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The magnitude of preconception care utilization and associated factors among women in Ethiopia: systematic review and meta-analysis, 2024

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Abstract

Background Nowadays globally a woman dies every two minutes, and a neonate dies even in every 12 s, and more than two-thirds of these maternal deaths are preventable. Preconception care is a continuum of maternity care which is one of the proven strategies to reduce not only maternal mortality and morbidity but also neonatal mortality and morbidity by improving women's health. Therefore, this study aimed to assess the pooled magnitude of preconception care utilization and its associated factors among women in Ethiopia.

Methods Searching of studies done through PubMed, Medline, Embase, Cochrane Library, List of References, and Google Scholar. Duplication of records was removed through the Endnote software manager. The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) godliness was adhered to. A Newcastle- Ottawa Scale (NOS) assessment tool was used to evaluate the quality of studies. Analysis was performed using a random effect model with STATA 17 version software. Egger's weighted regression and I^2 test were used to evaluate publication bias and heterogeneity respectively.

Results In this systematic review and meta-analysis, a total of 6,808 women from 14 primary studies were included. The overall pooled magnitude of preconception care utilization in Ethiopia was 26% (95% CI: 18, 34). Educational status (OR = 2.18, 95%CI 1.54, 2.82), adequate knowledge of women regarding preconception care (OR = 2.69, 95%CI 1.90, 3.48), pre-existing medical illness (OR = 4.79, 95%CI 2.61, 6.06), history of adverse pregnancy outcome (OR = 3.18, 95%CI 2.74, 3.62), and husband /partner support (OR = 3.26, 95%CI 1.55, 4.97) were the identified predictors of utilization of preconception care.

Conclusion The overall magnitude of preconception care utilization among Ethiopian women was significantly low. Educational status of women, knowledge of women regarding Preconception care, history of adverse birth outcome, pre-existing chronic medical illness, and either psychological or financial husband support were the identified predictors of preconception care utilization. Thus, healthcare organizations should work on strategies to improve

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the utilization of preconception care. Moreover, advocating for better women's education, awareness creation, and encouraging male involvement is very essential to optimize service utilization.

Prospero registration CRD42023492995 registered on 23/12/2023.

Keywords Preconception care, Utilization, Women, Systematic review, Meta-analysis, Ethiopia

Background

Preconception care (PCC) is a critical component of maternal and child health, defined as a comprehensive set of interventions aimed at identifying and modifying biomedical, behavioral, and social risks that may affect a woman's health or pregnancy outcome [1]. The goal of PCC is to provide the couple with all the information required to make informed decisions regarding their future reproductive planning [2]. A continuum of maternity care, beginning before conception and extending through pregnancy, childbirth, infancy, childhood, and adolescence, is essential in reducing maternal and childhood mortality and morbidity. By implementing comprehensive interventions prior to pregnancy, the health and well-being of adolescents, adult women, and men can significantly improve pregnancy and childbirth outcomes [3, 4]. PCC includes a wide array of interventions such as reproductive planning, screening for modifiable risk factors, management of existing medical conditions, treatment of infectious diseases, immunization, and supplementation with iron and folic acid [5, 6].

Despite global efforts to improve maternal health, an estimated 287,000 women die annually from pregnancy & childbirth-related complications, equating to approximately 800 maternal deaths daily [7], with Sub-Saharan Africa (SSA) and South East Asia together accounting for approximately 86% of all maternal deaths [8]. Many of these deaths occur due to hemorrhage, infections, or pre-existing medical conditions exacerbated by pregnancy. However, evidence-based interventions, including quality PCC provided by skilled professionals before pregnancy, can prevent these adverse outcomes [9, 10]. Each year, an estimated 227 million pregnancies occur worldwide, with 44% unintended & over half ending in abortion [11]. This can be prevented through the provision of quality family planning as an integral component of PPC [12, 13]. The Sustainable Development Goals (SDGs) aim to reduce maternal deaths to less than 70 per 100,000 live births and neonatal mortality to lower than 12 per 1,000 live births by 2030. However, the global maternal mortality ratio in 2020 remained high at 223 per 100,000 live births, with SSA recording even higher rates of 547 per 100,000 [14]. In Ethiopia, the maternal mortality ratio stood at 401 per 100,000 live births [7, 15]. Despite a significant advancement, an estimated 2.5 million newborns passed away in 2017 alone globally, and countries with the highest neonatal mortality rates were concentrated

in developing regions including Ethiopia. These neonatal deaths are mainly associated with disorders that develop prior to & throughout pregnancy and complications related to the birth process highlighting the urgent need for improved maternal health services [16, 17].

The Ethiopian government prioritizes maternal and child health services, yet mortality and morbidity rates among women and children remain high. The 2019 Mini Demographic and Health Survey reported an under-five, infant and neonatal mortality rate of 59, 47, and 33 per 1,000 live births respectively [18]. Studies indicate that PCC plays a crucial role in preventing short and long-term adverse health outcomes. Healthy women at conception are more likely to experience successful pregnancies and give healthy children [19, 20]. Conversely, inadequate PCC utilization increases the risks of low birth weight, preterm births, intrauterine fetal death, perinatal mortality, and birth defects [21, 22].

World Health Organization (WHO) developed a package of PCC interventions; that includes nutritional supplementation (iron and folic acid), vaccine-preventable disease, infertility /subfertility, too-early pregnancy, unintended, and rapid successive pregnancy, female genital mutilation, sexually transmitted infections including human immune deficiency virus (HIV), interpersonal violence /violence against women, psychoactive substance use, tobacco and genetic conditions [3].

Global studies identify several factors contributing to the low utilization of PCC, especially in developing countries. These include poor knowledge, negative attitudes, limited access to quality health services, and lack of spousal support [23, 24], age, residence, marital status [25], family monthly income, educational status, history of adverse birth outcome, presence of chronic diseases were factors associated with utilization of PCC [26–28]. For instance, in one study of systematic review and meta-analysis to determine the association between knowledge of women and utilization of PCC in SSA; having good knowledge among women regarding PCC increases their utilization by twofold [29]. Similarly, another study shows women who had previous adverse birth outcomes increase the utilization of PCC by fivefold [27].

In Ethiopia, different studies were conducted across the country regarding PCC utilization and its associated factors. However, the magnitude of these separate studies ranges from 6.3% [30] to 58.3% [31]. This showed a significant variation related to the magnitude and the

determinant factors. A systematic review and meta-analysis were conducted previously in Ethiopia by Ayela et al. published in 2021 [32] incorporating 13 studies. While it provides an important foundation for understanding PCC, 7 studies exclusively reported on women's knowledge of PCC rather than utilization, and only 6 studies were reported on PCC utilization. Besides, the current study includes 14 primary studies each reported utilization of PCC (more studies were coming after Ayela et al. studies were published), providing a more comprehensive and representative pooled estimate. The previous study cannot address more studies published after 2021. Thus, this study aimed to estimate the pooled magnitude, and associated factors of PCC utilization among women in Ethiopia. The findings will provide valuable evidence for policymakers and healthcare providers to enhance PCC implementation, ultimately improving maternal and child health outcomes in the country.

Objectives of the review.

1. To determine the estimated pooled magnitude of PCC utilization among women in Ethiopia.
2. To determine the estimated pooled effect size of factors associated with PCC utilization among women in Ethiopia.

Methods

Registration protocol and study design

The protocol of this systematic review and meta-analysis was registered under the Prospective International Register of Systematic Review (PROSPERO) with CRD42023492995.

Study selection and eligibility criteria

This systematic review and meta-analysis included observational studies such as cross-sectional, case-control, and cohort conducted in Ethiopia among reproductive-age women. Despite the intimal criteria allowing various observational study designs, only cross-sectional studies were available and included. Only studies conducted in the English language were considered with no restriction on publication status or study period. To capture all relevant studies, there was no restriction based on the study period. However, only studies published up to 2024 were included. Regarding measurement outcome, eligible studies were required to quantify the magnitude of PCC utilization and its associated factors, while conference abstracts, editorials, qualitative studies, and review articles were excluded. The final search was conducted on January 25, 2024, and study screening was independently completed by three authors (AA, TD, and SS). With any disagreements are resolved through discussion and consensus based on predefined inclusion and exclusion criteria.

Measurements of the outcome

In this study, the outcome interests were the utilization of PCC and associated factors. The first outcome had to estimate the pooled magnitude of PCC utilization among women in Ethiopia, and the second outcome was the association factors. For the first outcome, the magnitude was determined by women who received at least one service among the WHO-recommended packages of PCC before their pregnancy. These include nutritional counseling, folic acid supplementation, infectious disease screening, chronic disease management, family planning counseling, and substance use cessation. The magnitude of PCC utilization was calculated by the number of women who received at least one PCC service divided by the total number of women who participated in the primary studies and then multiplied by 100. For the associated factors (second outcome), the pooled odds ratio with 95%CI was employed to ascertain the degree of association between PCC utilization and its determinants.

Searching strategies

All published studies were searched using PubMed, MEDLINE, Embase, and Cochrane Library. Searching for unpublished studies (Gray literature) was also done with Google Scholar. Moreover, the List of Reference Index was used to retrieve both published and unpublished studies. Endnote X7 software was utilized to retrieve and organize the studies identified through the search strategy, and to eliminate any duplicate records. To locate the relevant studies within the search databases, the following search terms were used: (magnitude) OR (prevalence) OR (incidence) OR (proportion) AND (preconception care) OR (pre-pregnancy care) AND (utilization) OR (practice) AND (associated factors) OR (risk factors) OR (predictors) OR (determinants) AND (women) OR (reproductive age women) OR (pregnant women) AND (Ethiopia). These were done in accordance with, the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guideline.

Data extraction process

The relevant data were extracted from the selected studies by the three authors (AA, SS, and TD) independently using a predetermined data extraction format. This predetermined data extraction format was prepared using the Microsoft Excel 16 version agreed upon by the five authors (AA, WT, GA, SS, and TD); with the following structure: Author detail (name and year of publication, year of study, study design, study setting (institutional versus community-based), sample size, sampling technique, response rate, and region where the specific study was done. Furthermore, the number of women who received PCC along with 95%CI was included in the data extraction format for the first outcome (magnitude of

PCC). For the second outcome (factors), data were collected in the form of a two-by-two table, and the log odds ratio for each factor was calculated based on the findings of the primary studies. After three trials, discrepancies among the data extractors were resolved through further discussion and Consensus. To capture all relevant studies, restrictions were not made based on the study period. However, only studies published up to 2024 were included since the last search was on January 25, 2024.

Data quality assessment

The quality of each primary study was assessed by using the Newcastle Ottawa Assessment (NOS) scale specifically adapted for cross-sectional studies. The assessment of quality and eligibility of the screened articles was based on ten scores distributed into the three major categories (category I, II & III). Category I (selection): included scores for representativeness of the sample, sample size justification, response rate, and ascertainment of the exposure which scores a maximum of 5 points. Category II (comparability) involved a score for controlling a confounding variable by adjusting data or results for relevant predictors and scores a maximum of two points. Category III (outcome): comprised of scores for the assessment of the outcome, and the use of appropriate statistical tests, which score a maximum of three points. Based on this, the NOS assessment tool classifies the quality of each study in a score of 0 to 4, 5 to 6, 7 to 8, and 9 to 10 points as unsatisfactory, satisfactory, good, and very good study respectively [33, 34]. Accordingly, a score of 7 and above out of 10 was declared as having high quality (eligible for the study) and enrolled

in this meta-analysis (Table 1). Quality assessment was done independently by AA, SS, and TD. Any subjectivity and disagreements between them were resolved through consensus and further discussion.

Dada analysis and synthesis

Analysis was done using STATA 17 version software. By considering heterogeneity among the included studies, a random effect model with a restricted maximum likelihood method was used to compute the estimated pooled magnitude of PCC utilization. The graphical Forest plot was created to determine the estimated pooled magnitude of PCC utilization with a 95%CI. Publication bias was determined by creating the Funnel plot visually, as well as by conducting Egger's weighted regression test statistically. Pooled OR with 95%CI was calculated to assess the relationship between PCC utilization and its associated factors. Statistical heterogeneity was assessed by using I-squired (I^2) test value. This statistic quantifies the proportion of total variation between studies that can be attributed to heterogeneity rather than chance. Accordingly, the result of the I^2 value was interpreted as < 25, 25–50, 50–75, and ≥75 as low, moderate, high, and very high heterogeneity respectively [35]. Subgroup analysis for high and very high values, was done to identify the possible source of variation between studies.

Results

Search results

A total of 5,425 study records were identified through database searching of PubMed, MIDLINE, Embase, Cochrane Library, Google Scholar, and List of References

Table 1 Quality assessment of included studies of the magnitude of PCC utilization and associated factors among women in Ethiopia, using NOS assessment tool, 2024

First author & publication year	Selection				Comparability	Outcome		Total	
	Representativeness of sample size	Sample size justified	Non-Response rate	Ascertainment of the exposure (max **)	Cofounding controlled max (**)	Outcome assessment (max **)	Statistics	Total Score (max 10*)	Overall quality
Negash et al. (2023)	*	*	*	*	*	**	*	8*	Good
Tsrity et al. (2019	*	*	*	**	*	**	*	9*	Very Good
Yitayal et al. (2018)	-	-	*	*	**	**	*	7*	Good
Addisu et al. (2023)	*	*	*	*	*	**	*	8*	Good
Ketema et al. (2021)	*	*	*	*	**	**	*	9*	Very Good
Elias et al. (2022)	*	*	*	**	*	**	*	9*	Very Good
Daniel et al. (2020)	*	*	*	*	**	**	*	9*	Very Good
Meron et al. (2022)	*	*	*	*	*	**	*	8*	Good
Tesfanesh et al. (2019)	*	*	*	*	**	**	*	9*	Very Good
Melsew et al. (2022)	*	*	*	*	*	*	*	7*	Good
Tura (2021)	*	*	*	**	*	**	*	9*	Very Good
Alemu et al. (2022)	*	*	*	*	**	**	*	9*	Very Good
Frianbon et al. (2021)	*	*	*	*	**	**	*	9*	Very Good
Eriste et al. (2022)	*	-	*	**	*	**	*	8*	Good

Note: * refers to getting one point, and ** refers to getting two points

indexes. Of which 525 were removed due to duplication. The remaining 4,900 records were screened by their title and abstracts. After assessing the title and their abstracts we also excluded 4,816 study records due to these articles were not related to our review. Then after assessing 84 full-text articles, 70 were further excluded due to the specific outcome variable (the magnitude of preconception care utilization) was not reported. Although unpublished studies (Gray literature) were searched through Google Scholar, no study was available. Finally, fourteen [14] primary studies fulfilled the eligibility criteria and enrolled in this systematic review and meta-analysis (Fig. 1).

Characteristics of included studies

This systematic review and meta-analysis were carried out from 14 primary studies with a total of 6,808 study participants. From the total of 14 studies, six were Oromia region, three were Amhara region, two were from the South Nation Nationality People of Ethiopia region (SNNP), two were from Addis Ababa city administration, and the remaining one study was from Tigray region. Nearly two-thirds (nine) studies were conducted community-based while nearly one-third (five) were done at the health facility. The sample size ranges from as low as 229 in a study done at Adet town, Amhara region to as high as 669 in the study done at West Shewa zone,

Oromia region. The magnitude of PCC utilization ranged from 6.3% reported in the study done at Mana district, Oromia region, to 58.3% reported in the study done at Sendafa, Oromia region. Regarding study design, all studies were cross-sectional (no eligible study was found other than cross-sectional study design). Response rates ranged from 95 to 100%. Half (seven) studies were done using simple random sampling (SRS), six were done using systematic random sampling, and the rest one was done using consecutive sampling (Table 2).

Quality of the included studies

The quality of each included study was assessed using the NOS scale adapted for cross-sectional studies, with scores ranging from 7 to 9 out of 10, indicating high quality. (Table 1).

The magnitude of preconception care utilization among Ethiopian women

To compute this meta-analysis, 14 primary studies with a total of 6,808 women participated. A random effect model with a restricted maximum likelihood method was used to determine the estimated pooled magnitude with a 95% CI, and a Forest plot was used to show graphically. Accordingly, the overall estimated pooled magnitude of PCC utilization among women in Ethiopia was 26%
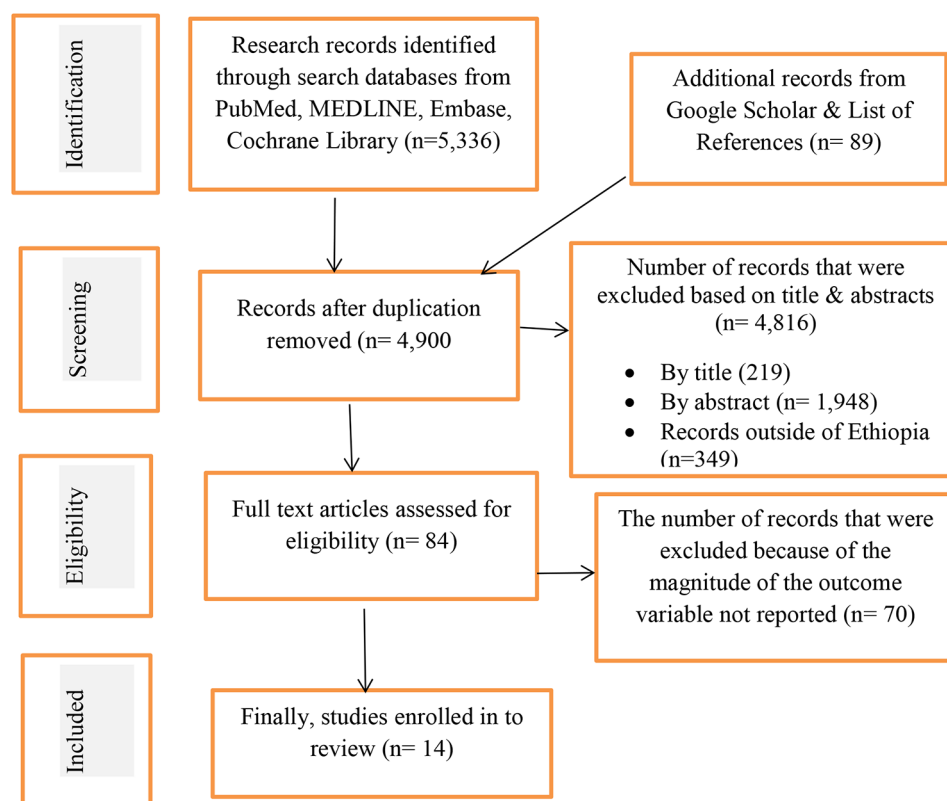

Fig. 1 Show the data selection and eligibility of the magnitude of preconception care utilization and associated factors among Ethiopian women, 2024

Table 2 Summary of studies included in the systematic review and meta-analysis of the preconception care utilization among women in Ethiopia, 2024

Authors name	Year of publication	Study setting	Region	Sample size	Response rate (%)	Magnitude % with 95%CI	Sampling technique
Negash et al. [36]	2023	Community	Oromia	388	98.7	21.6(17.7, 25.6)	Simple random
Tsrity et al. [23]	2019	Community	Tigray	561	100	18.2(15, 21.4)	SRS
Yitayal et al. [37]	2018	Community	Amhara	229	100	9.6 (5.8, 13.4	SRS
Addisu et al. [38]	2023	Institutional	Addis Ababa	385	100	40 (35.1, 44.9)	Consecutive
Ketema et al. [31]	2021	Institutional	Oromia	592	95.8	58.3(54.3, 62.3)	Systematic random
Elias et al. [24]	2022	Community	Oromia	660	97.5	22.3 (18.9, 25.6)	Systematic random
Daniel et al. [39]	2020	Community	Oromia	669	98.3	14.5 (11.8, 17.2)	SRS
Meron et al. [40]	2022	Institutional	SNNP	400	100	19 (15.2, 22.8)	
Tesfanesh et al. [41]	2019	Community	Amhara	410	96.3	13.4 (10.1, 16.7)	Systematic random
Melsew et al. [42]	2022	Community	SNNP	605	96.9	28.6 (24.9, 32.2)	Systematic random
Tura et al. [43]	2021	Institutional	Oromia	455	100	49.9(47.6, 52.3)	Systematic random
Alemu et al. [24]	2022	Community	Amhara	500	99.2	22.4(18.7, 26)	SRS
Frianbon et al. [30]	2021	Community	Oromia	623	98	6.3 (4.4, 8.2)	SRS
Eriste et al. [44]	2022	Facility	Addis Ababa	331	98.2	40.5% (35.3, 45.6)	SRS

Note: SNNP refers to South Nation Nationality People of Ethiopia, and SRS refers to simple random Sampling

(95% CI: 18, 34) with a heterogeneity index (I^2) of 95.6% ($p = 0.000$) (Fig. 2).

Subgroup analysis

In this meta-analysis, the I-squired test result ($I^2 = 95.6\%$, $P < 0.001$) shows a significant heterogeneity among studies. As a result, in order to determine the potential cause of variation among studies, subgroup analyses were done using the regions where the study was done, and study settings (institutional versus community-based). Consequently, the lowest pooled magnitude of PCC utilization was observed in Amhara region (15% (95% CI: 8.00, 22.00), $I^2 = 69.13\%$), and the highest was in Addis Ababa city administration with 40% (95% CI: 33, 47) with I^2 0.01%, followed by Oromia region (29.00% (95% CI: 12.00, 45.00), $I^2 = 98.14\%$) (Fig. 3). Variation was also observed between institutional and community-based studies. Hence, the estimated pooled magnitude of PCC utilization was low in the community-based studies 17% (95% CI: 1^2, 22), $I^2 = 81.31\%$, and higher among institutional-based studies 42.0% (95% CI: 29, 55) with $I^2 = 93.37\%$) (Fig. 4).

Publication bias

Publication bias was evaluated using Egger's weighted regression test and the funnel plot. The asymmetry of the research was displayed graphically using the Funnel plot (Fig. 5). Nevertheless, the results of Egger's weighted regression test showed that there was no significant publication bias.

Factors associated with preconception care utilization

The utilization of PCC was highly impacted by a variety of determinant factors. The variables included in the current meta-analysis were those that were identified as significant factors in a minimum of two primary investigations. Therefore, the educational status of women, knowledge of women regarding PCC history of previous adverse birth outcomes, presence or absence of chronic medical illness, and husband/partner support were significantly associated with PCC utilization.

The educational status of women was one of the determinant factors affecting the utilization of PCC. This particular meta-analysis was computed using data from four primary studies involving over 2,117 women. As a result, compared to their peers, women who attend college and above had a three-times higher likelihood of using preconception care OR = 2.94 (95%ci: 2.20, 3.68) (Fig. 6). Another determinant factor in this research was knowledge of women regarding PCC. To perform this particular meta-analysis, over 3,268 study participants were drawn from seven primary studies. Therefore, the odds of PCC utilization were higher among women who had good knowledge as compared to women who had poor knowledge [OR = 2.52(95% CI: 1.77, 3.26) $I^2 = 36.46\%$, $P < 0.001$] (Fig. 7). Previous history of adverse birth outcome positively associated with PCC utilization. To compute this particular meta-analysis, more than 1,890 women were involved in four primary studies. Accordingly, the odds of PCC utilization were higher among women who had a history of previous adverse birth outcomes as compared to their counterparts OR = 3.18 (95% CI: 2.75, 3.62) with $I^2 = 78\%$] (Fig. 8). Similarly, women's use of PCC was affected by factors like either financial or psychological support from their husbands or parents. Therefore, the odds of PCC utilization were three and half times higher among women who received either financial or psychological support from their husbands or partners as compared to their counterparts OR = 3.41 (95% CI: 2.45, 4.37) (Fig. 9). Lastly, among five primary
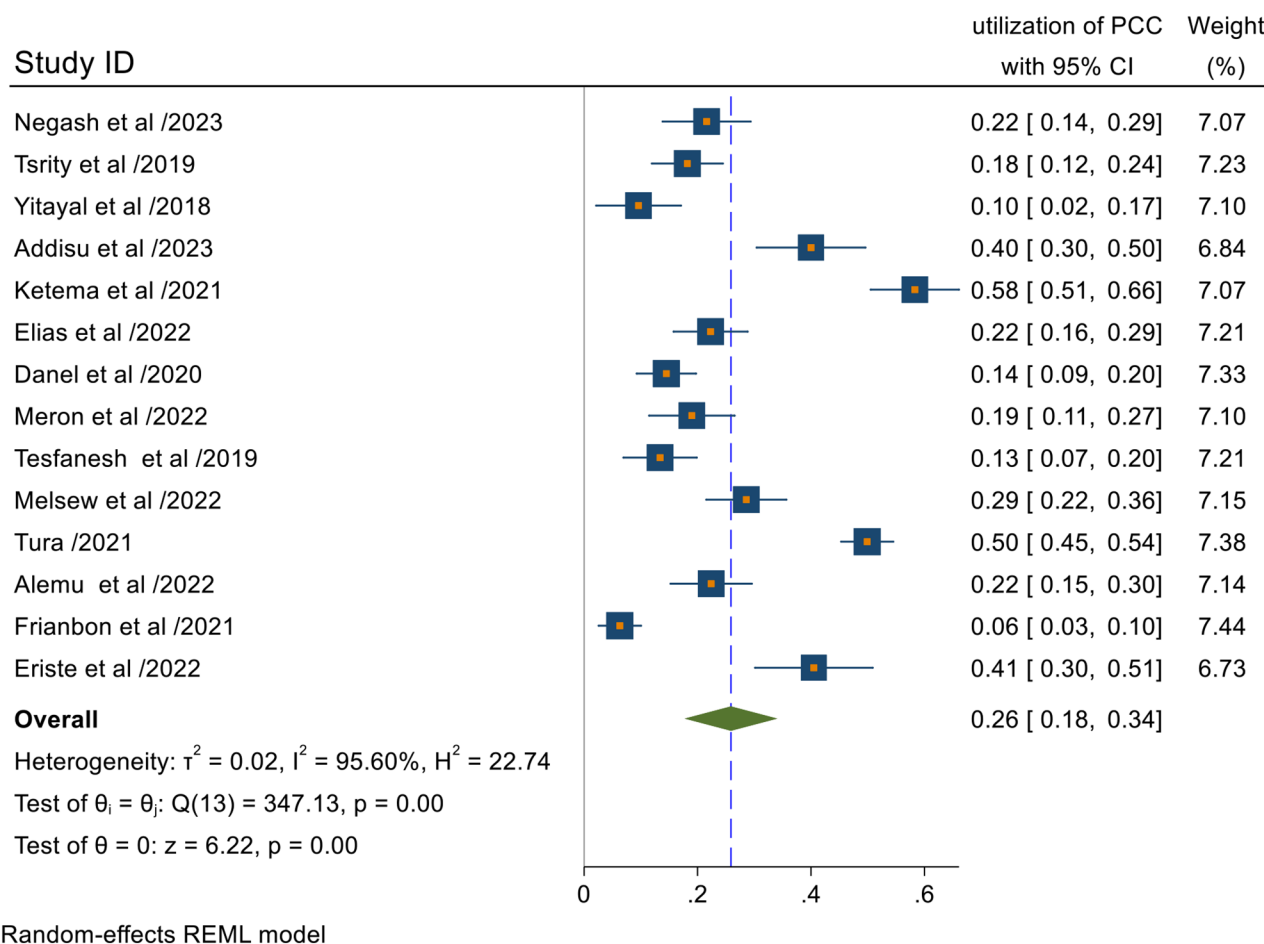
Fig. 2 Forest plot of the pooled magnitude of preconception care among women in Ethiopia, 2024

studies, women who had chronic medical follow up were nearly four times more likely to utilize PCC as compared to women who didn't have any chronic medical illness OR = 4.09, 95% CI: 2.89, 5.30) (Fig. 9) (Fig. 10).

Discussion

Centers for Disease Prevention and Control (CDC) and WHO recommend each woman, man, and couple should be encouraged to have a reproductive life span; all women of childbearing age should screened before becoming pregnant for risks associated with the consequence of pregnancy [45, 46]. Moreover, it is also recommended that all healthcare providers screen all women for their intention to become pregnant to provide them with appropriate services [47]. To determine the pooled magnitude and associated factors of PCC utilization among women in Ethiopia, this systematic review and meta-analysis were conducted. The finding of this study will have an implication on policymakers, program planners, and specifically for health care providers since it gives the general picture of PCC utilization. Therefore, the estimated pooled magnitude of PCC utilization in

Ethiopia was 26% (955 CI: 18, 34). This finding was in line with different studies such as a systematic review and meta-analysis study conducted in Africa 18.6% [48], a study of Kenya 21.7% [49], a study of South East Nigeria (23.4%) [50], a study of Southern Sri-Lanka (27%) [51], the study of Southern part of Nigeria 34% [52], and a study conducted in Al Ahsa, Saudi Arabia [53]. This finding however, was substantially lower than the study conducted in the Surveillance summary review of the CDC (79%) [54], a survey on the implementation of PCC in Shanghai, China 40% [55], a study of Iran 77% [56], and a study conducted in Malaysia 44% [57]. This variation might be due to the differences in the socio-demographic status of study participants, study population (pregnant women versus non-pregnant), study settings (community-based versus health facility-based), and variations in the access to healthcare facilities and healthcare systems within countries. Besides, it could be also explained by differences in policies and implementation strategies of maternal and child health services among countries. Furthermore, differences between the nature of the meta-analysis, and the primary studies might be the cause for
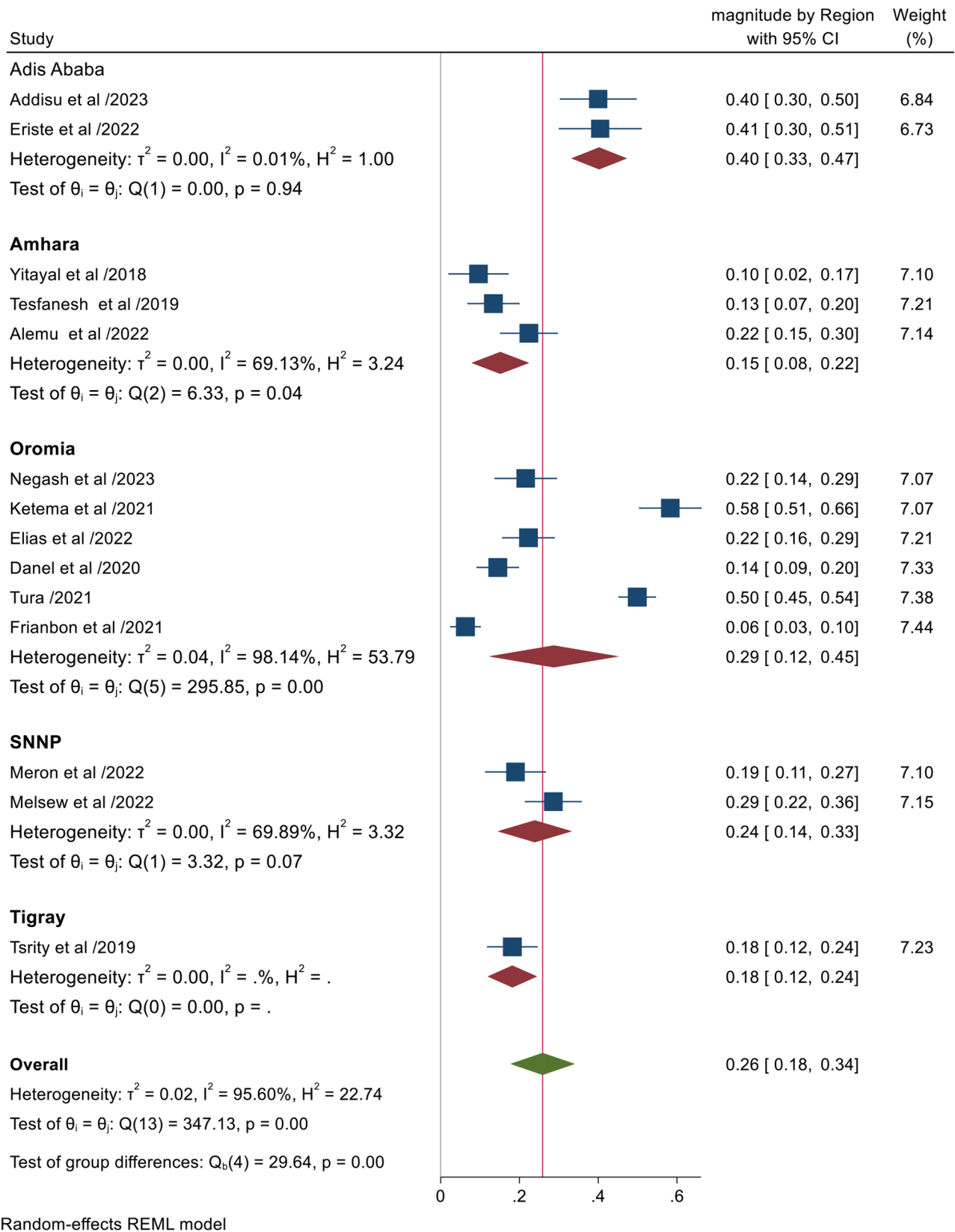
Study	magnitude by Region with 95% CI	Weight (%)
Adis Ababa		
Addisu et al /2023	0.40 [0.30, 0.50]	6.84
Eriste et al /2022	0.41 [0.30, 0.51]	6.73
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.01\%$, $H^2 = 1.00$	0.40 [0.33, 0.47]	
Test of $\theta_i = \theta_j$: Q(1) = 0.00, p = 0.94		
Amhara		
Yitayal et al /2018	0.10 [0.02, 0.17]	7.10
Tesfanesh et al /2019	0.13 [0.07, 0.20]	7.21
Alemu et al /2022	0.22 [0.15, 0.30]	7.14
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 69.13\%$, $H^2 = 3.24$	0.15 [0.08, 0.22]	
Test of $\theta_i = \theta_j$: Q(2) = 6.33, p = 0.04		
Oromia		
Negash et al /2023	0.22 [0.14, 0.29]	7.07
Ketema et al /2021	0.58 [0.51, 0.66]	7.07
Elias et al /2022	0.22 [0.16, 0.29]	7.21
Danel et al /2020	0.14 [0.09, 0.20]	7.33
Tura /2021	0.50 [0.45, 0.54]	7.38
Frianbon et al /2021	0.06 [0.03, 0.10]	7.44
Heterogeneity: $\tau^2 = 0.04$, $I^2 = 98.14\%$, $H^2 = 53.79$	0.29 [0.12, 0.45]	
Test of $\theta_i = \theta_j$: Q(5) = 295.85, p = 0.00		
SNNP		
Meron et al /2022	0.19 [0.11, 0.27]	7.10
Melsew et al /2022	0.29 [0.22, 0.36]	7.15
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 69.89\%$, $H^2 = 3.32$	0.24 [0.14, 0.33]	
Test of $\theta_i = \theta_j$: Q(1) = 3.32, p = 0.07		
Tigray		
Tsrity et al /2019	0.18 [0.12, 0.24]	7.23
Heterogeneity: $\tau^2 = 0.00$, $I^2 = .\%$, $H^2 = .$	0.18 [0.12, 0.24]	
Test of $\theta_i = \theta_j$: Q(0) = 0.00, p = .		
Overall	0.26 [0.18, 0.34]	
Heterogeneity: $\tau^2 = 0.02$, $I^2 = 95.60\%$, $H^2 = 22.74$		
Test of $\theta_i = \theta_j$: Q(13) = 347.13, p = 0.00		
Test of group differences: $Q_b(4) = 29.64$, p = 0.00		

Random-effects REML model

Fig. 3 Forest plot of magnitude of preconception care utilization, subgroup analysis by using region among women in Ethiopia, 2024

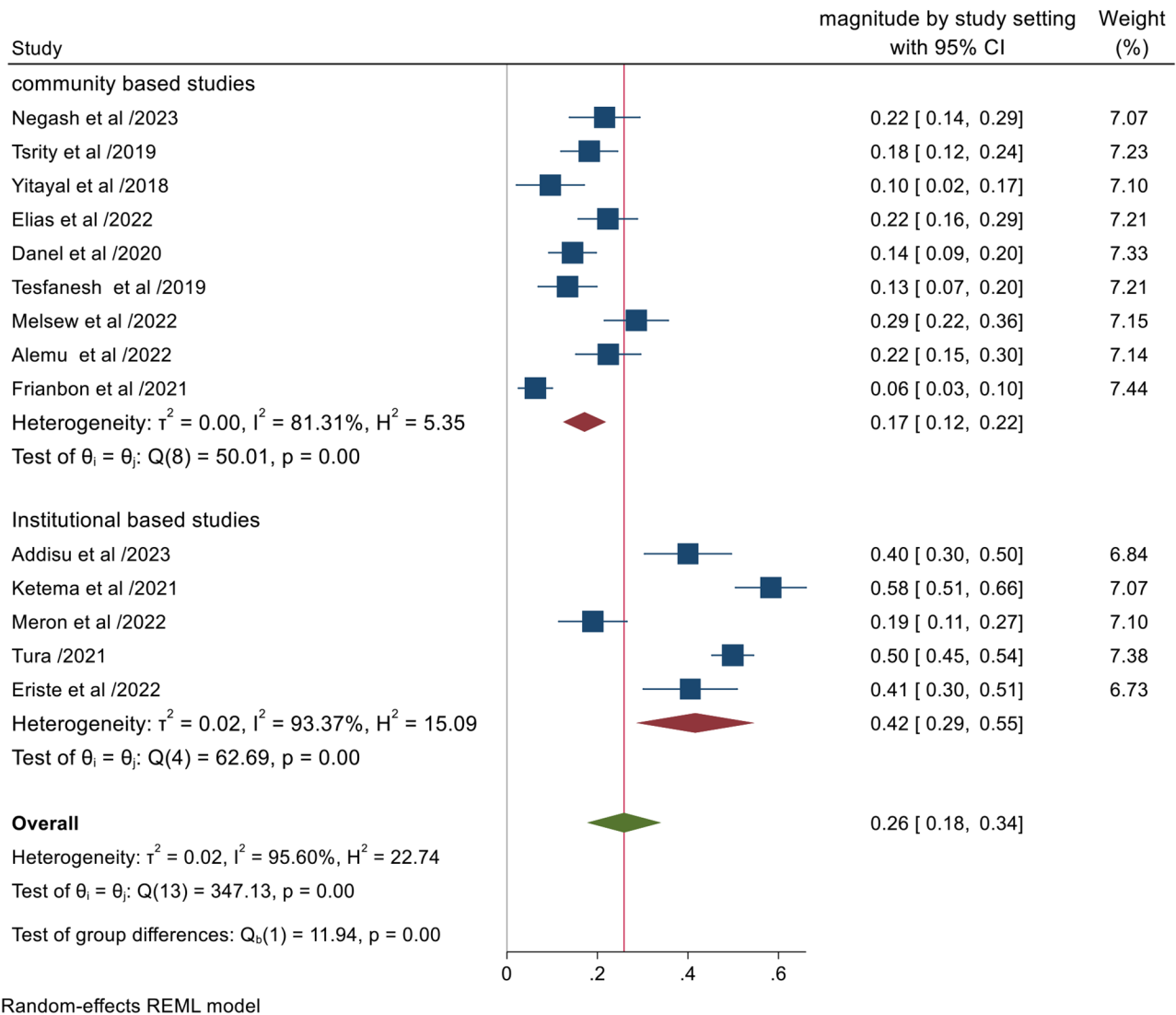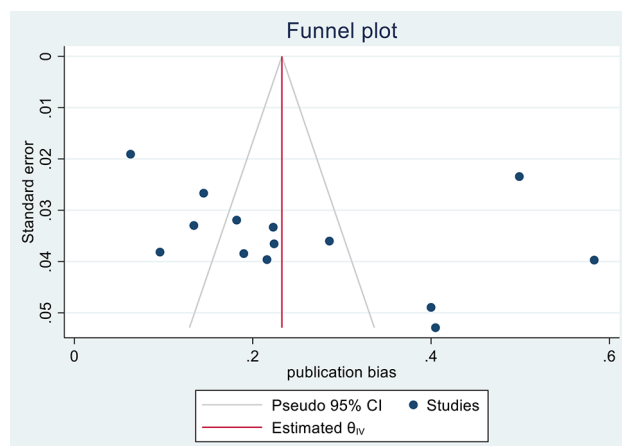| Study	magnitude by study setting with 95% CI	Weight (%)
community based studies		
Negash et al /2023	0.22 [0.14, 0.29]	7.07
Tsrity et al /2019	0.18 [0.12, 0.24]	7.23
Yitayal et al /2018	0.10 [0.02, 0.17]	7.10
Elias et al /2022	0.22 [0.16, 0.29]	7.21
Danel et al /2020	0.14 [0.09, 0.20]	7.33
Tesfanesh et al /2019	0.13 [0.07, 0.20]	7.21
Melsew et al /2022	0.29 [0.22, 0.36]	7.15
Alemu et al /2022	0.22 [0.15, 0.30]	7.14
Frianbon et al /2021	0.06 [0.03, 0.10]	7.44
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 81.31\%$, $H^2 = 5.35$	0.17 [0.12, 0.22]	
Test of $\theta_i = \theta_j$: Q(8) = 50.01, p = 0.00		
Institutional based studies		
Addisu et al /2023	0.40 [0.30, 0.50]	6.84
Ketema et al /2021	0.58 [0.51, 0.66]	7.07
Meron et al /2022	0.19 [0.11, 0.27]	7.10
Tura /2021	0.50 [0.45, 0.54]	7.38
Eriste et al /2022	0.41 [0.30, 0.51]	6.73
Heterogeneity: $\tau^2 = 0.02$, $I^2 = 93.37\%$, $H^2 = 15.09$	0.42 [0.29, 0.55]	
Test of $\theta_i = \theta_j$: Q(4) = 62.69, p = 0.00		
Overall	0.26 [0.18, 0.34]	
Heterogeneity: $\tau^2 = 0.02$, $I^2 = 95.60\%$, $H^2 = 22.74$		
Test of $\theta_i = \theta_j$: Q(13) = 347.13, p = 0.00		
Test of group differences: $Q_b(1)$ = 11.94, p = 0.00		

Random-effects REML model

Fig. 4 Forest plot of the pooled magnitude of preconception care utilization, subgroup analysis by using study setting among women in Ethiopia, 2024

Fig. 5 Funnel plot of to test publication bias

variations. On the other hand, the result of the current study was higher than the previous systematic review and meta-analysis study done in Ethiopia 16% [32], a study conducted in Sudan 9% [58], and a study in Brazil (15%) [59]. Differences might be due to variations in sample size, study setting, and socio-demographic status of each country's study participants. Moreover, the nature of the research between the original studies and the meta-analysis could account for the above-observed differences.

According to subgroup meta-analysis results, the highest utilization of PCC (40%; 95% CI: 33, 47) was seen in the Addis Ababa city administration, and the lowest (15% (95% CI: 8, 22) was in the Amhara region. Variations were also observed based on study settings; hence, the highest result 42% (95% CI: 29, 55) was seen among institutional-based studies, and the lowest (17%; 95% CI: 12, 22) was seen in community-based studies. The reason for the
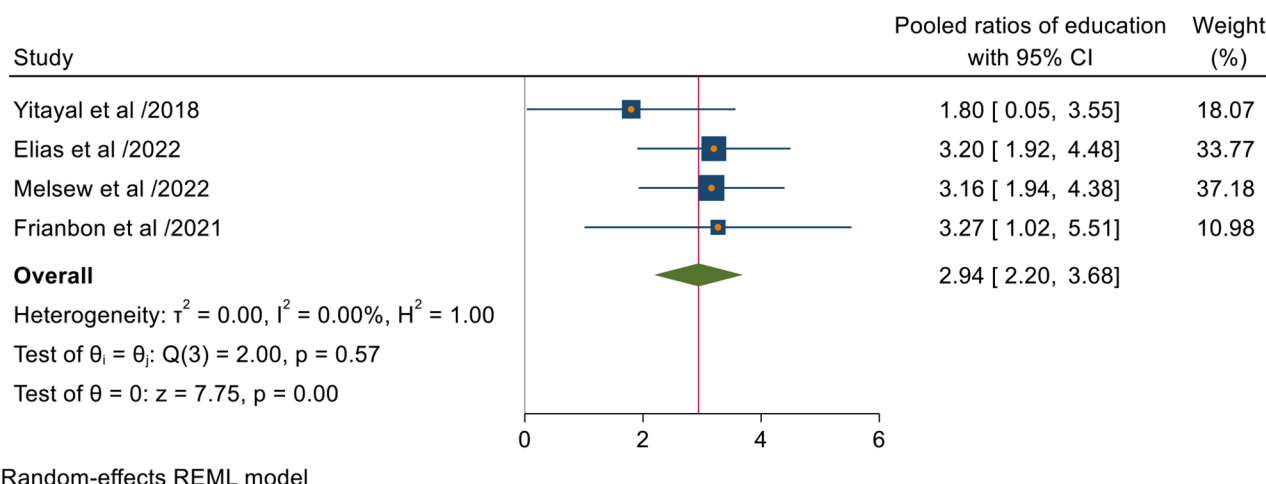
Fig. 6 Shows the relationship between maternal educational status and preconception care utilization among women in Ethiopia, 2024
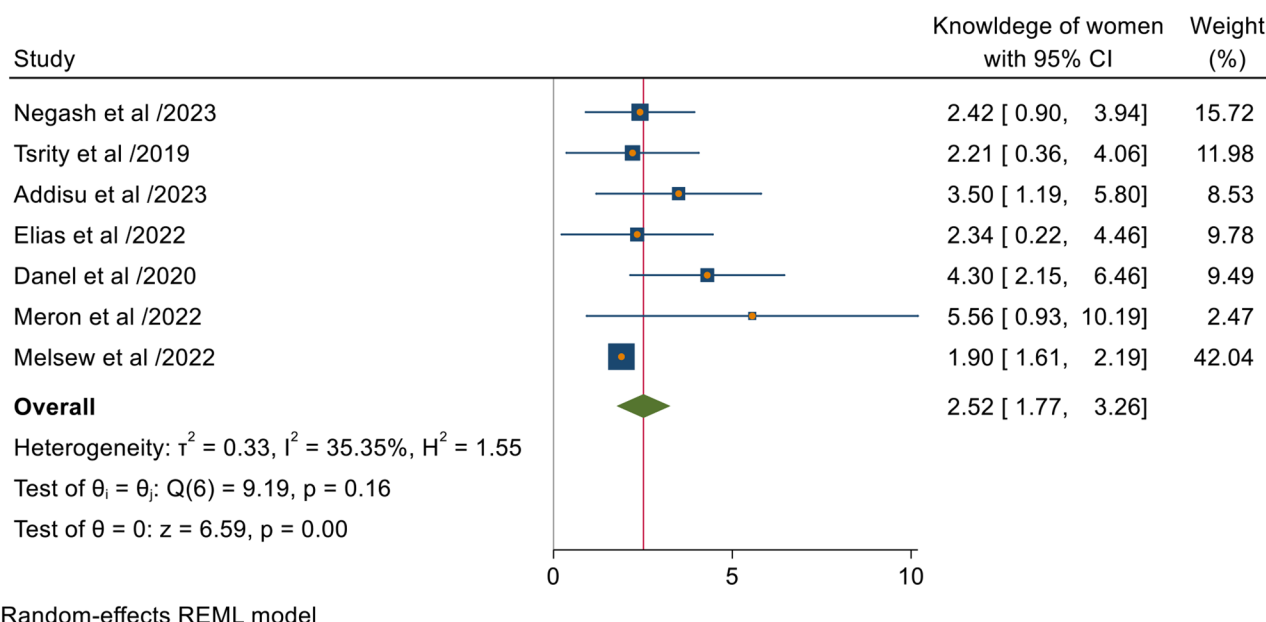

Fig. 7 Shows the relationship between the factor of maternal Knowledge status and preconception care utilization among women in Ethipia, 2024

above-observed difference is obvious. Compared to their rural counterparts, Ethiopian women living in urban areas typically have better access to maternity healthcare services and a greater level of experience. Additionally, urban residents benefited from a variety of health promotion initiatives which were urban-focused programs. Moreover, rural women are highly influenced by traditional practices other than modern healthcare practices [60, 61].

The educational status of women is one of the identified determinant factors for the utilization of PCC. Women who had a diploma and above were two times more likely to utilize PCC compared to those who didn't attend formal education. This finding is consistent with the study findings of systematic review and meta-analysis in SSA

[62]. This might be due to educated women who can read and access a wide range of information related to the continuum of maternity care. This, in turn, increases maternal awareness, and a better understanding of maternal health services. In addition to this, women's empowerment positively influences the use of maternal and child health services. Education is one of the proven strategies for empowering women, particularly in low and middle-income countries including Ethiopia.

Having a good knowledge regarding PCC increases service utilization by two and a half folds. This study is supported by a study of systematic review and meta-analysis to determine the correlation between women's knowledge level and PCC utilization in SSA [29], and a study conducted in South Africa [63]. Knowing is the first
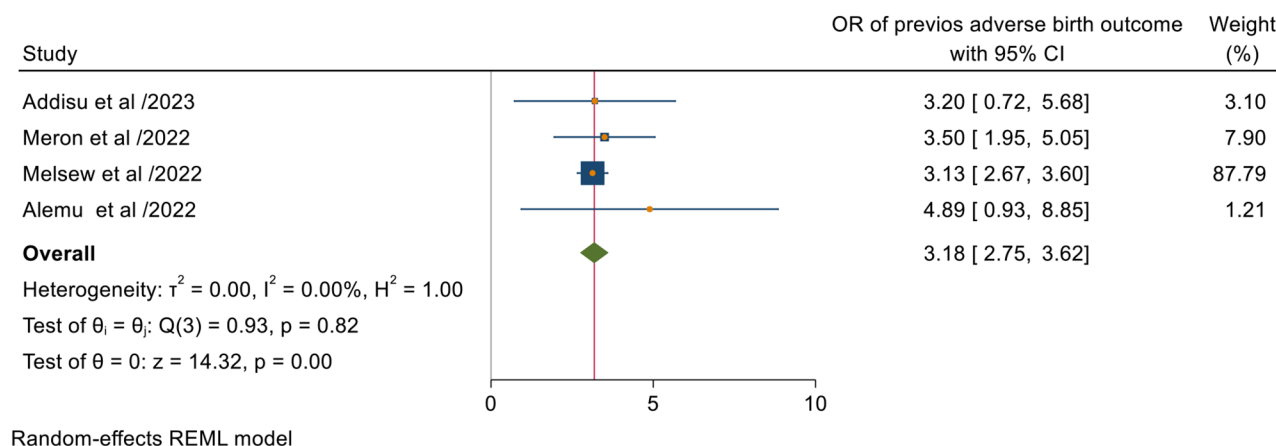
Fig. 8 Shows the relationship between the factor history of previous adverse pregnancy outcome and utilization of preconception care among women in Ethiopia, 2024
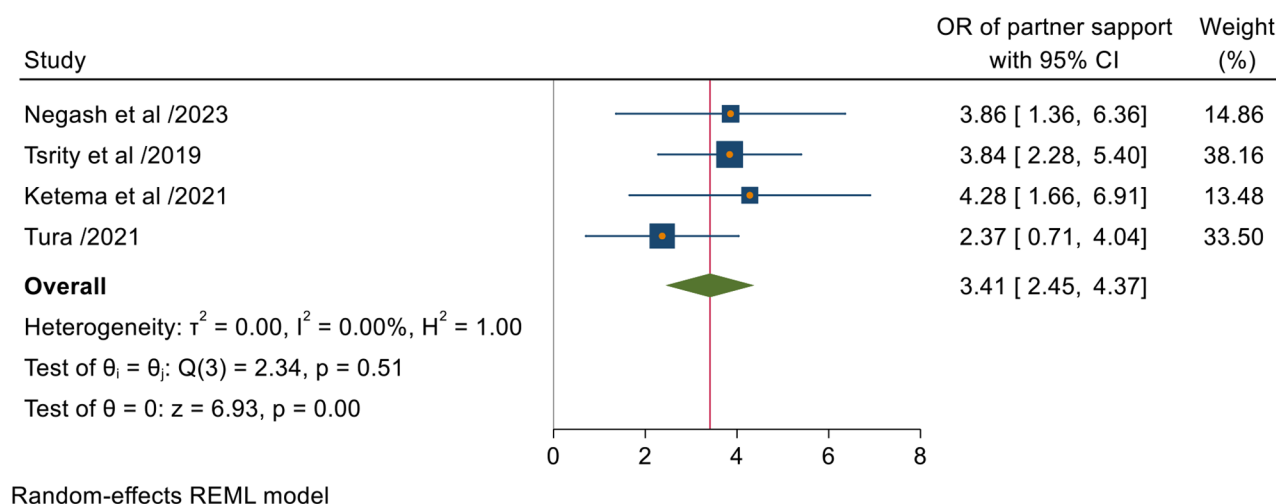

Fig. 9 Shows the relationship between the factor husband or partner support and preconception care utilization among women in Ethiopia, 2024
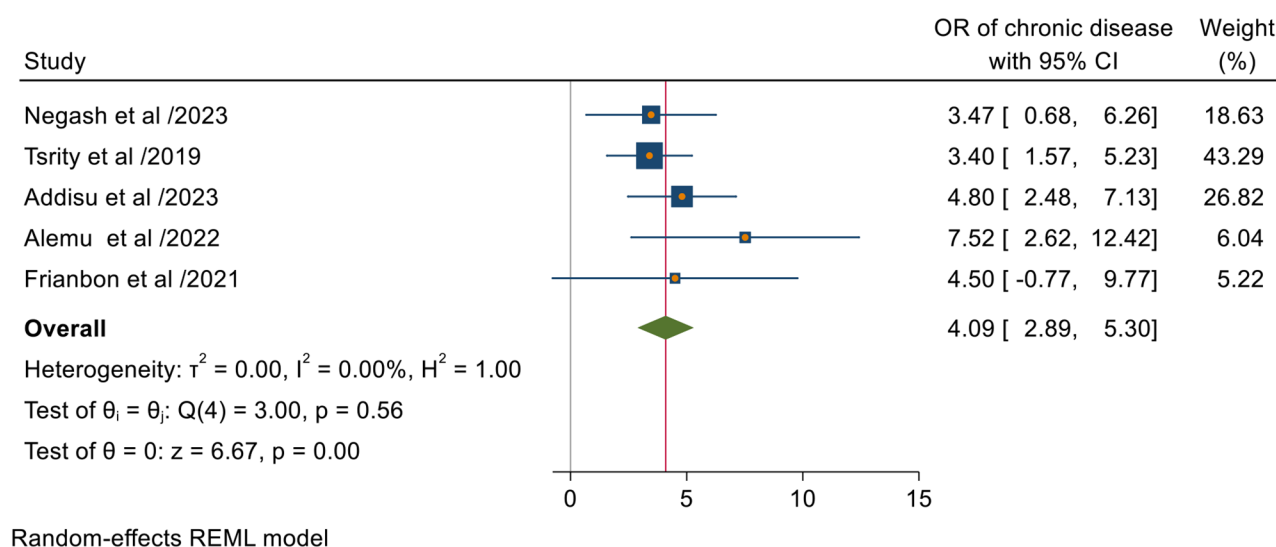

Fig. 10 Maternal chronic disease affects the utilization of preconception care among women in Ethiopia, 2024

entry point for either acceptance or decline of the utilization of health care services. This could be explained by having good knowledge increases awareness and a positive attitude toward health-seeking behavior; this in turn increases the utilization of maternal health services [64].

History of previous adverse birth outcomes had a positive association with PCC utilization. Women who had at least one adverse birth outcome in the previous pregnancy were three times more likely to utilize PCC compared with those who had no history of adverse birth outcomes. This finding is supported by the study of previous adverse infant outcomes as a predictor of PCC use in Los Angeles [65], and a study of factors associated with folic acid intake in Sudan [66]. This might be due to women experiencing adverse birth outcomes, and having a high alert for the future subsequent pregnancy; this leads to a need for health care before pregnancy. In addition to this, women who experience adverse infant outcomes get advice and counseling from their healthcare provider for the next pregnancy; for instance, folic acid supplementations before pregnancy to prevent neural tube defects in women who had a child with neural tube defects in the previous childbirth. Neural tube defects such as spinal Bifida, anencephaly, hydrocephalus, and meningocele are prevented by the provision of folic acid at least one month prior to pregnancy and continued at least up to two months after conception [67]. Similarly, women with previous chronic medical health problems were almost four times more likely to utilize PCC as compared to their counterparts. This finding is consistent with the study of Malaysia [57] and Georgia [68]. The reason for this might be due to women on follow-up of their medical illness had a greater chance of getting PCC from their doctor or health care provider due to repeated contacts. Furthermore, it might also be due to the Doctor or health care provider giving more attention to screening diseases and counseling for women who had chronic medical illnesses compared to their counterparts. It is believed that proper PCC utilization in women with chronic medical cases significantly reduces the risk of congenital malformation. One study of systematic review and meta-analysis on PCC and the risk of congenital malformation among diabetic women shows that utilization of PCC specifically folic acid supplementation significantly reduces congenital malformations in their offspring [69]. Lastly, the financial and psychological support from the husband or partner had a strong positive association with PCC utilization. Accordingly, women obtaining either financial or psychological support from their husbands/partners were three times more likely to utilize PCC compared with their counterparts. This finding is consistent with the study conducted in Shanghai, Chain [70]. It is obvious, that male involvement improves maternal health service utilization. However, men are typically the primary decision-makers in low- and middle-income countries including Ethiopia, which frequently determines how easily women can access financial resources. Such practices have implications for maternal health as it determines mainly women's access to maternal health services. Moreover, the active participation of men in maternal health services encourages and supports their wives; these in turn improve the utilization of maternal health services by women [71, 72].

Limitations of the study

There were certain limitations to this systematic review and meta-analysis. First, while the included studies in the current study report overall utilization of PCC, many studies do not provide a component of separate data. As a result, subgroup analysis by individual components of PCC services was not feasible. The first one was, all primary studies included in this systematic review and meta-analysis were cross-sectional study designs. Due to this reason, the outcome variable may be affected by other confounding variables. Secondly, primarily studies included in this study were from only five regions of the country. Nowadays, the country Ethiopia has twelve regions and it may not be fair to generalize the results.

Conclusion

The overall magnitude of PCC utilization among Ethiopian women was significantly low as compared to the WHO, and CDC recommendations. Educational status of women, knowledge of women regarding PCC, previous history of adverse birth outcome, pre-existing chronic medical illness, and either psychological or financial husband support were the identified predictors of PCC utilization. The government of Ethiopia gives priorities for maternal health services such as family planning, antenatal care, and skilled delivery care which avert the majority of causes of maternal mortality and morbidity. Despite, PCC is one of the essential components of the continuum of maternity care which is given one step back to pregnancy, it gives less emphasis by the government of Ethiopia; this leads to less practice throughout the country. Based on this finding, we recommend that program planners and strategists formulate clear implementation strategies to implement the whole components of the continuum of maternity care. Doctors and health care workers shall provide all components of PCC before pregnancy, and give information and deep understanding regarding the importance of PCC, these may lead to better utilization.

Abbreviations

CDC   Center for Disease Prevention and Control
CI   Confidence Interval

EDHS	Ethiopian, Demographic Health Survey
NOS	Newcastle-Ottawa Scale
AOR	Adjusted Odds Ratio
PCC	Preconception Care
PRISMA	Proffered Reporting Items for Systematic Review and Meta-Analysis
SDG	Sustainable Development Goal
SNNP	South Nation Nationality and People
SSA	Sub-Saharan Africa
WHO	World Health Organization

Supplementary Information

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> Supplementary Material 1

Data availability
The data included in this systematic review and meta-analysis are available in the manuscript, and from the corresponding author with a reasonable request.

Declarations

Ethics approval and consent for participants
Not applicable.

Consent for publication
Not applicable.

Prospero registration
Registered on December 2023 with CRD42023492995.

Competing interests
The authors declare no competing interests.

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