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Adherence to iron–folic acid supplementation among pregnant women in east africa: a systematic review and meta-analysis

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Abstract

Introduction Iron and folic acid deficiency anemia remains a major global public health problem, accounting for approximately 1.45% of all disability-adjusted life years (DALYs). It is widely recognized as a significant contributor to the high levels of maternal and perinatal morbidity and mortality worldwide. Adequate adherence to iron and folic acid supplementation during pregnancy is essential for preventing anemia and reducing its related health complications. Although numerous studies have been conducted in different settings, their findings have been inconsistent and insufficient to inform clear interventions. Therefore, this systematic review and meta-analysis aimed to estimate the pooled prevalence of adherence to iron and folic acid supplementation and to identify its determinants among pregnant women in East Africa.

Methods The protocol for this systematic review and meta-analysis was registered in the PROSPERO database with the registration number CRD420261335746. An extensive literature search was conducted using several international databases, including PubMed, Google Scholar, the Cochrane Library, and Embase. The meta-analysis was conducted using a random-effects model, and all statistical analyses were performed using STATA version 14 for Windows. The I^2 statistic was used to assess heterogeneity among the included studies, while Egger's test was applied to evaluate potential publication bias.

Results This systematic review and meta-analysis included a total of 26 eligible studies. The pooled adherence to iron–folic acid supplementation among pregnant women in East Africa was 58% (95% CI: 57.24–58.76) and heterogeneity among studies was **(I^2 = 99.5%, $p<0.001$)**. This study identified several significant determinants of adherence, including counseling on the importance of iron–folic acid supplementation (AOR = 2.41; 95% CI: 1.73–3.09), good knowledge of iron–folic acid supplementation (AOR = 1.80; 95% CI: 1.43–2.17), good knowledge about anemia (AOR = 3.19; 95% CI: 1.87–4.52), history of anemia during the current pregnancy (AOR = 2.77; 95% CI: 1.40–4.13), and attending four or more antenatal care visits (AOR = 4.14; 95% CI: 1.87–6.42).

Conclusion The review found that adherence was moderate; however, it remains below the optimal level recommended by current guidelines. The findings revealed that counseling, good knowledge of iron–folic acid supplementation, knowledge of anemia, history of anemia during the current pregnancy, and attending four or more

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antenatal care visits were significantly associated with adherence. Healthcare providers should strengthen antenatal care counseling by emphasizing the benefits and proper use of iron–folic acid supplementation and addressing side effects. Health systems and policymakers should promote early antenatal care initiation and completion of at least four antenatal care visits to improve adherence.
Clinical trial number Not applicable.

Keywords Adherence of iron -folic acid · East Africa · systematic review and meta-analysis

Introduction

Iron and folic acid supplementation (IFAS) during pregnancy is one of the most effective and widely recommended interventions to prevent maternal anemia and improve pregnancy outcomes [1, 2]. The World Health Organization recommends that all pregnant women receive daily iron (30–60 mg) and folic acid (400 µg) supplementation throughout pregnancy to prevent iron deficiency anemia, neural tube defects, low birth weight, and preterm birth [3–5]. Adherence to Iron and folic acid supplementation is defined as taking Iron and folic acid supplements 90 times or more throughout the gestation period [6–8].

Globally, anemia affects a substantial proportion of pregnant women and remains a major public health problem, particularly in low- and middle-income countries. According to the World Health Organization, approximately 40% of pregnant women worldwide are anemic, with iron deficiency being the most common cause [1]. Iron deficiency during pregnancy can lead to several adverse outcomes, including maternal morbidity, impaired fetal development, increased risk of infection, and maternal mortality [9–11].

In sub-Saharan Africa, maternal anemia remains highly prevalent due to poor dietary intake, repeated pregnancies, parasitic infections, and limited access to quality antenatal care services [12]. East African countries have implemented iron–folic acid supplementation programs as part of routine antenatal care services to address this problem. Governments and health systems in the region have integrated IFAS distribution within antenatal care services to improve maternal nutrition and pregnancy outcomes [13].

Despite these efforts, adherence to iron–folic acid supplementation among pregnant women remains suboptimal in many East African countries. Several primary studies conducted in countries such as Ethiopia, Kenya, Uganda, and Tanzania have reported low adherence levels among pregnant women. Factors such as poor knowledge about anemia, late initiation of antenatal care, side effects of supplements, forgetfulness, limited counseling from health professionals, and poor access to health services have been reported to influence adherence [14, 15].

Improving adherence to iron–folic acid supplementation is critical for reducing maternal anemia and improving pregnancy outcomes in the region [16, 17]. However, evidence from individual studies across East Africa shows considerable variation in adherence rates and determinants. Therefore, synthesizing the available evidence through a systematic review and meta-analysis is essential to provide comprehensive and reliable estimates of adherence and its associated factors in East Africa.

Despite the widespread implementation of iron–folic acid supplementation (IFAS) programs through routine antenatal care services, adherence among pregnant women remains suboptimal across East Africa. Studies conducted in Ethiopia, Kenya, Uganda, Tanzania, Sudan, and Uganda have reported substantial variation in adherence levels [2, 11, 14–32].

Although adherence to iron–folic acid supplementation (IFAS) during pregnancy has been investigated in several East African countries, the reported prevalence varies considerably across studies. These variations may be attributed to differences in healthcare systems, antenatal care service utilization, maternal education, socioeconomic status, cultural beliefs, accessibility of iron–folic acid supplements, and the quality of counseling provided during antenatal care. Differences in study settings, sample characteristics, and methods used to measure adherence have also contributed to inconsistent findings across countries. Previous systematic reviews have examined IFAS adherence at the global level or within individual countries, particularly Ethiopia. However, to our

knowledge, no systematic review and meta-analysis has comprehensively synthesized evidence on IFAS adherence and its associated factors across East African countries. Consequently, there is no regional pooled estimate that reflects the overall burden of adherence or identifies the most consistent determinants influencing adherence throughout East Africa.This evidence gap limits the ability of policymakers and public health practitioners to design coordinated regional strategies for improving IFAS adherence. Therefore, a comprehensive systematic review and meta-analysis is needed to generate pooled estimates of adherence and identify common determinants across East African countries. Such evidence will provide a stronger basis for evidence-informed policies and targeted interventions aimed at improving maternal nutrition, reducing maternal anemia, and enhancing pregnancy outcomes throughout the region.

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Methods

Study protocol and reporting

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed to conduct this systematic review and meta-analysis [33]. The eligibility criteria for selecting studies were developed based on the Joanna Briggs Institute (JBI) 2017 guidelines for systematic reviews [34]. The review protocol was prepared in accordance with the PRISMA 2020 statement to ensure transparency and methodological rigor. Furthermore, the protocol was registered in the PROSPERO International Prospective Register of Systematic Reviews with the registration number **CRD420261335746**. For reference management, EndNote X8 was used to download, organize, and screen the retrieved studies from various databases. In addition, Mendeley reference management software was utilized to manage and insert citations of the included studies during the study preparation process. This systematic approach helped ensure accurate organization of the literature and improved the efficiency of the review process.

Search strategies

An extensive literature search was conducted to identify relevant studies using multiple electronic databases, including PubMed, Embase, Cochrane Library, Google Scholar, and Web of Science. Initially, studies were broadly searched using the full title phrase: *"prevalence* OR *magnitude or risk factors* OR *determinants*, AND Iron-Folic Acid Supplementation OR Iron Supplementation iron OR folic acid supplementation OR folic acid supplementation, AND *adherence of iron–folic acid* OR supplement adherence OR compliance to iron folic acid supplementation, AND Pregnant Women or antenatal care AND *East Africa* OR Ethiopia OR Kenya OR Uganda OR Tanzania OR Rwanda OR Burundi OR Eritrea OR Somalia OR Djibouti.*"* Boolean operators such as **"**OR" and "AND**"** were applied either individually or in combination to link the keywords and develop appropriate search strings for English-language publications. In addition, the reference lists of all included studies were carefully screened to identify potentially relevant articles that might have been missed during the initial database search. The literature search was conducted over two weeks, from March 01 to March 16, 2026 (Fig. 1).

Population

The study participants: - Pregnant women were included.

Types of studies: Observational, cross-sectional, and case-control studies were considered.

Outcome of interests: The primary studies reported the prevalence, magnitude, risk factors, determinants, and adherence of iron-folic supplementation in East Africa.

Publication condition: Published and unpublished articles were included.

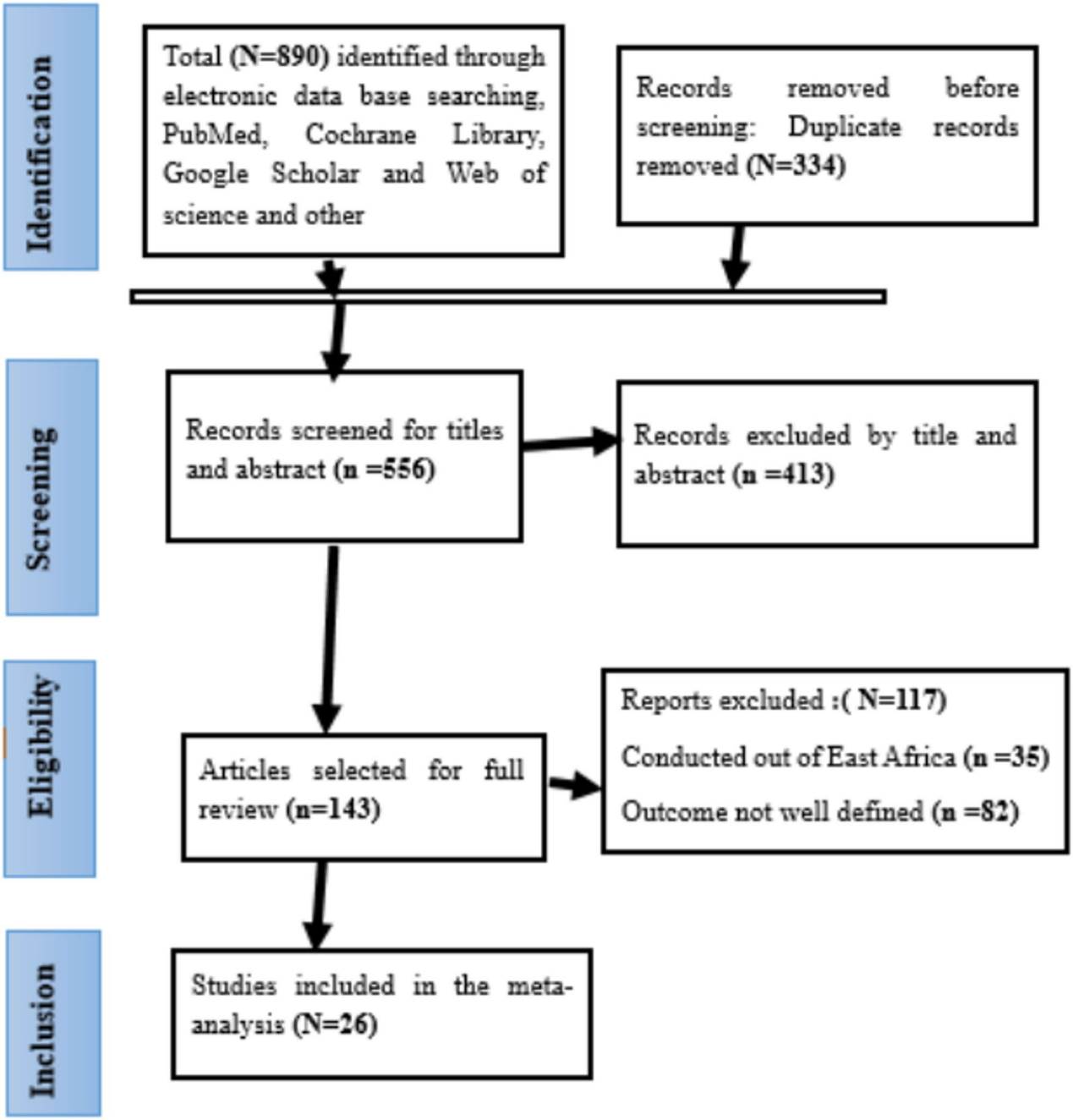


Fig. 1 PRISMA 2020 checklist flow diagram describing the selection of studies for systematic review and meta-analysis

Study area: Studies conducted in East Africa.
Publication date: Studies were conducted in East Africa through March 2026.

Eligibility criteria

Inclusion criteria

The inclusion and exclusion criteria for this systematic review and meta-analysis were determined using the CoCoPop framework, which is commonly applied for prevalence studies. The CoCoPop approach focuses on three key elements: condition, context, and population, enabling a clear and structured formulation of the research question. In this review, the population consisted of pregnant women, the condition referred to adherence to iron–folic acid supplementation, and the context included studies conducted in East African countries. This framework helped to systematically define the eligibility criteria and ensured that relevant studies addressing the prevalence and determinants of iron–folic acid supplementation adherence among pregnant women in East Africa were appropriately identified and included in the review.

Exclusion *criteria*

Studies that reported outcomes unrelated to the objectives of this review or those with missing or insufficient outcome data were excluded from the analysis. Additionally, review articles, commentaries, editorials, case reports, case series, qualitative studies, and patient narratives were not considered for inclusion, as they did not meet the required study design criteria. Articles without an accessible abstract and/or full text, as well as duplicate publications, were also excluded. Furthermore, studies that failed to report outcomes for both exposed and non-exposed groups were excluded after at least two attempts were made to contact the corresponding authors via email to obtain the necessary information. These exclusions were implemented because reliable data extraction and analysis could not be performed without complete and clearly reported outcome measures.

Variables and measurement of the outcome of interest

Adherence of iron-folic supplementation among pregnant women in East Africa. Knowledge was categorized as either poor or good. Pregnancy planning was divided into two groups: planned and unplanned. Advice from healthcare providers was classified as either given or not given. Media exposure was grouped into exposed and not exposed.

Data quality assessment

The retrieved articles were manually exported to EndNote for reference management. Duplicate records were identified and removed, after which the remaining studies were screened according to the predefined inclusion and exclusion criteria. The methodological quality of the eligible studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist for prevalence studies [34]. Each study was evaluated against the JBI quality assessment criteria, and studies scoring 50% or higher on the checklist were considered to have acceptable methodological quality and were included in the final analysis. Based on this evaluation, the quality scores of the included studies ranged from 55.56% to 100% (Table 1).

The JBI appraisal tool uses specific response categories, including Y (Yes), N (No), U (Unclear), and Q (Question not applicable), and the total score is calculated by counting the number of "Yes" responses for each study. The checklist consists of nine methodological criteria: [1] whether the sampling frame was appropriate to address the target population [2], whether study participants were sampled appropriately [3], whether the sample size was adequate [4], whether the study subjects and setting were described in detail [5], whether data analysis was

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Table 1 General characteristics of the included cross-sectional studies for the systematic review and meta-analysis of adherence to iron–folic acid supplementation among pregnant women in East Africa

Authors	Year of publication	JBI's critical appraisal questions									Quality score (100%)	Level of quality	Included
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9			
Bahati et al., [29]	2021	Y	Y	Y	N	Y	N	Y	Y	Y	77.78%	high	√
Kamau et al., [30]	2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Gebre et al., [31]	2015	Y	Y	Y	Y	Y	N	Y	Y	Y	88.89%	high	√
Saeed et a, [32]	2024	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Abdullahi et al., [17]	2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Lyoba et al., [15]	2020	Y	Y	N	Y	Y	N	N	N	Y	55.56%	medium	√
Munyogwa et al., [2]	2024	Y	Y	Y	N	Y	N	Y	Y	Y	77.78%	high	√
Koka et al., [18]	2024	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Tessema M et al., [19]	2023	Y	N	N	Y	Y	N	N	Y	Y	55.56%	medium	√
Agegnehu et al., [20]	2019	Y	N	N	Y	Y	Y	N	N	Y	55.56%	medium	√
Gebreamlak et al., [21]	2017	Y	Y	Y	N	Y	N	Y	Y	Y	77.78%	high	√
Nimwesiga et al., [14]	2021	Y	N	N	Y	Y	N	Y	Y	N	55.56%	medium	√
Eleni et al., [22]	2021	Y	Y	Y	Y	Y	N	Y	Y	Y	88.89%	high	√
Maher et al.,[11]	2022	Y	N	Y	Y	Y	N	N	N	Y	55.56%	medium	√
Hector et al.,[35]	2025	Y	N	Y	N	Y	N	N	Y	Y	55.56%	medium	√
Hardido et al., [23]	2023	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Assefa et al., [24]	2019	Y	Y	Y	Y	Y	N	Y	Y	Y	88.89%	high	√
Washo et al., [25]	2024	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Gebregyorgis et al., [26]	2020	Y	Y	Y	N	Y	N	Y	Y	Y	77.78%	high	√
Solomon et al., [27]	2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Yismaw et al.,[16]	2022	Y	Y	Y	Y	Y	N	Y	Y	Y	88.89%	high	√
Seid et al.,[28]	2025	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Ismail et al., [36]	2024	Y	N	Y	Y	Y	N	N	N	Y	55.56%	medium	√
Molla et al.,[37]	2019	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Kiwanuka et al., [38]	2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√
Tizalegn et al. [39]	2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	high	√

conducted with sufficient coverage of the identified sample [6], whether valid methods were used to identify the condition [7], whether the condition was measured in a standard and reliable manner for all participants [8], whether appropriate statistical analysis was applied, and [1] whether the response rate was adequate and, if not, whether the low response rate was properly addressed. This systematic appraisal ensured that only studies with acceptable methodological rigor were included in the meta-analysis.

Data extraction

Data were extracted using a Microsoft Excel spreadsheet to ensure systematic organization of the information obtained from the included studies. Two separate data extraction formats were developed to capture the necessary variables for the analysis. The data extraction process was conducted independently by three reviewers (**Bacha Merga**, **and Gada Edea**) to minimize potential bias and errors. The extraction sheet included key study characteristics such as the first author's name, publication year, study year, study design, study location, study setting, sample size, and the number of cases related to adherence to iron–folic acid supplementation in East Africa.

In addition, for studies assessing factors associated with adherence, the extraction format included information such as the author's last name, publication year, and the number of participants in the exposed (risk) and non-exposed (non-risk) groups, including both cases and controls. All reviewers independently extracted the relevant data and subsequently cross-checked their entries to ensure accuracy and consistency. Any discrepancies identified during the process were resolved through discussion and careful re-evaluation of the original articles until a consensus was reached. This rigorous approach enhanced the reliability and validity of the extracted data used in the analysis (Table 2).

Statistical methods and analysis

The extracted data from the Microsoft Excel spreadsheet were imported into Stata version 14 for statistical analysis. A meta-analysis was conducted to estimate the pooled prevalence of adherence to iron–folic acid supplementation among pregnant women in East Africa. Statistical heterogeneity among the included studies was assessed using the I^2 statistic, which quantifies the percentage of total variation across studies attributable to heterogeneity rather than chance. An I^2 value of 30–60% indicates moderate heterogeneity, 50–90% suggests substantial heterogeneity, and 75–100% represents considerable heterogeneity [40].

Accordingly, a random-effects model was applied to estimate the pooled adherence to iron–folic acid supplementation in East Africa due to the presence of heterogeneity among studies. Statistical significance was determined using p-values and 95% confidence intervals (CI). The random-effects model was used when statistical heterogeneity was present, whereas a fixed-effects model was applied when no significant heterogeneity was detected. To further explore potential sources of heterogeneity, meta-regression and subgroup analyses were performed.

Publication bias was assessed visually using a funnel plot and statistically evaluated using Egger's regression test, where a p-value less than 0.05 indicated the presence of potential publication bias. In addition, a contour-enhanced funnel plot was employed to help distinguish asymmetry caused by publication bias from that resulting from other factors. Finally, sensitivity analysis was conducted to determine the influence of individual studies on the overall pooled estimate and to evaluate the robustness of the meta-analysis results.

Measurement of the outcome of interest

This systematic review and meta-analysis estimated the pooled adherence to iron–folic acid supplementation (IFAS) among pregnant women in East Africa. In addition, five significant determinants of adherence were identified across the included studies: attending four or more antenatal care (ANC) visits, having good knowledge of

Table 2 Summary of characteristics of study included in systematic review and meta-analysis adherence to iron and folic acid supplementation among pregnant women in East Africa

Authors	Year of study	Year of publication	study area	Country	study setting	study design	sample	cases
Bahati et al., [29]	2021	2021	Kakamega level 5 hospital	Kenya	IB	CS	241	146
Kamau et al., [30]	2016	2018	Kiambu County	Kenya	IB	CS	364	119
Gebre et al., [31]	2015	2015	North Western Zone of Tigray	Ethiopia	IB	CS	714	266
Saeed et a, [32]	2023	2024	Gadarif Maternal Hospital	Sudan	IB	CS	568	449
Abdullahi et al., [17]	2014	2014	Khartoum Hospital	Sudan	IB	CS	855	788
Lyoba et al., [15]	2019	2020	Kasulu district,	Tanzania	IB	CS	320	65
Munyogwa et al., [2]	2023	2024	Dodoma City	Tanzania	IB	CS	452	161
Koka et al., [18]	2023	2024	Dar es Salaam	Tanzania	IB	CS	428	136
Tessema M et al., [19]	2021	2023	Lira district	Uganda	IB	CS	252	243
Agegnehu et al., [20]	2018	2019	Lay Armachiho Health Centers	Ethiopia	IB	CS	418	120
Gebreamlak et al., [21]	2016	2017	Akaki Kality Sub City, Addis Ababa	Ethiopia	IB	CS	557	339
Nimwesiga et al., [14]	2020	2021	Bwindi Community Hospital	Uganda	IB	CS	438	98
Eleni et al., [22]	2019	2021	Gulele Sub-City Government Health Centers in Addis Ababa	Ethiopia	IB	CS	398	248
Maher et al.,[11]	2021	2022	Rubanda District were	Uganda	IB	CS	172	107
Hector et al.,[35]	2025	2025	Mbarara district	Uganda	IB	CS	172	111
Hardido et al., [23]	2022	2023	Southern Ethiopia	Ethiopia	IB	CS	339	189
Assefa et al., [24]	2018	2019	Aykel town	Ethiopia	IB	CS	412	196
Washo et al., [25]	2024	2024	Shashemene town	Ethiopia	IB	CS	403	268
Gebregyorgis et al., [26]	2018	2020	Adwa town	Ethiopia	IB	CS	616	252
Solomon et al., [27]	2019	2021	Dire Dawa	Ethiopia	IB	CS	401	288
Yismaw et al.,[16]	2021	2022	Metema District	Ethiopia	IB	CS	575	200
Seid et al.,[28]	2024	2025	Waghimra zone	Ethiopia	IB	CS	406	183
Ismail et al., [36]	2022	2024	Ahmed-dhagah district	Somalia	IB	CS	320	74
Molla et al.,[37]	2018	2019	West Dembia district	Ethiopia	IB	CS	348	184
Kiwanuka et al., [38]	2014	2017	Mulago National Referral Hospital	Uganda	IB	CS	370	41
Tizalegn et al. [39]	2018	2021	Dila town	Ethiopia	IB	CS	339	172

anemia, a history of anemia during the current pregnancy, good knowledge of iron–folic acid supplementation, and receiving counseling on the importance of IFAS during antenatal care.

Results

A comprehensive search across multiple international databases initially identified 890 published and unpublished studies. After importing the records into EndNote for reference management, 334 duplicates were removed, leaving 556 articles for title and abstract screening. Of these, 413 studies were excluded due to irrelevance, resulting in 143 full-text articles assessed for eligibility. Following full-text review, 117 studies were further excluded: 35 were conducted outside East Africa, and 82 did not report clearly defined outcomes. Consequently, 26 studies met the inclusion criteria and were incorporated into the systematic review and meta-analysis.

Characteristics of selected studies

As described above (Table 1), all included studies were published between 2014 and 2025. In this systematic review and meta-analysis, a total of 10,878 pregnant women attending antenatal care were included to estimate the pooled adherence to iron–folic acid supplementation in East Africa. All included studies employed institution-based cross-sectional designs. Reported adherence to iron–folic acid supplementation ranged from 21.75% to 69.39%. The meta-analysis incorporated studies from six East African countries, with a total of 26 studies

included. Among these, 13 studies were conducted in Ethiopia [16, 20–28, 31, 37, 41], 2 studies were conducted study in Kenya [29, 30], 5 studies were conducted study in Uganda [11, 14, 19, 35, 38], 2 studies were conducted study in Sudan [17, 32], 3 studies were conducted study in Tanzania [2, 15, 18] and one study was conducted in Somalia [36].

Pooled adherence to iron–folic acid supplementation in East Africa

The pooled adherence to iron–folic acid supplementation among pregnant women in East Africa [2, 11, 14–32] was estimated to be 58% (95% CI: 57.24–58.76) (Fig. 2). Heterogeneity across the included studies was assessed using the I^2 statistic, which indicated substantial heterogeneity among studies **(**$I^2 = 99.5\%$, $p < 0.001$**)** (Fig. 2**)**.

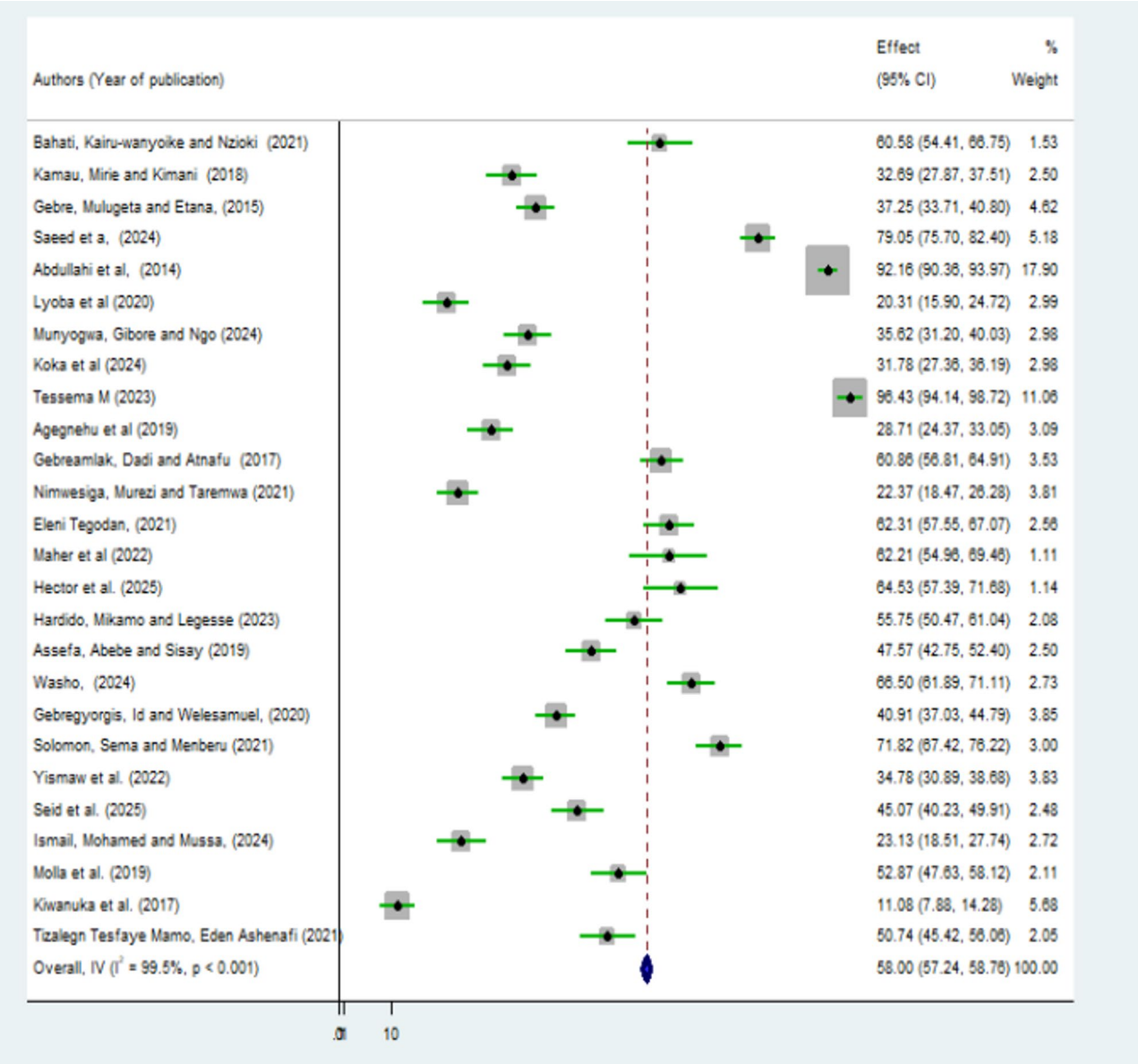


Fig. 2 Forest plot showing overall pooled estimates of adherence to iron–folic acid supplementation among pregnant women in East Africa

Publication bias and heterogeneity

To Heterogeneity among the included studies was assessed using the Cochrane Q test and the I^2 statistic along with their corresponding p-values. Heterogeneity was categorized as none ($I^2 = 0\%$), low ($I^2 = 25\%$), moderate ($I^2 = 50\%$), or high ($I^2 = 75\%$). Due to the observed variability among studies, a random-effects model was applied for the meta-analysis. The I^2 test indicated considerable heterogeneity across studies **(**$I^2 = 99.5\%$, $p < 0.001$**)**, suggesting that most of the variation in effect estimates was attributable to differences between studies rather than chance.

Potential publication bias was also evaluated. Visual inspection of the funnel plot revealed an asymmetrical distribution of studies, suggesting the presence of bias. To further investigate the sources of asymmetry, meta-regression analyses were performed, allowing for exploration of potential study-level factors contributing to heterogeneity (Fig. 3).

Subgroup analysis

Based on the countries, the subgroup analyses were done, and their results were revealed that Sudan had the highest pooled estimate of adherence of iron–folic acid supplementation among pregnant women 89.22% (95%CI: 87.63–90.8) and the lowest pooled estimate of adherence of iron–folic acid supplementation among pregnant women in Somalia 23.13% (95%CI: 18.1-27.74) (Fig. 4).

Based on the level of quality, the subgroup analyses were done, and their results were revealed that high quality had the highest pooled estimate of adherence of iron–folic acid supplementation among pregnant women 57.95% (95%CI: 57.07–58.84) and the medium quality level of pooled estimate of adherence of iron–folic acid supplementation among pregnant women was 58.13% (95%CI: 56.63–59.63) (Fig. 5).

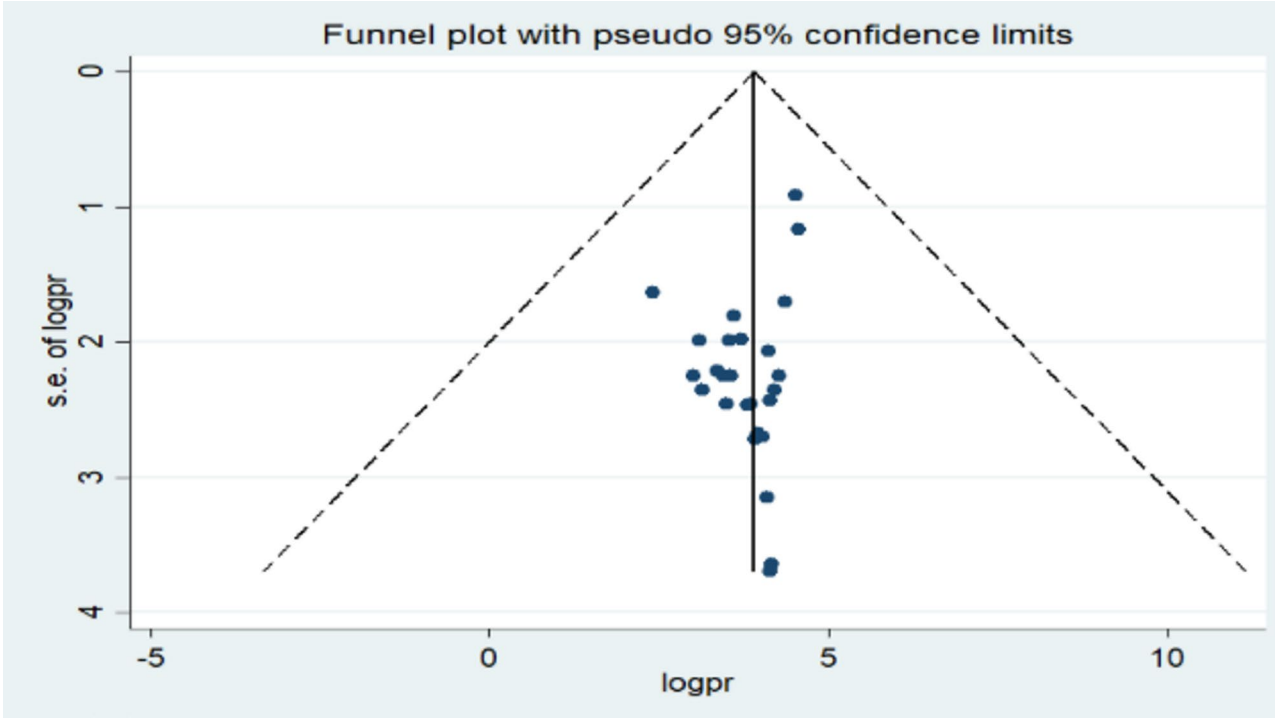


Fig. 3 Funnel plot shows the study's publication bias of adherence iron–folic acid supplementation among pregnant women in East Africa

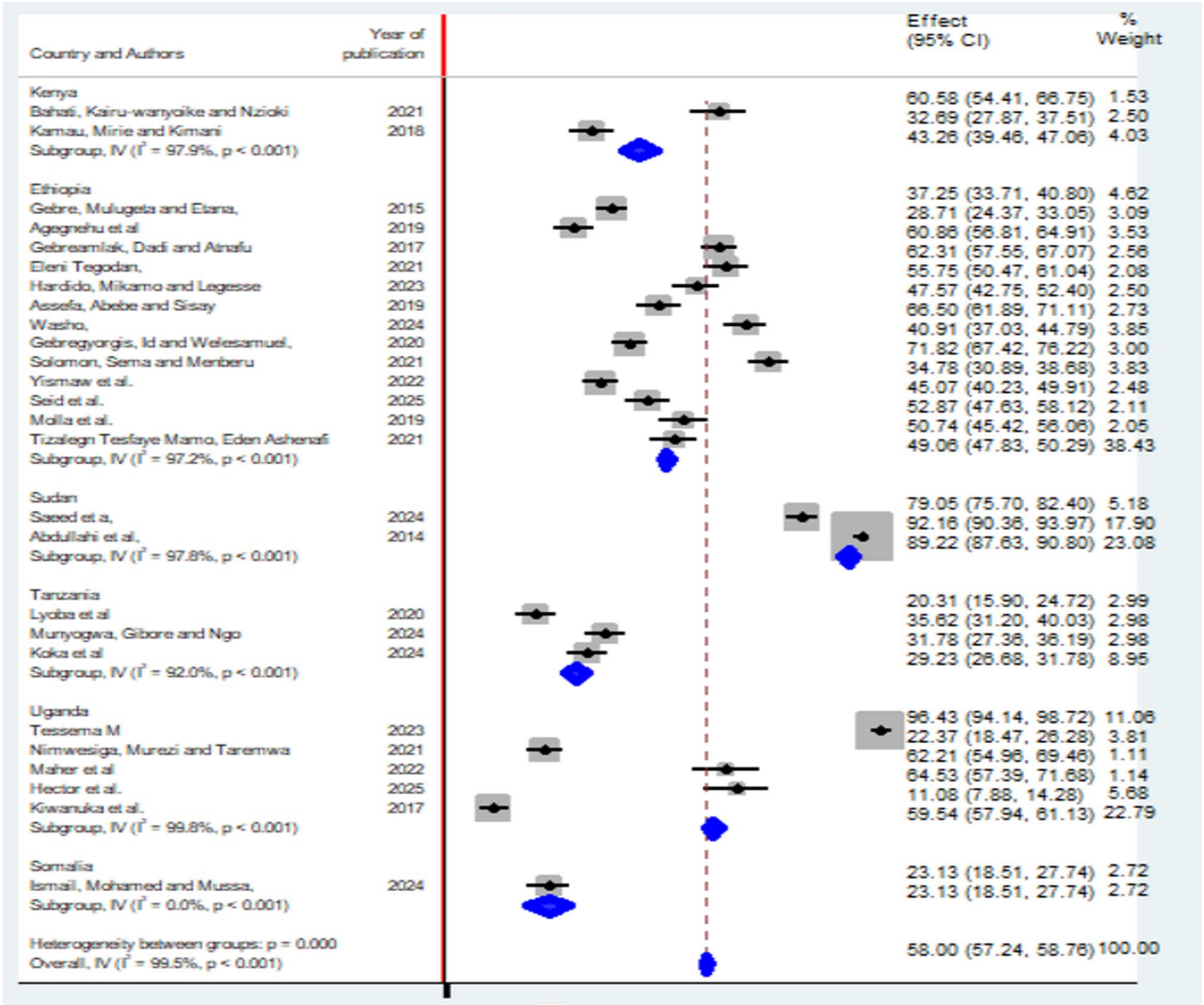


Fig. 4 Sub-group analysis of the study by the countries of adherence iron–folic acid supplementation among pregnant women in East Africa

Based on the year of the study, the subgroup analyses were done, and their results were showed that that 2021 years of study had the highest pooled estimate of adherence of iron–folic acid supplementation among pregnant women 77.67% (95%CI: 75.85–79.49) and 2020 years of study had the lowest pooled estimate of adherence of iron–folic acid supplementation among pregnant women was22.37% (95%CI: 18.47–26.28) (Fig. 6).

According to sample size, the subgroup analyses were done, and their results were indicated that that sample size less than and or equal to <=300 had the highest pooled estimate of adherence of iron–folic acid supplementation among pregnant women 87.75% (95%CI: 85.77–89.72) and sample size 300–400 had the lowest pooled estimate of adherence of iron–folic acid supplementation among pregnant women was 33.47% (95%CI: 31.87–35.07) (Fig. 7).

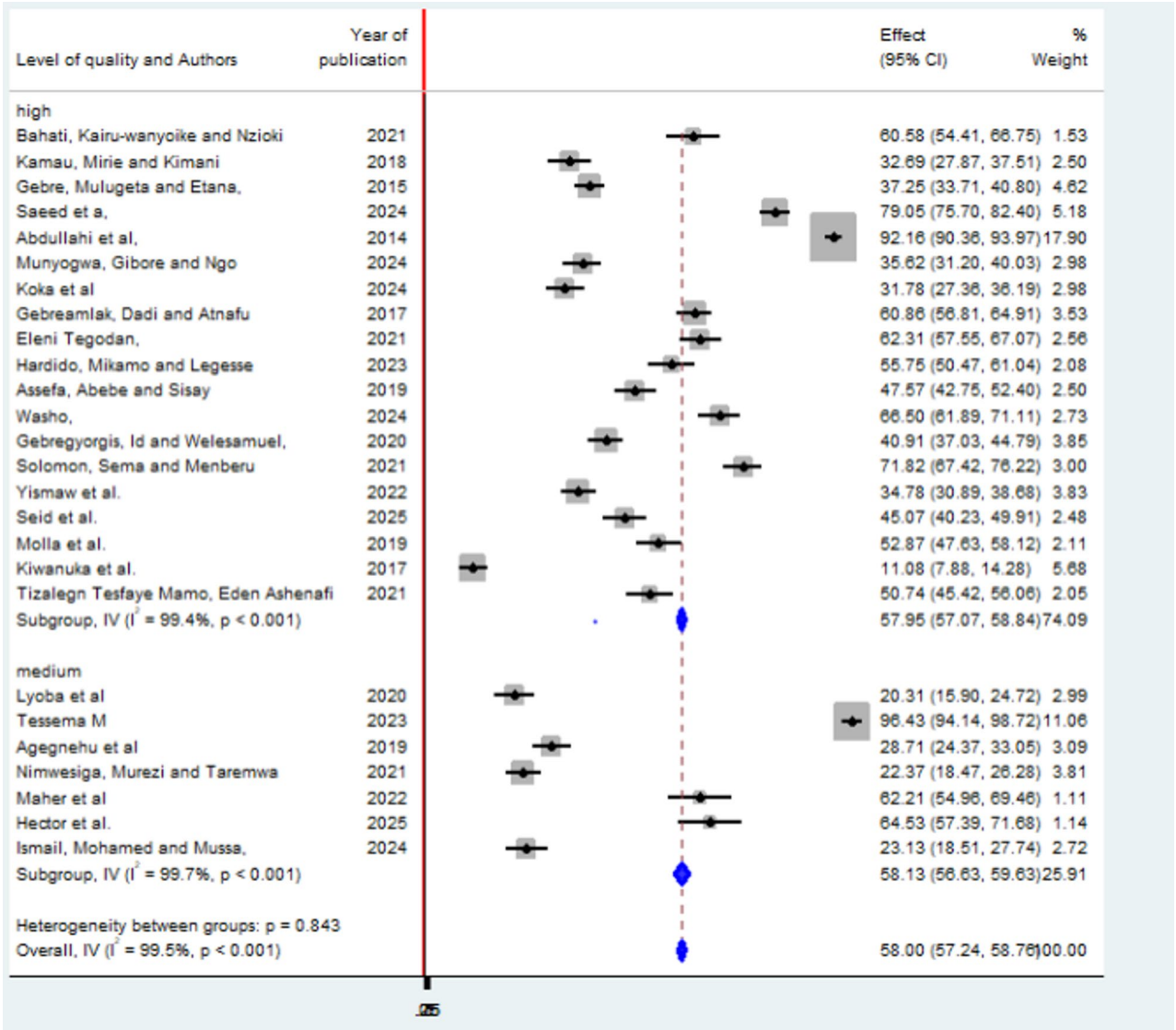


Fig. 5 Sub-group analysis of the study by level of quality of adherence iron–folic acid supplementation among pregnant women in East Africa

Meta-regression of Egger test

Egger's regression test was performed to assess publication bias and small-study effects. The result showed statistically significant evidence of small-study effects (intercept = -0.368, 95% CI: -0.723 to -0.013, p = 0.043), indicating possible publication bias or funnel plot asymmetry among the included studies (Fig. 8).

Trim-and-fill analysis

A meta-analysis of 26 studies yielded a pooled effect estimate of 3.91 (95% CI: 3.15–4.67), which was statistically significant ($z = 10.05$, $p < 0.001$). There was no evidence of heterogeneity among the included studies ($Q = 2.41$, $df = 25$, $p = 1.000$; $\tau^2 = 0.000$). Consequently, the fixed-effect and random-effects models produced identical pooled estimates, indicating high consistency across studies (Fig. 9).

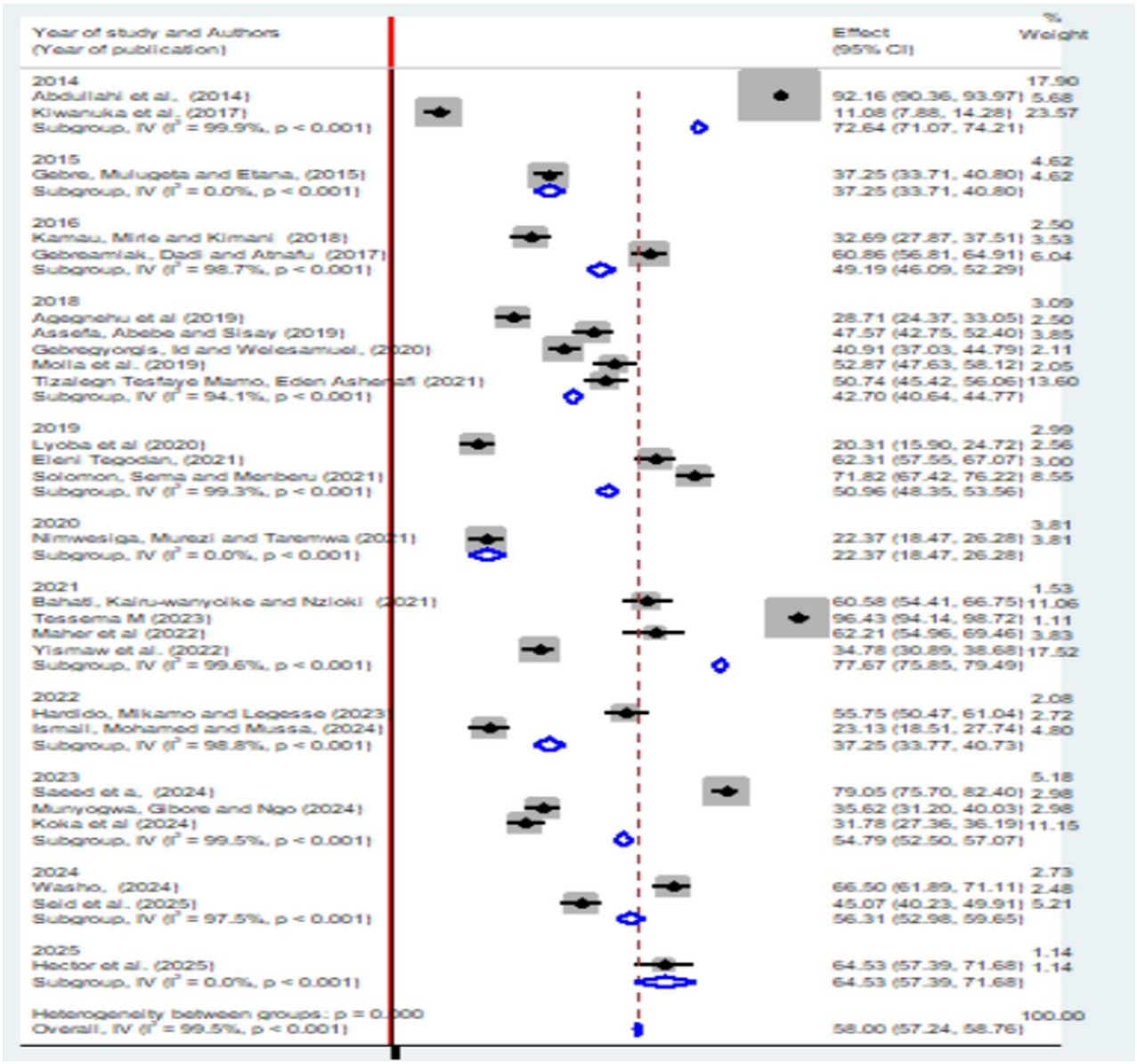


Fig. 6 Sub-group analysis of the study by the year of the study of adherence iron–folic acid supplementation among pregnant women in East Africa

Sensitivity analysis

A sensitivity analysis with a random-effects model was done to assess any outliers on the overall estimate of the pooled adherence to iron–folic acid supplementation, and it showed that there was no single study influence (Fig. 10)

Determinants of adherence iron–folic acid supplementation

Due to inconsistencies in the categorization and grouping of exposure variables across the included studies, it was not possible to quantitatively synthesize all factors associated with adherence to iron–folic acid supplementation. The other included study also assessed these factors; however, in those studies the factors were not significantly

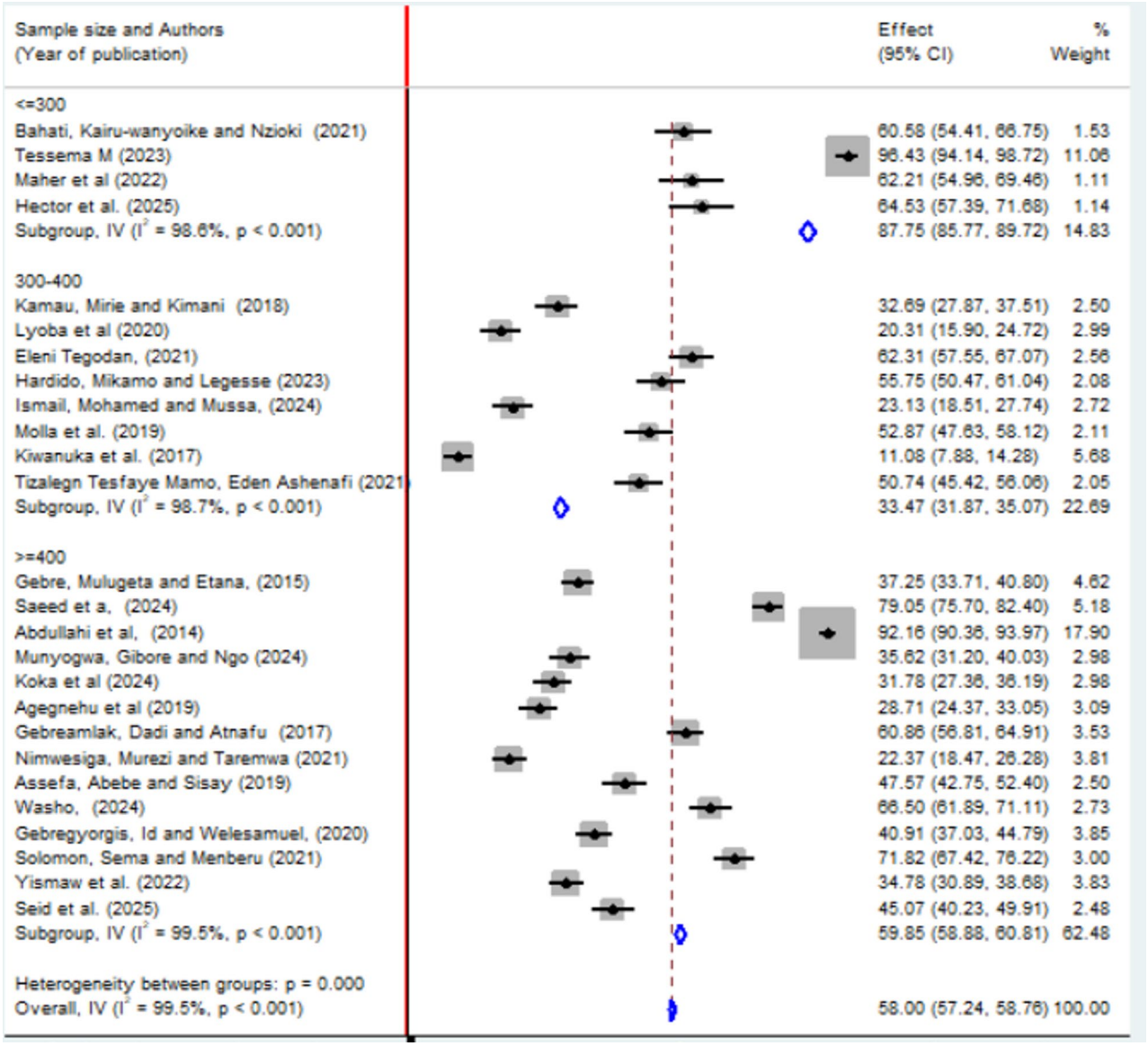


Fig. 7 Sub-group analysis of the study by the sample size of adherence iron–folic acid supplementation among pregnant women in East Africa

associated with the outcome in the primary. As a result, only selected variables with comparable definitions were included in the meta-analysis. From the included studies, five key variables were identified as significant determinants of adherence to iron–folic acid supplementation. These were: attending four or more antenatal care (ANC) visits, having good knowledge about anemia, a history of anemia during the current pregnancy, possessing good knowledge of iron–folic acid supplementation, and receiving counseling on the importance of iron–folic acid intake.

Counseling on the importance of the iron-folic acid

Findings from seven studies indicated that pregnant women who received counseling on the importance of iron–folic acid supplementation were more likely to adhere to the supplementation compared to those who did not receive such counseling. The pooled analysis of adjusted odds ratio further demonstrated that women who were

```
Number of studies =  26                                  Root MSE      =    .2906

------------------------------------------------------------------------------
     Std_Eff |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       slope |   4.594502   .3407585    13.48   0.000     3.891211    5.297793
        bias |  -.3678139   .1718845    -2.14   0.043    -.7225661   -.0130618
------------------------------------------------------------------------------

Test of H0: no small-study effects          P = 0.043
```

Fig. 8 Meta-regression Egger test of adherence to iron–folic acid supplementation among pregnant women in East Africa

```
Filled
Meta-analysis

        |  Pooled       95% CI          Asymptotic       No. of
Method  |     Est    Lower    Upper   z_value  p_value    studies
--------+-------------------------------------------------------
Fixed   |   3.907    3.145    4.669    10.048    0.000       26
Random  |   3.907    3.145    4.669    10.048    0.000

Test for heterogeneity: Q=  2.414 on 25 degrees of freedom (p= 1.000)
Moment-based estimate of between studies variance =  0.000
```

Fig. 9 Trim-and-fill analysis of adherence iron–folic acid supplementation among pregnant women in East Africa

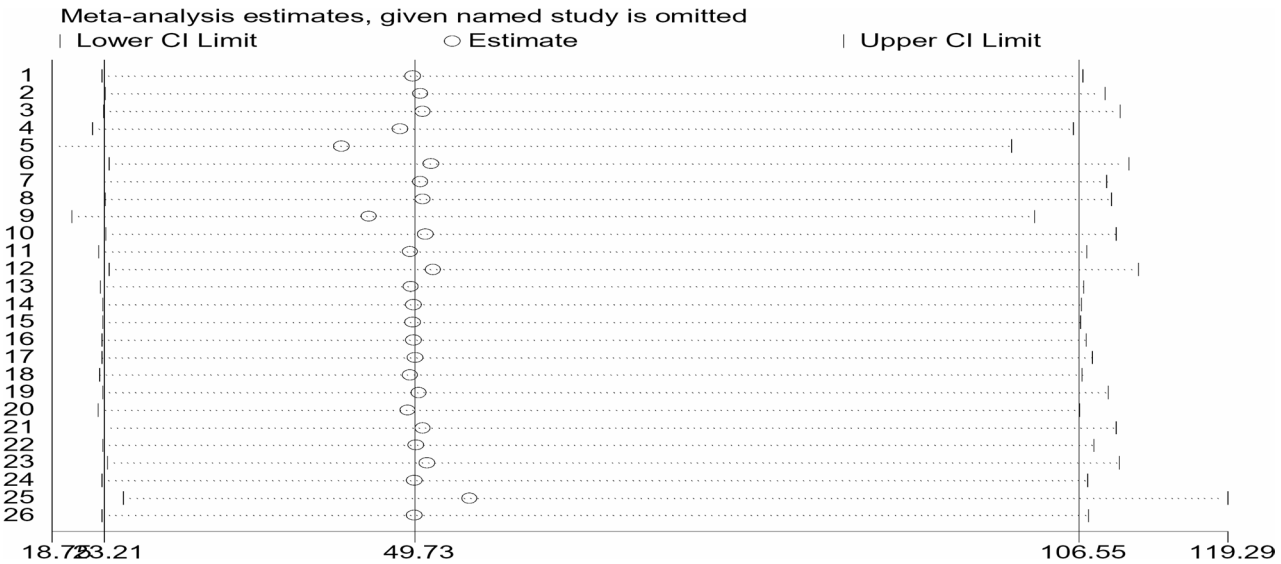


Fig. 10 Sensitivity analysis of adherence iron–folic acid supplementation among pregnant women in East Africa

counseled were 2.41 times more likely to adhere to iron–folic acid supplementation than their counterparts who did not receive counseling (OR = 2.41; 95%CI: 1.73–3.09) (Fig. 11).

Good knowledge of iron-folic acid

The results of the current meta-analysis of seven studies indicated that pregnant women who had good knowledge of iron-folic acid supplementation were more likely to Adherence of iron–folic acid supplementation. Thus, the pooled data of adjusted odds ratios showed that pregnant women who had good knowledge of iron-folic acid supplementation were 1.8 times more likely to Adherence of iron–folic acid supplementation than pregnant women who did not have good knowledge of iron-folic acid supplementation (AOR = 1.8; 95%CI:1.43–2.17) (Fig. 12).

Good knowledge about anemia

The results of the current meta-analysis of three studies indicated that pregnant women who had good knowledge about anemia were more likely to Adherence of iron–folic acid supplementation. Thus, the pooled data adjusted odds ratios showed that pregnant women who had good knowledge about anemia were 3.19 times more likely to Adherence of iron–folic acid supplementation than pregnant women who did not have good knowledge about anemia(AOR = 3.19; 95%CI:1.87–4.52) (Fig. 13).

Anemia history during current pregnancy

According to the findings of four studies, pregnant women who developed anemia history during current pregnancy were more likely to Adherence to iron–folic acid supplementation compared with pregnant women who did not develop anemia history during current pregnancy. Thus, the pooled data adjusted odds ratios showed that pregnant women who developed anemia history during current pregnancy were 2.49 times more likely to

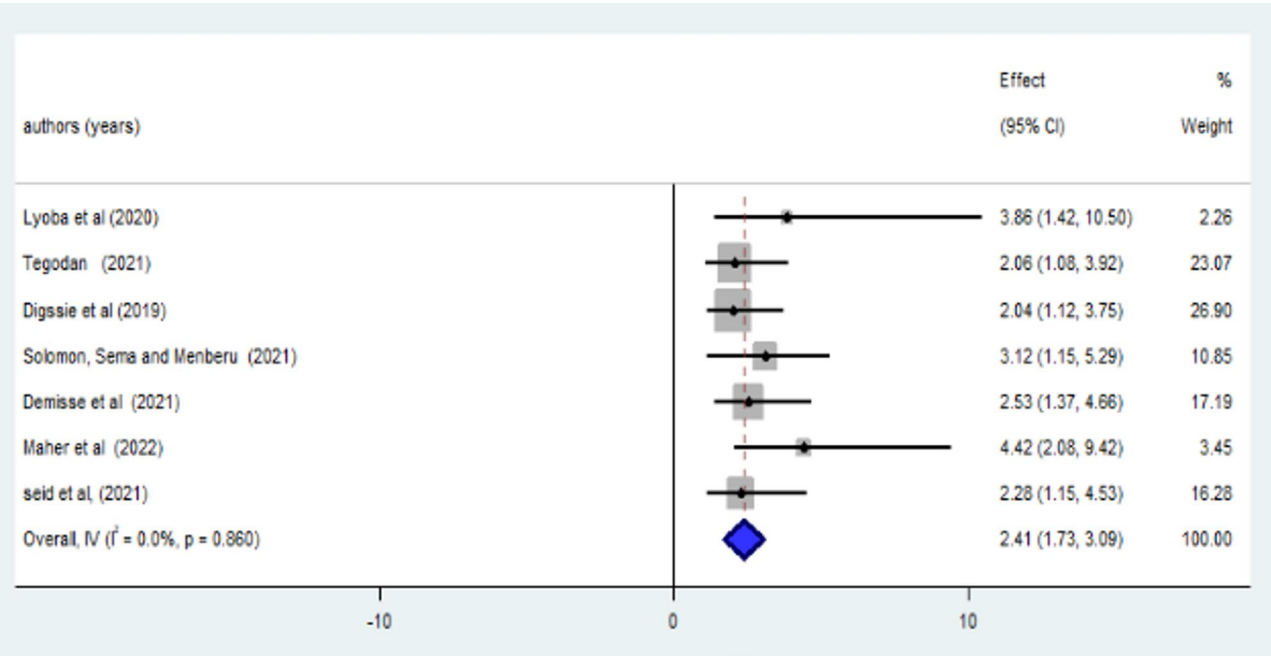


Fig. 11 Pooled odds ratio of the association between counseling on the importance of iron–folic acid supplementation and adherence of iron–folic acid supplementation among pregnant women in East Africa

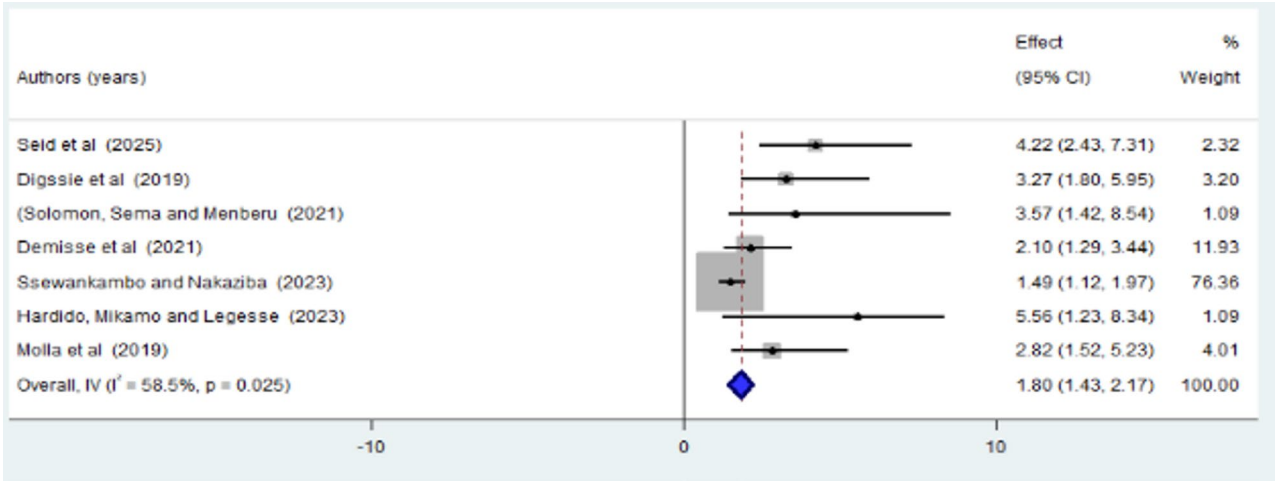


Fig. 12 Pooled odds ratio of the association between good knowledge of iron-folic acid supplementation and Adherence of iron–folic acid supplementation among pregnant women in East Africa

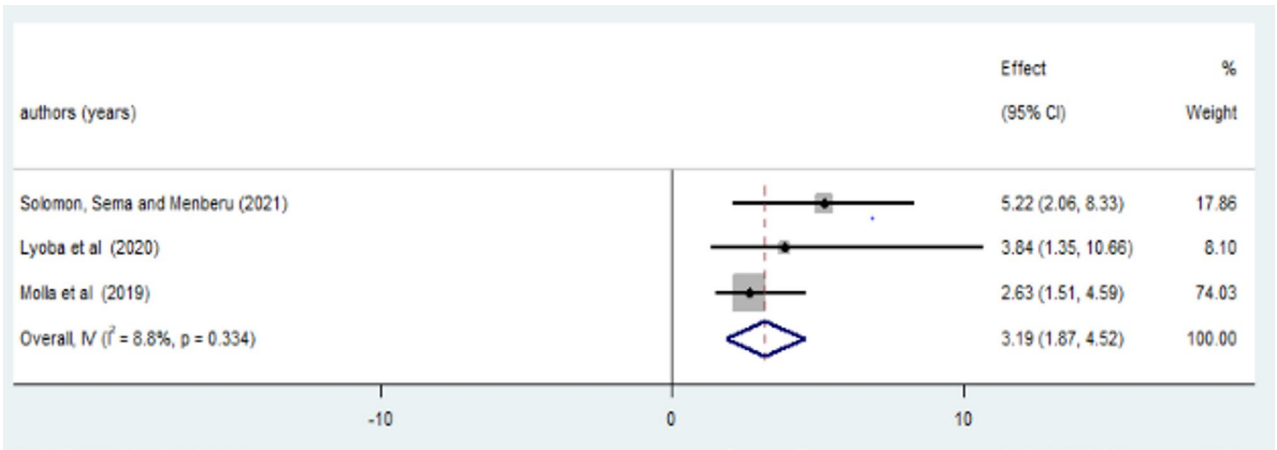


Fig. 13 Pooled odds ratio of the association between good knowledge about anemia and Adherence to iron–folic acid supplementation among pregnant women in East Africa

Adherence of iron–folic acid supplementation than pregnant women who did not develop anemia history during current pregnancy (AOR = 2.77; 95%CI: 1.4–4.13) (Fig. 14).

Four or more ANC visits

According to the findings of three studies, pregnant women who had four or more ANC visits were more likely to Adherence of iron–folic acid supplementation. Thus, the pooled data showed that pregnant women who had four and more ANC visits were 4.14 times more likely to Adherence of iron–folic acid supplementation than pregnant women who did not four and more ANC visits (AOR = 4.14; 95%CI: 1.87–6.42) (Fig. 15).

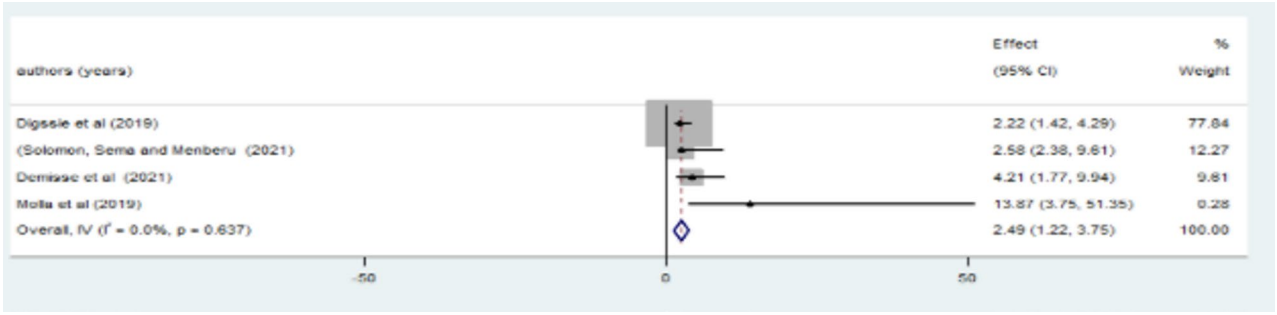


Fig. 14 Pooled odds ratio of the association between anemia history during current pregnancy and adherence to iron–folic acid supplementation among pregnant women in East Africa

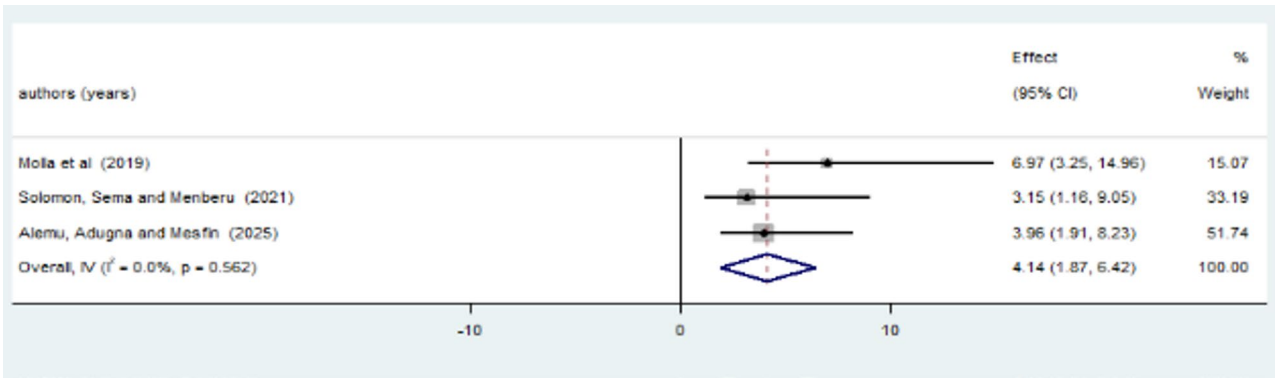


Fig. 15 Pooled odds ratio of the association between four and more ANC visits and adherence to iron–folic acid supplementation among pregnant women in East Africa

Discussion

This systematic review and meta-analysis aimed to estimate the pooled prevalence of adherence to iron–folic acid supplementation among pregnant women in East Africa and identify factors associated with adherence. The result of this systematic review and meta-analysis study was 58% (95% CI: 57.24–58.76). The finding of this systematic review and meta-analysis is lower than the study done in Simada District, Northwest Ethiopia 67.5% [42], Cambodia (91% [43], Karnataka, India 89% [44], peri-urban municipality, Ghana 84.5% [8], and Dodoma City, Tanzania 66.5% [2]. These differences may be explained by variations in maternal characteristics, healthcare systems, and study settings across countries. Moreover, differences in the burden of anemia, dietary iron intake, and the prevalence of infections that increase iron requirements may also contribute to variations in adherence across populations.

The finding of this study was higher than systematic review and meta-analysis studies conducted in Ethiopia 41.38% [45], Kasulu, Tanzania 20.3% [15], Bwindi Community Hospital, Uganda 22.37% [14], Dilla town, South Ethiopia 44.3% [41], and Adwa town, Ethiopia 40.9% [26]. These differences may be attributed to variations in maternal knowledge and perceptions regarding IFAS, educational attainment, healthcare access, and the quality of antenatal care services across study settings. Women with better awareness of the benefits of IFAS and the health consequences of anemia during pregnancy are more likely to adhere to the recommended supplementation regimen. Furthermore, differences in health system factors, including the availability of supplements, the quality of counseling provided during antenatal care, and the implementation of maternal nutrition programs, may have contributed to the higher adherence observed in the present study compared with these previous reports.

In this systematic review and meta-analysis, women who were counseled were 2.41 times more likely to adhere to iron–folic acid supplementation than their counterparts who did not receive counseling (AOR = 2.41; 95%CI: 1.73–3.09). This study finding is supported by the study conducted in Ethiopia [28], Tanzania [15],Uganda [11] and Ethiopia [28]. Counseling plays a crucial role in providing accurate information about the purpose, dosage, and duration of supplementation. It also allows healthcare providers to address concerns regarding possible side effects and correct misconceptions about the tablets. As a result, counseling enhances women's confidence in the intervention and encourages consistent use of iron–folic acid supplements during pregnancy.

Pregnant women who had good knowledge of iron-folic acid supplementation were 1.8 times more likely to adhere to iron–folic acid supplementation than pregnant women who did not have good knowledge of iron-folic acid supplementation (AOR = 1.8; 95%CI:1.43–2.17). This study finding is supported by the study conducted in Ethiopia [27], and Sudan [32]. This could be because knowledge about the benefits of iron and folic acid, such as prevention of maternal anemia and promotion of fetal growth and development, helps women understand the importance of regular supplement intake. Adequate knowledge also reduces misconceptions and negative attitudes toward the supplements, thereby improving adherence.

In addition, pregnant women who had good knowledge about anemia were 3.19 times more likely to Adherence of iron–folic acid supplementation than pregnant women who did not have good knowledge about anemia(AOR = 13.19; 95%CI:1.87–4.52). This study finding is supported by the study conducted in Ethiopia [37], and Tanzania [15]. This could be explained by the fact that awareness of the causes, symptoms, and complications of anemia increases women's understanding of the importance of preventive measures during pregnancy. When pregnant women recognize the potential health risks of anemia for both mother and fetus, they may be more motivated to take iron–folic acid tablets regularly as recommended.

Pregnant women who developed anemia history during current pregnancy were 2.49 times more likely to Adherence of iron–folic acid supplementation than pregnant women who did not develop anemia history during current pregnancy (AOR = 2.77; 95%CI: 1.4–4.13). This study finding is supported by the study conducted in Ethiopia [37]. This might be due to increased awareness of their health condition and the potential consequences of untreated anemia. Women diagnosed with anemia often receive more intensive counseling and follow-up from healthcare providers, which may improve their commitment to taking the supplements. Furthermore, experiencing symptoms related to anemia may motivate women to comply with treatment and preventive measures.

Pregnant women who had four or more ANC visits were 4.14 times more likely to adhere to iron–folic acid supplementation than pregnant women who did not four or more ANC visits (AOR = 4.14; 95%CI: 1.87–6.42). This study finding is supported by the studies conducted in Ethiopia [27, 37]. This may be because repeated ANC visits provide opportunities for healthcare providers to educate mothers about the benefits of iron–folic acid supplementation and the risks of anemia during pregnancy. Frequent contact with health professionals also allows continuous monitoring and encouragement of supplement intake. In addition, women who attend ANC more frequently are more likely to receive an adequate supply of iron–folic acid tablets and follow-up support. These factors collectively contribute to improved adherence.

Strengths of the study

The strengths of this study were it followed the guidelines of the PRISMA group to ensure transparency and methodological rigor in the systematic review process and searched multiple international databases, which increased the likelihood of identifying relevant studies. This study used a standardized quality assessment tool to evaluate the methodological quality of included studies, and the use of meta-analysis allowed the estimation of pooled prevalence and provided more precise evidence than individual studies.

Limitations of the study

The limitations of this study were most of the included studies employed observational, predominantly cross-sectional, study designs, which preclude the establishment of causal relationships between adherence to iron–folic acid supplementation (IFAS) and its associated factors. Substantial statistical heterogeneity was observed across the included studies, likely reflecting differences in study populations, healthcare settings, sample sizes, measurement methods, and methodological quality. Evidence of potential publication bias was detected, suggesting that studies reporting statistically significant findings may have been more likely to be published and included in the review. Only studies published in English were included, which may have introduced language bias by excluding relevant studies published in other languages, and some East African countries were underrepresented because of the limited availability of eligible studies, which may reduce the generalizability and regional representativeness of the pooled estimates.

Implications of the study

The findings of this study have important implications for public health policy and maternal health programs in East Africa. The level of adherence to iron–folic acid supplementation suggests the need for stronger interventions aimed at improving maternal nutrition during pregnancy. Healthcare providers should strengthen counseling services during antenatal care visits to educate pregnant women about the benefits of iron–folic acid supplementation and how to manage potential side effects. In addition, community-based health education programs should be implemented to increase awareness about maternal anemia and the importance of supplementation. Policymakers should also ensure consistent availability and accessibility of iron–folic acid tablets in health facilities to improve adherence among pregnant women.

Conclusion

This systematic review and meta-analysis demonstrated that adherence to iron–folic acid supplementation among pregnant women in East Africa remains below the desired level. The study identified antenatal care attendance, counseling, and maternal knowledge-related factors as key determinants of adherence. Strengthening routine antenatal care services through improved counseling, health education, and continuous support for pregnant women is recommended to enhance IFAS adherence.

Based on these findings, it is recommended that healthcare providers enhance and standardize counseling services during antenatal care visits, with a strong focus on improving women's understanding of the benefits, proper use, and possible side effects of iron–folic acid supplementation. Health systems and policymakers should promote early initiation and completion of at least four or more antenatal care visits while ensuring uninterrupted availability of supplements at health facilities. Community-based health education strategies, including the use of health extension workers and mass media, should be strengthened to improve knowledge and address misconceptions about anemia and supplementation. Furthermore, special attention should be given to high-risk groups with limited awareness or poor access to healthcare services. Future research should focus on longitudinal and interventional studies to better establish causal relationships and evaluate effective strategies to improve adherence.

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Data availability The original contributions presented in the study were included in the articles. Material; further inquiries can be directed to the corresponding author based upon reasonable request.

Declarations

Ethical approval and consent to participate Not applicable; since we did not use primary data that needed ethical approval and consent to participate.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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