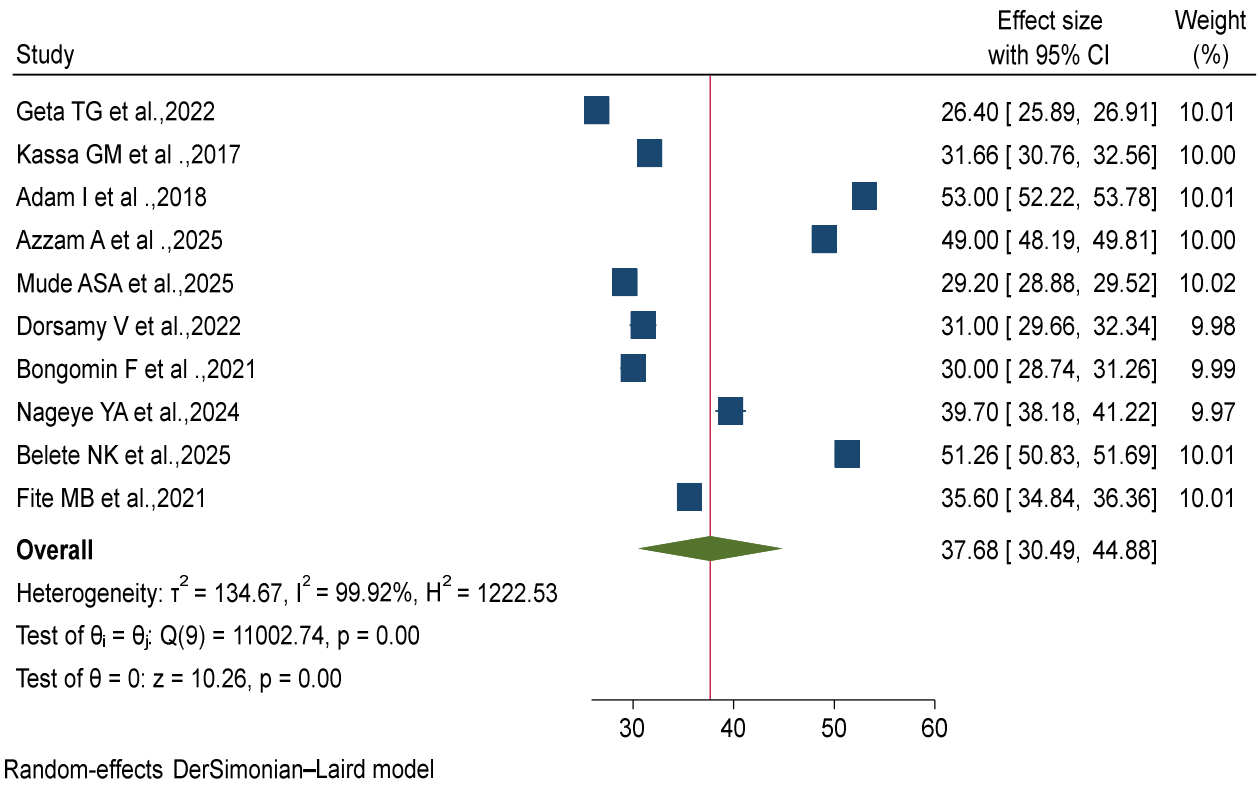
Variables	No. of studies	OR (95% CI)	*P*-value	I^2 (%)	*P*-value

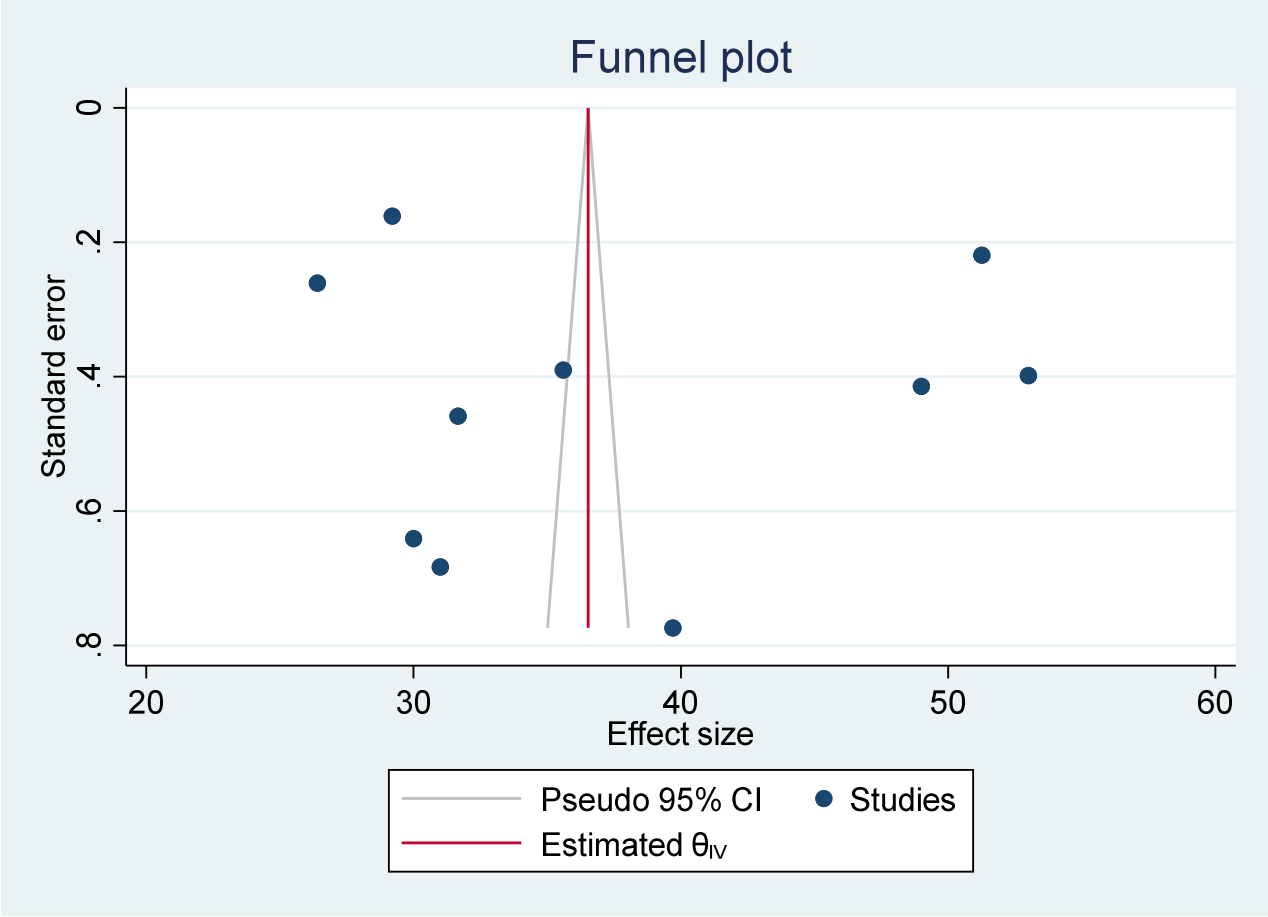
Women with low dietary diversity	2	3.02(2.21,4.13)	0.000		0.227
		1		31.6%	
Women with high dietary diversity					
Women who had no take feso4 supplementation	3	1.62(1.36,1.92)	0.000	7.0%	0.341
		1			
Women who had taken iron/folic acid supplementation					
Women with intestinal parasites	3	2.16(1.28, 3.65)	0.000	91.8%	0.000
		1			
Women with no intestinal parasites					
Malaria infection	3	1.95(1.64, 2.33)	0.000	0.0%	0.998
With no malaria infection		1			
Women in the third trimester pregnancy	2	1.66(0.84, 3.25)	0.000	94.1%	0.000
		1			
Women in the first trimester pregnancy					
Women who had short pregnancy interval	3	1.83(1.42, 2.34)	0.000	58.7%	0.089
		1			
Women who had long pregnancy interval					

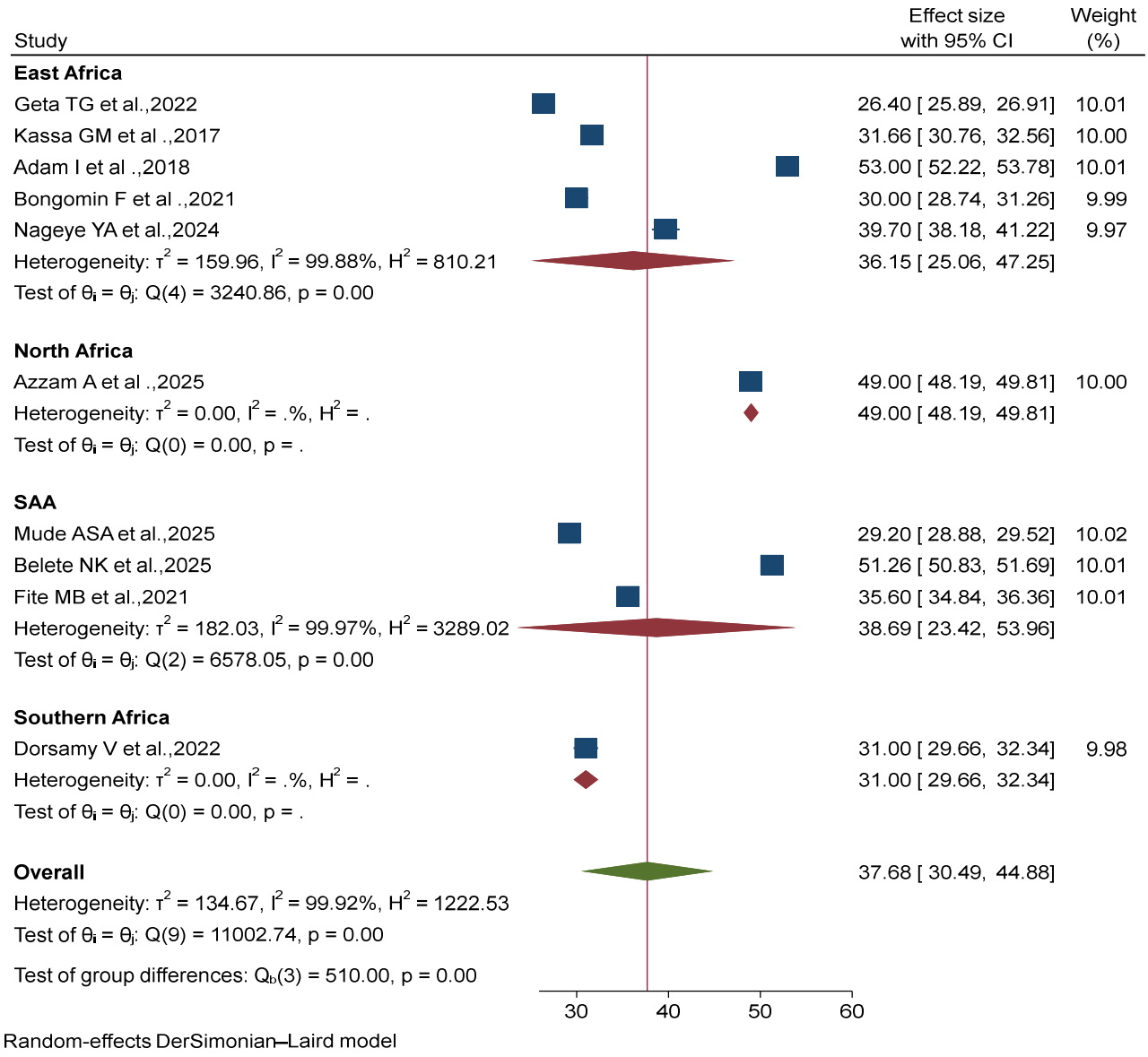
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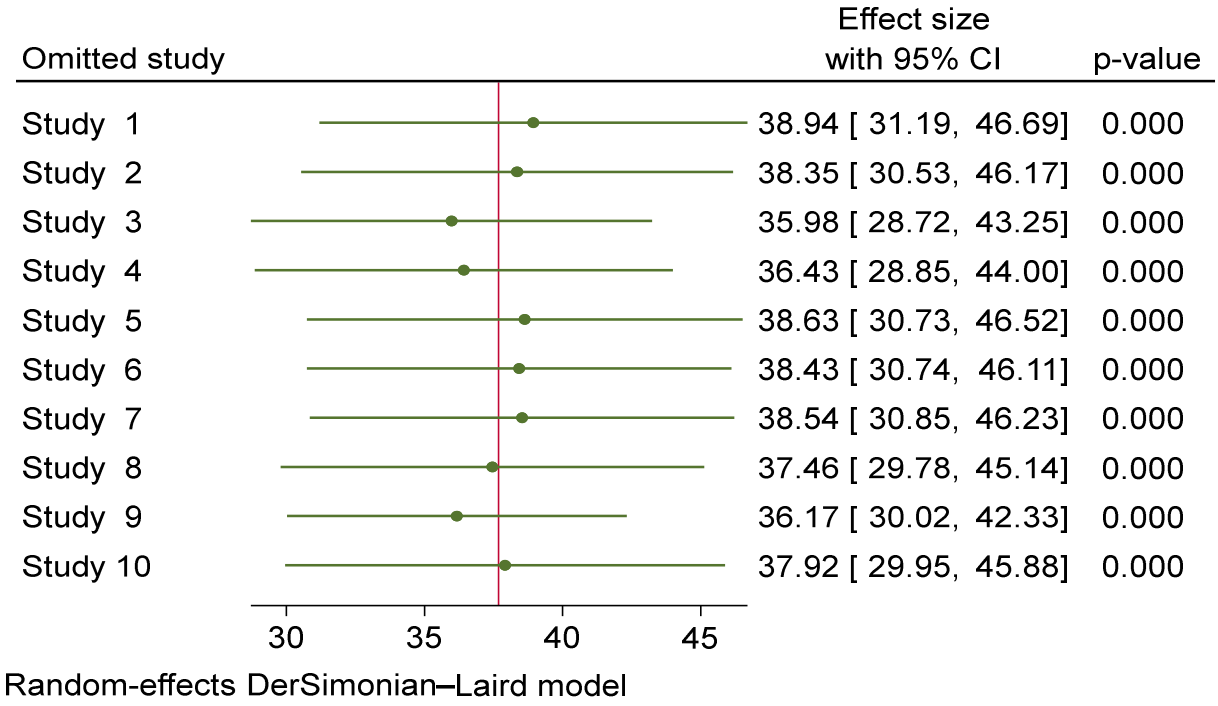
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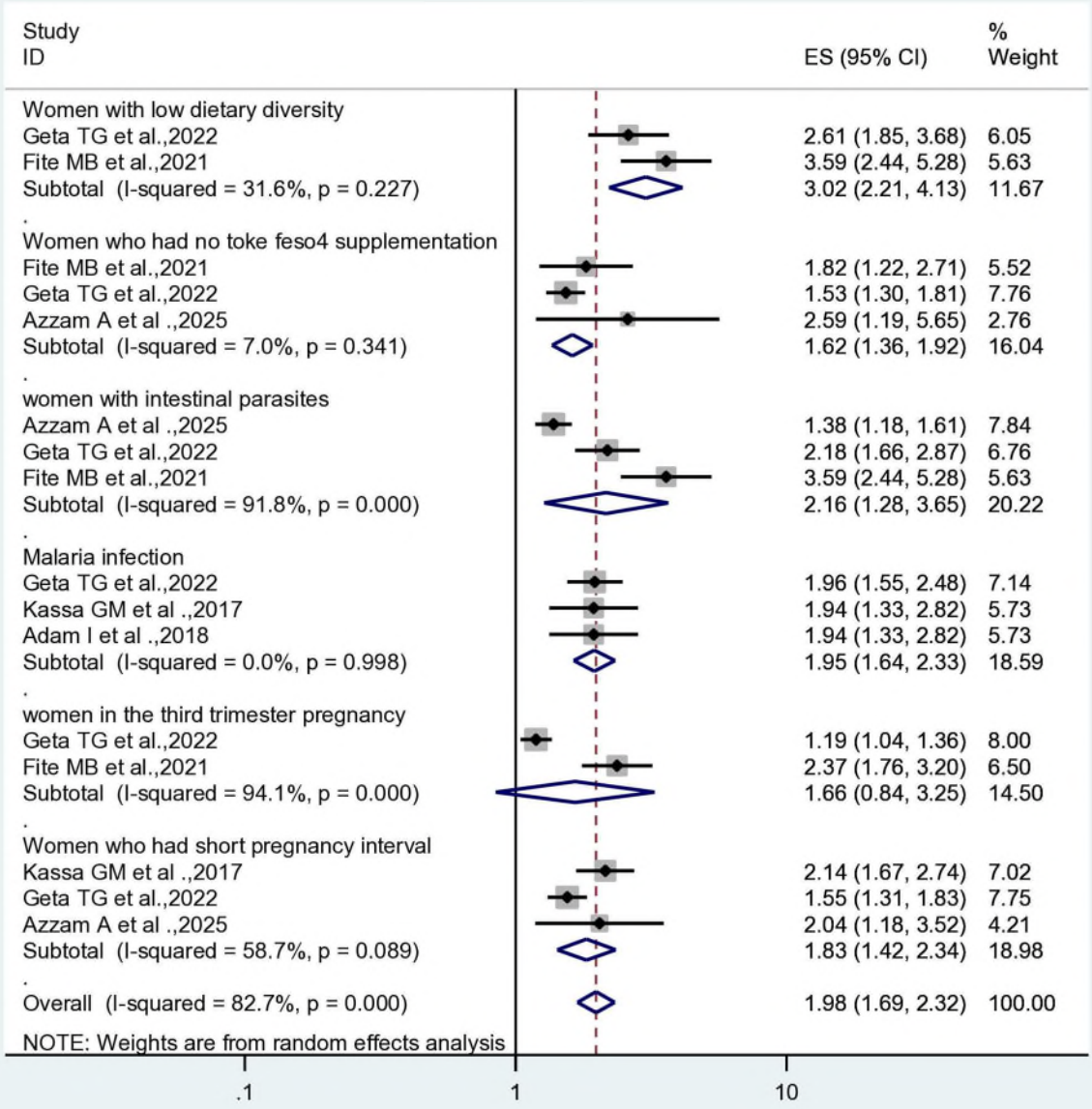

Identification
Using various searching engines, 1,500 records were found (Google Scholar = 1230, PubMed =98, Hinari = 102, Science Direct =70)
Records removed before screening:
Duplicate records removed (n =650)
Screening
Records screened (n = 850)
Records exclude by reading the tittles and abstracts(n=1420)
Eligibility
Reports assessed for eligibility (n = 80)
Reports Excluded (n=70)
Not exactly similar with the outcome of interest (n = 25)
Vary in study population(n=15)
Vary in the study context(n=10)
Qualitative synthesis(n=10)
Scoping review(n=6)
Protocol for systematic review(n=4)
Included
Studies included in the Quantitative Umbrella Review (n = 10)


Study
Effect size with 95% CI
Weight (%)
Geta TG et al.,2022
26.40 [25.89, 26.91]
10.01
Kassa GM et al .,2017
31.66 [30.76, 32.56]
10.00
Adam I et al .,2018
53.00 [52.22, 53.78]
10.01
Azzam A et al .,2025
49.00 [48.19, 49.81]
10.00
Mude ASA et al.,2025
29.20 [28.88, 29.52]
10.02
Dorsamy V et al.,2022
31.00 [29.66, 32.34]
9.98
Bongomin F et al .,2021
30.00 [28.74, 31.26]
9.99
Nageye YA et al.,2024
39.70 [38.18, 41.22]
9.97
Belete NK et al.,2025
51.26 [50.83, 51.69]
10.01
Fite MB et al.,2021
35.60 [34.84, 36.36]
10.01
Overall
37.68 [30.49, 44.88]
Heterogeneity: τ^2 = 134.67, I^2 = 99.92%, H^2 = 1222.53
Test of $\theta_i = \theta_j$: Q(9) = 11002.74, p = 0.00
Test of θ = 0: z = 10.26, p = 0.00
30
40
50
60
Random-effects DerSimonian–Laird model


Funnel plot
Standard error
0
.2
.4
.6
.8
20
30
40
50
60
Effect size
Pseudo 95% CI
Studies
Estimated θIV


Study
Effect size with 95% CI
Weight (%)
East Africa
Geta TG et al.,2022
26.40 [25.89, 26.91]
10.01
Kassa GM et al .,2017
31.66 [30.76, 32.56]
10.00
Adam I et al .,2018
53.00 [52.22, 53.78]
10.01
Bongomin F et al .,2021
30.00 [28.74, 31.26]
9.99
Nageye YA et al.,2024
39.70 [38.18, 41.22]
9.97
Heterogeneity: τ² = 159.96, I² = 99.88%, H² = 810.21
36.15 [25.06, 47.25]
Test of θi = θj: Q(4) = 3240.86, p = 0.00
North Africa
Azzam A et al .,2025
49.00 [48.19, 49.81]
10.00
Heterogeneity: τ² = 0.00, I² = .%, H² = .
49.00 [48.19, 49.81]
Test of θi = θj: Q(0) = 0.00, p = .
SAA
Mude ASA et al.,2025
29.20 [28.88, 29.52]
10.02
Belete NK et al.,2025
51.26 [50.83, 51.69]
10.01
Fite MB et al.,2021
35.60 [34.84, 36.36]
10.01
Heterogeneity: τ² = 182.03, I² = 99.97%, H² = 3289.02
38.69 [23.42, 53.96]
Test of θi = θj: Q(2) = 6578.05, p = 0.00
Southern Africa
Dorsamy V et al.,2022
31.00 [29.66, 32.34]
9.98
Heterogeneity: τ² = 0.00, I² = .%, H² = .
31.00 [29.66, 32.34]
Test of θi = θj: Q(0) = 0.00, p = .
Overall
37.68 [30.49, 44.88]
Heterogeneity: τ² = 134.67, I² = 99.92%, H² = 1222.53
Test of θi = θj: Q(9) = 11002.74, p = 0.00
Test of group differences: Qb(3) = 510.00, p = 0.00
30
40
50
60
Random-effects DerSimonian–Laird model


Omitted study
Effect size with 95% CI
p-value
Study 1
38.94 [31.19, 46.69]
0.000
Study 2
38.35 [30.53, 46.17]
0.000
Study 3
35.98 [28.72, 43.25]
0.000
Study 4
36.43 [28.85, 44.00]
0.000
Study 5
38.63 [30.73, 46.52]
0.000
Study 6
38.43 [30.74, 46.11]
0.000
Study 7
38.54 [30.85, 46.23]
0.000
Study 8
37.46 [29.78, 45.14]
0.000
Study 9
36.17 [30.02, 42.33]
0.000
Study 10
37.92 [29.95, 45.88]
0.000
30
35
40
45
Random-effects DerSimonian–Laird model


Study
ID
ES (95% CI)
%
Weight
Women with low dietary diversity
Geta TG et al.,2022 2.61 (1.85, 3.68) 6.05
Fite MB et al.,2021 3.59 (2.44, 5.28) 5.63
Subtotal (I-squared = 31.6%, p = 0.227) 3.02 (2.21, 4.13) 11.67
Women who had no toke feso4 supplementation
Fite MB et al.,2021 1.82 (1.22, 2.71) 5.52
Geta TG et al.,2022 1.53 (1.30, 1.81) 7.76
Azzam A et al .,2025 2.59 (1.19, 5.65) 2.76
Subtotal (I-squared = 7.0%, p = 0.341) 1.62 (1.36, 1.92) 16.04
women with intestinal parasites
Azzam A et al .,2025 1.38 (1.18, 1.61) 7.84
Geta TG et al.,2022 2.18 (1.66, 2.87) 6.76
Fite MB et al.,2021 3.59 (2.44, 5.28) 5.63
Subtotal (I-squared = 91.8%, p = 0.000) 2.16 (1.28, 3.65) 20.22
Malaria infection
Geta TG et al.,2022 1.96 (1.55, 2.48) 7.14
Kassa GM et al .,2017 1.94 (1.33, 2.82) 5.73
Adam I et al .,2018 1.94 (1.33, 2.82) 5.73
Subtotal (I-squared = 0.0%, p = 0.998) 1.95 (1.64, 2.33) 18.59
women in the third trimester pregnancy
Geta TG et al.,2022 1.19 (1.04, 1.36) 8.00
Fite MB et al.,2021 2.37 (1.76, 3.20) 6.50
Subtotal (I-squared = 94.1%, p = 0.000) 1.66 (0.84, 3.25) 14.50
Women who had short pregnancy interval
Kassa GM et al .,2017 2.14 (1.67, 2.74) 7.02
Geta TG et al.,2022 1.55 (1.31, 1.83) 7.75
Azzam A et al .,2025 2.04 (1.18, 3.52) 4.21
Subtotal (I-squared = 58.7%, p = 0.089) 1.83 (1.42, 2.34) 18.98
Overall (I-squared = 82.7%, p = 0.000) 1.98 (1.69, 2.32) 100.00
NOTE: Weights are from random effects analysis
.1
1
10

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementaryfile1PRISMAChecklist.docx
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- Supplementaryfile3Dataextraction.xlsx