

# Magnitude, disparity, and predictors of poor-quality antenatal care service: A systematic review and meta-analysis

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Dereje Bayissa Demissie<sup>1,2</sup>, Gebeyaw Molla<sup>1</sup>,  
Firew Tiruneh Tiyare<sup>3</sup>, Abebe Sorsa Badacho<sup>1</sup> and Ashenif Tadele<sup>1</sup>

## Abstract

**Background:** Antenatal care is directed toward ensuring healthy pregnancy outcomes. Quality antenatal care increases the likelihood of receiving an effective intervention to maintain maternal, fetal, and neonatal well-being, while poor quality is linked to poor pregnancy outcomes. However, owing to the complex nature of quality, researchers have followed several approaches to systematically measure it. The evidence from these variable approaches appears inconsistent and poses challenges to programmers and policymakers. Hence, it is imperative to obtain a pooled estimate of the quality of antenatal care. Therefore, considering the scarcity of evidence on the quality of antenatal care, this study aimed to review, synthesize, and bring pooled estimates of accessible evidence.

**Objective:** This study aimed to estimate the pooled magnitude and predictors of quality of antenatal care services and compare regional disparity.

**Method:** We conducted a comprehensive systematic three-step approach search of published and unpublished sources from 2002 to 2022. The methodological quality of eligible studies was checked using Joanna Briggs Institute critical appraisal tool for cross-sectional studies. Meta-analysis was carried out using STATA version 16. Statistical heterogeneity was assessed using Cochran's *Q* test. In the presence of moderate heterogeneity ( $I^2$  more than 50%), sensitivity and subgroup analyses were conducted and presented in a forest plot. Effect size was reported using standardized mean difference and its 95% confidence interval. Funnel plots and Egger's regression test were used to measure publication bias at the 5% significance level. A trim-and-fill analysis was conducted to adjust for publication bias. Pooled estimates were computed using random-effects models and weighted using the inverse variance method in the presence of high heterogeneity among studies. A 95% CI and 5% significance level were considered to declare significance variables.

**Results:** The global pooled poor-quality antenatal care was 64.28% (95% CI: 59.58%–68.98%) ( $I^2=99.97%$ ,  $p=0.001$ ). The identified pooled predictors of good-quality antenatal care service were: number of antenatal care visits (fourth and above antenatal care visit) (Adjusted odds ratio (AOR)=2.6, 95% CI: 1.37–3.84), family wealth index (AOR=2.72, 95% CI: 1.89–3.55), maternal education attainment (AOR=3.03, 95% CI: 2.24–3.82), residence (urban dwellers) (AOR=4.06, 95% CI: 0.95–7.17), and confidentiality antenatal care (AOR=2.23, 95% CI: –0.36 to –4.82).

**Conclusions:** The study found regional and country-level disparities in the quality of antenatal care services for pregnant women, where poor-quality antenatal care services were provided for more than two-thirds to three-fourths of antenatal care attendants. Therefore, policymakers and health planners should put a great deal of emphasis on addressing the quality of antenatal care services.

## Plain language summary

This study aimed to estimate the magnitude, disparity, and predictors of the quality of antenatal care services. A comprehensive literature search was conducted from August 24/2022 to September 08/2022 found that a total of 76 studies with a sample size of 940,164 were included in the final analysis. The global pooled poor quality of antenatal care service utilization was 64.28%. The study found that nearly two-thirds of pregnant women worldwide received poor-quality antenatal care services,

<sup>1</sup>Ethiopian Public Health Institute, Addis Ababa, Ethiopia

<sup>2</sup>St Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

<sup>3</sup>Faculty of Public Health, Department of Epidemiology, Institute of Health, Jimma University, Jimma, Ethiopia

## Corresponding author:

Dereje Bayissa Demissie, St Paul's Hospital Millennium Medical College, Paster, Gulelle, Addis Ababa 1271, Ethiopia.  
Email: dereje.bayissa@sphmmc.edu.et



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and nearly 3/4th of pregnant women in Ethiopia received poor-quality ANC. This study discovered continental, regional, and country-level disparities in the quality of antenatal care services, with pregnant women in the Asian, African, and South American continents using low-quality antenatal care services compared to those in North America and Europe. The authors strongly recommend providing high-quality antenatal care based on WHO recommendations globally for pregnant women in need of quality services at all levels to provide quality healthcare to the target population.

## Keywords

Antenatal care, pregnant women, poor quality, pooled prevalence

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## Background

Maternal and neonatal health remain a global agenda.<sup>1</sup> Despite tremendous advances in healthcare, over 295,000 women died during and after pregnancy and delivery in 2017, particularly in ‘low- and middle-income nations’. Additionally, 2 million stillbirths occur annually, one occurring every 16s, a tragedy that can be averted with better quality care.<sup>2,3</sup> In addition, nearly 2/3rd of ‘maternal and neonatal health burdens’ can be alleviated through optimum antenatal care (ANC).<sup>4–6</sup>

‘ANC’ is healthcare provided by skilled professionals to pregnant women and adolescent girls to ensure optimal health conditions during pregnancy. It reduces maternal and perinatal morbidity and mortality by detecting and treating pregnancy-related complications and identifying those at increased risk during labor and delivery.<sup>7–10</sup>

‘Globally, 85% of pregnant women attend at least one ANC’ visit with a skilled health professional, with 58% attending at least four ANC visits. However, utilization varies between countries, with 18% in Guatemala and 81% in Nicaragua. ‘Quality of care during ANC visits’ is crucial, especially in low-resource settings, where barriers exist to providing high-quality care.<sup>11</sup> Women in ‘developing countries’ receive higher quality ANC than ‘women in developed countries’. The range of quality ANC was reported to range from 2.5% in Uganda to 97.5% in Scotland.<sup>12,13</sup>

‘The World Health Organization’ has defined quality ANC as the degree to which maternal and newborn health services (for individuals and the population) increase the likelihood of timely and appropriate care to achieve desired outcomes that are both consistent with current professional knowledge and consider the preferences and aspirations of individual women and their families.<sup>14</sup> ANC is crucial for reproductive, maternal, newborn, and child health. Integrating ANC with other health services enhances its utilization, quality, and outcomes. Quality ANC allows for screening for chronic conditions and non-communicable diseases. However, ‘shortages of essential medicines, equipment, and trained staff hinder high-quality care in low-resource settings’.<sup>15</sup> ‘High-quality ANC’ is associated with improved maternal, fetal, and neonatal outcomes. Thus, close monitoring of ANC quality and delivery models is one of the key elements of successful programs that

benefit the health and well-being of women, their newborns, and their families.<sup>16</sup> A full evaluation of care delivery models is required to establish the acceptability, accessibility, availability, and quality of ANC service delivery is very crucial.<sup>16</sup> Several studies have assessed the overall quality of global maternal neonatal health (MNH) services. Some studies have reported dissatisfaction with both clients and care providers regarding the existing Quality of Care.<sup>17</sup> Several authors have proposed various quality indicators for ANC. Some studies have proposed binary or categorical classifications considering the number of interventions received by pregnant women. In most studies, good ANC quality was defined as having received all or most of the components considered.<sup>18–21</sup> However, quality ANC is difficult to define owing to the complex nature of the concept, and it is challenging to measure it directly.<sup>22</sup> Hence, researchers have followed several approaches to systematically measure the processes of different MNH services.<sup>18–21</sup> These inconsistent approaches to measuring ANC quality pose challenges to programmers and policymakers. Hence, it is important to obtain a pooled estimate of the quality of ANC. However, to the best of our knowledge, no systematic review or meta-analysis has been conducted to estimate the pooled quality of ANC worldwide and across regions. Therefore, considering the scarcity of evidence on the quality of ANC, this study aimed to fill this knowledge gap. Hence, programmers and policymakers rely on the evidence from their businesses. Furthermore, researchers can gain insights into another research question to further study the quality of ANC. This systematic review and meta-analysis aimed to enable governments, policymakers, health professionals, and reproductive-age populations to inform themselves about the importance of high-quality ANC service utilization and delivery of high-quality essential components of ANC services and to evaluate changes and trends in quality ANC service utilization over time.

The objectives of this review were

- To conduct a systematic review of poor-quality ANC service
- To conduct meta-analysis of pooled estimate magnitude of poor-quality ANC service

- To compare regional disparities of poor-quality ANC service
- To identify pooled predictors of good-quality ANC service

## Methods

### Protocol and registration

The protocol was registered as PROSPERO Registration Number: CRD42022365349 in the International Prospective Register of Systematic Reviews (PROSPERO).

### Information source and search strategies

We followed the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guideline<sup>23</sup> to prepare the whole document. National surveys and published and unpublished articles were obtained from different databases. In addition, the reference lists of the included articles were checked to identify those that were not assessed in the search strings. We sought for comprehensive literature research published on PubMed, CINAHL (EBSCOhost), Global Health (CABI), Medline (EBSCOhost) and other sources (Google Scholar and Google) since 2002 (date of launch of the WHO basic ANC model) to September 08/2022 that reported prevalence of quality of ANC, or ‘prenatal care’, or ‘focused ANC service delivery’ has been included in this systematic review and meta-analysis.

The appropriateness of the key terms was checked before conducting searches in each database. Examples of search strings in PubMed: (((Antenatal Care) OR (“Prenatal Care” [Mesh])) OR (Focused Antenatal Care Service Delivery)) AND (“Quality of Health Care” [Mesh]) AND ((2002 [Filter]) AND (filter [Filter]) AND (humans [Filter]) AND (female [Filter]) AND (data[Filter]))). Boolean operators AND and OR were used (Supplemental File Appendix 1).

Predictors, determinates, associated factors, ANC, Quality, and Ethiopia, were used in the search process. The Boolean operators AND and OR were used accordingly. PubMed search strings were (((((((determinants) OR (Predictors)) OR (“associated factors” [Mesh])) AND (“Quality” [Mesh] OR “Antenatal Care” [Mesh])) OR (Prenatal Care)) AND (“Focused Antenatal Care” [Mesh])) OR (ANC) AND (“Ethiopia” [Mesh]) (Supplemental File Appendix 1).

### Eligibility criteria

#### Inclusion criteria

The question format for this meta-analysis was as follows: Condition, Context, and Population (CoCoPop).<sup>24</sup> The CoCoPop framework used for reviews addressing a question relevant to the prevalence Quality of ANC; (a)

Condition (Quality of ANC, or ‘prenatal care’, or ‘focused ANC’); (b) Context global, regional and national, study design (cohort studies, cross-sectional studies, epidemiology, observational studies), study setting (community-based surveys, health institutions, web-based surveys) and (c) population pregnant women attended ANC. Data from each study were verified for eligibility using the study area, study setup, assessment methods, study designs, titles, abstracts, and full texts. Observational studies reporting the magnitude of quality of ANC among pregnant women and Journal Articles in the last 20 years, gray literature, English language, and study settings in any country across the globe were included.

*Exclusion criteria:* The same patients were enrolled in different articles, commentaries, editorials, case reports, letters, family-based studies, and short communication.

Nonetheless, studies with incomplete or unclear quality of ANC/service operational definitions and those without full text were excluded. Letters to the editors, conference proceedings, and qualitative studies were excluded. EndNote X8 reference manager was used to manage the articles.

#### Selection process of studies

The selection of studies (i.e., identification, screening, and ensuring eligibility) was carried out by the investigators. The research team member were involved in the identification and screening of studies independently. Studies selected for retrieval was again assessed for methodological quality prior to inclusion. The assessment was done using relevant standardized critical appraisal instruments from the Joanna Briggs Institute, JBI Critical appraisal checklist (Supplemental File Appendix 1).

#### Data extraction procedures

Data were extracted by two independent investigators (Dereje Bayissa Demissie and Firew Tiruneh) to assess the quality of the study, and a third author (Abebe Sorsa Badacho) resolved any inconsistencies.

Inter-rater agreement was computed by the author (DBD) before inclusion in this study was made. Inter-rater agreement was computed using Cohen’s kappa coefficient ( $\kappa$ ). The findings revealed a substantial agreement<sup>25</sup> between the two raters ( $\kappa=0.712$ ,  $p<0.01$ ).

The extracted data included first author’s name, publication year, continent, study country, study period, study design, sample size, prevalence of poor antenatal quality, and number of poor antenatal quality. The data were summarized using a Microsoft Excel 2016 spreadsheet (Supplemental File Appendix 1).

#### Quality assessment

The quality of the study was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools,<sup>26</sup> and the results

were graded as low, medium, or high if the quality score was <60%, 60%–80%, or >80%, respectively. We inspected the funnel plot and conducted Egger's regression tests to assess publication bias.<sup>27</sup>

### Publication bias and heterogeneity

Funnel plots and Egger's regression test were used to measure publication bias at the 5% significance level.<sup>28</sup> In addition, heterogeneities among the studies used to compute the pooled estimates in this meta-analysis were explored using forest plots,  $I^2$  tests, and Cochran  $Q$  statistics.<sup>29</sup>  $I^2$  values of 25%, 50% and 75% were interpreted as indicating low, medium and high heterogeneity, respectively.<sup>30</sup> The current meta-analysis considered significant heterogeneity when the  $I^2$  value was  $\geq 50\%$ , with a  $p$ -value < 0.05. We inspected the funnel plot and conducted Egger's regression tests to assess publication bias.<sup>27</sup> A trim-and-fill analysis was conducted to adjust for publication bias.<sup>31</sup> The possible sources of significant heterogeneity were addressed through subgroup and sensitivity analyses.

### Outcome and summary measures

The primary outcome of this study was quality of ANC, or 'prenatal care' or 'focused ANC service delivery'. The CoCoPop framework was used for reviews that addressed questions relevant to ANC quality. CoCoPop represents conditions, context, and population.<sup>24</sup> Condition refers to the quality of ANC, or 'prenatal care' or 'focused ANC service delivery' measured based on the world health organization. Quality ANC receipt of all essential components of ANC services, such as blood pressure measurements, blood tests, urine tests, information on possible complications, counseling on nutrition, and advice on birth preparedness plans during pregnancy.<sup>21,32,33</sup>

Context Global level, regional, and national pooled prevalence of poor-quality ANC services utilization and the population of pregnant women attending ANC services.<sup>34</sup>

The primary objective of this study was to estimate the global quality of ANC services for pregnant women. The pooled prevalence of poor-quality ANC services was computed for global, developed, low- and middle-income, African, and Ethiopian countries.

### Data synthesis and statistical analysis

Pooled estimates were calculated using the STATA version 16 software (STATA Corporation, College Station, TX, USA). Both random- and fixed-effect methods were used to measure the pooled estimates. The pooled estimates were computed using 'metaprop' using a sample size as a weight (wgt) variable with 95% CIs. Pooled estimates were computed using random-effects models and weighted using the inverse variance method in the presence of high heterogeneity among

studies. Subgroup analyses were performed using different parameters (continent and country). We verified the appropriateness of each datum prior to analysis. Forest plots, summary tables, and text are used to present the findings of this study.

## Results

### Selection of studies

In the initial search, 9695 studies were obtained from databases and gray literature sources. First, 1840 studies were excluded because of duplication. Then, 7855 studies were screened using titles and abstracts, and 7716 were removed. Finally, the full texts of 138 studies were assessed for eligibility. Of the 138 studies, 63 were excluded due to inconsistent results.<sup>35–96</sup> Eventually, 76 eligible studies were used in the final analysis of the current systematic review and meta-analysis<sup>12,13,18–21,32,97–162</sup> (Figure 1).

### Study characteristics

A total of 76 studies with a sample size of 940,164 were included in the final analysis, and 70 studies were conducted in low- and middle-income countries.<sup>12,18–21,32,97,99–110,112–116,121–137,139–148,150,152–168</sup> six in developed countries, and in Europe and North America.<sup>100,113,120,138,149,151</sup> Of low and middle-income countries (LMIC), 15 studies were conducted in Ethiopia.<sup>102–104,118,122,135,140,143,145,146,148,152,157,161,163,168</sup> Four of the 76 studies were multi-country, with a minimum of 25 countries.<sup>55,87,111,114,132</sup> In summary, these studies were conducted in 36 countries and 5 continents. All studies were cross-sectional studies, and critical appraisal of cross-sectional studies revealed that approximately 95% of the studies scored high quality, and only 5% scored medium quality (Table 1).

### The global pooled prevalence of poor-quality ANC services

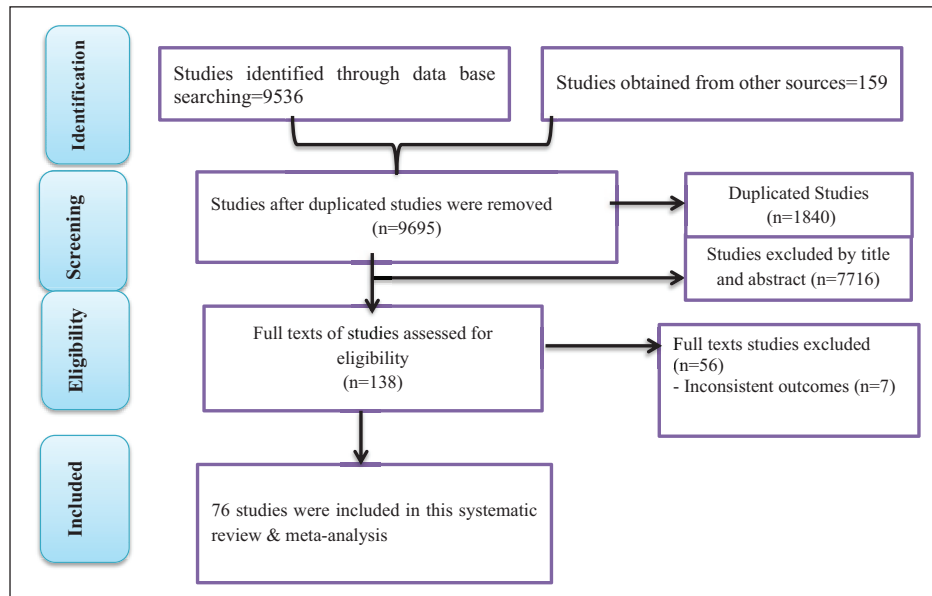
A total of 76 studies with a sample size of 940,164 were included in the final analysis, with sample sizes ranging from 81 to 190,898.<sup>116,107,108,128</sup>

Data collected from 940,164 pregnant women of ANC attendants revealed that 630,453 pregnant women utilized poor-quality ANC services, with a highly diverse prevalence ranging from 2.5% in Scotland<sup>151</sup> to 97.47% in Uganda<sup>114</sup> as depicted in Figure 2, from 2008 to 2022.

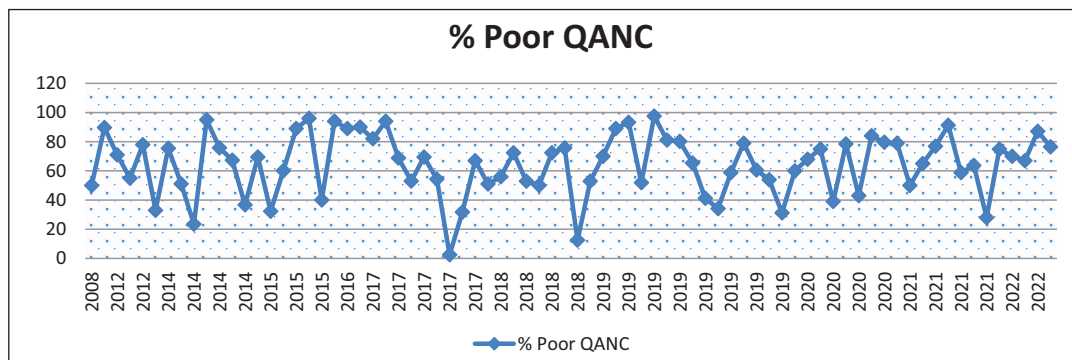
According to the random-effects model, the global pooled poor-quality ANC services was 64.28% (95% CI: 59.58%–68.98%) per 100 pregnant women who underwent ANC (Figure 3).

There was high heterogeneity among studies ( $I^2=99.96\%$ ,  $p=0.001$ ), and based on the trim-and-fill analysis, the learner estimator imputed 13 studies in the left (observed





**Figure 1.** PRISMA flow chart showing the study selection process.



**Figure 2.** Trend of poor-quality ANC services utilization globally from 2008 to 2022.

76 + imputed 13 = 89 studies), with a global pooled estimate of 58.55% (95% CI: 53.61%–63.49%) after trim-and-fill analysis (Figure 3).

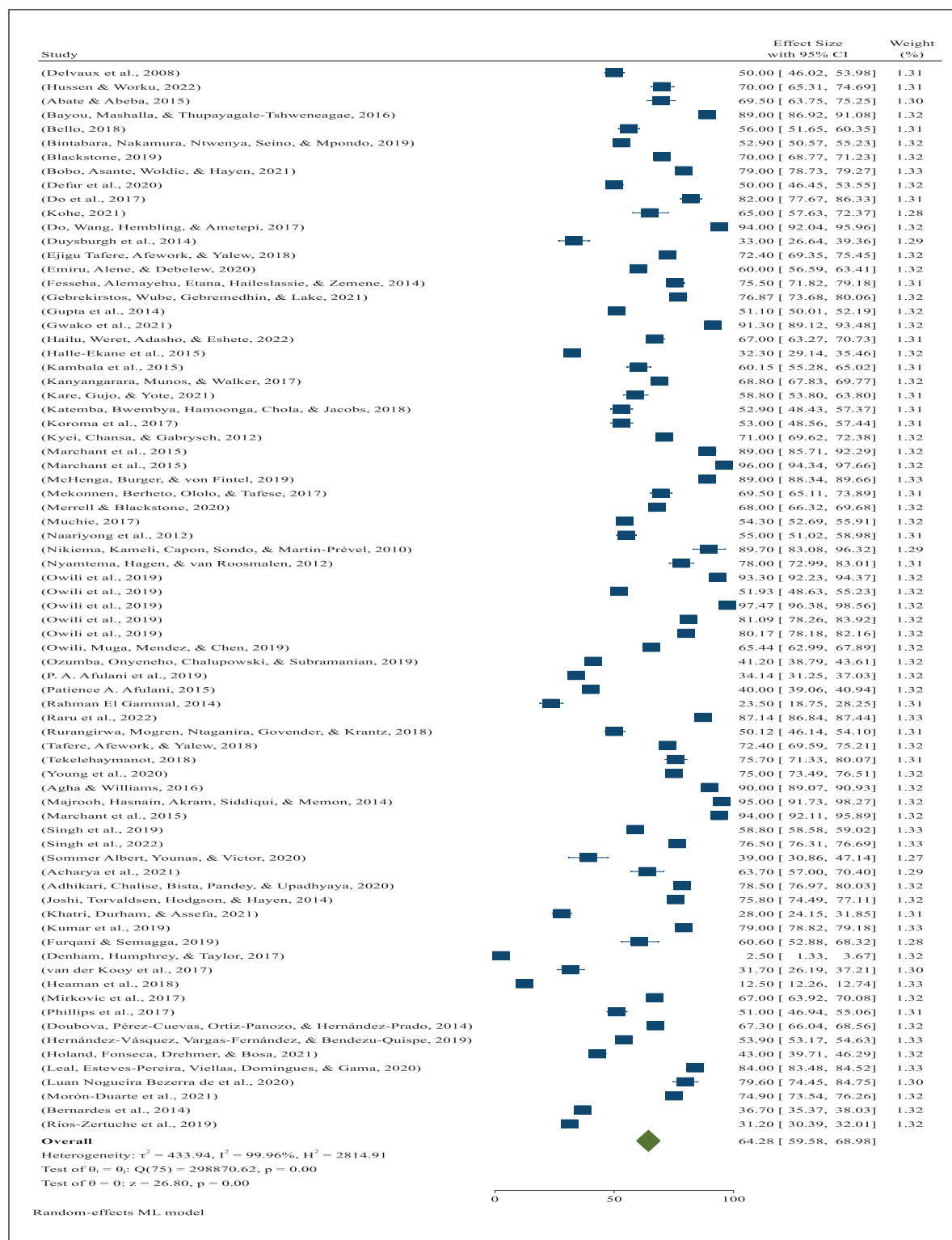
Publication bias was checked using a funnel plot and was objectively verified using Egger's regression test. Hence, the funnel plot seemed asymmetric despite Egger's regression test ( $p=0.1233$ ), which did not confirm the asymmetry of the funnel plot (Figure 4). Finally, the funnel plots appear asymmetric pinpointed to the right for global pooled poor-quality ANC (see Figure 4), which is confirmed by the Fisher fail safe- $N$ - $P$  (Chi-square test = 0.00) analysis finding warrants the acknowledgment of possible publication bias within the article, which revealed the existing body of literature.

Sensitivity analysis was also performed to identify the possible sources of heterogeneity among the included studies. However, no single study has shown a remarkable effect on the heterogeneity of the pooled estimates (Figure 5).

Based on nonparametric trim-and-fill analysis of the publication bias linear estimator imputed on the remaining 13 studies (observed 76 + imputed 13 = 89 studies) after trim-and-fill analysis, the global pooled estimate of poor-quality ANC services was 58.55% (95% CI: 53.61%–63.49%). As shown in Figure 6, the funnel plots appeared symmetric after trim-and-fill analysis of the linear estimator imputed 13 studies on the left global (see Figure 6).

This study performed a subgroup analysis to estimate the pooled prevalence of poor ANC services per continent, WHO ANC implementation guidelines based on publication year, and country.<sup>14</sup>

We conducted a continental subgroup analysis, which revealed that 12 studies were conducted in Asia, with a pooled prevalence of 70.07% (95% CI: 58.784%–81.364%) ( $I^2=99.99%$ ,  $p=0.001$ ), and 51 studies were done in Africa, with a pooled prevalence of poor ANC services of 66.87% (95% CI: 61.908%–71.84%) ( $I^2=99.86%$ ,  $p=0.001$ ) Figure 7.



**Figure 3.** Forest plot showing the global pooled prevalence of poor-quality ANC services per 100 among pregnant women 2022.

### *The prevalence of poor-quality ANC in developed countries (North America and Europe)*

Subgroup analysis was computed based on the World Bank's classification of countries; six studies were done

in developed countries (North America and Europe) with a total sample size of 78,388 pregnant women of ANC attendants revealed that 13,422 pregnant women utilized poor-quality ANC services, with highly diverse poor-quality ANC services prevalence ranging from 2.5%

**Table 1.** Characteristics of the individual studies on quality ANC services among pregnant women included in the present systematic review and meta-analysis 2022.

Author year	Year	Continent	Study area/ Country	Sample	Study design	Good- quality ANC	Poor QANC	4th ANC	Quality
(Hailu, Weret, Adasho, and Eshete, 2022)	2016-2022	Africa	Ethiopia	609	Cross-section	33	67	22.7	High
(Abate and Abeba, 2015)	2002-2015	Africa	Ethiopia	246	Cross-section	30.5	69.5	8.7	High
(Acharya et al., 2021)	2016-2022	Asia	Nepal	198	convergent mixed methods	37.3	63.7		High
(Adhikari, Chalise, Bista, Pandey, and Upadhyaya, 2020)	2016-2022	Asia	Nepal	2761	Demography Health Survey	21.5	78.5	70	Medium
(Patience A. Afulani, 2015)	2002-2015	Africa	Ghana	10,370	Demography Health Survey	60	40	79.7	High
(P. A. Afulani et al., 2019)	2016-2022	Africa	Kenya	1031	Demography Health Survey	65.86	34.14	66.67	High
(Agha and Williams, 2016)	2016-2022	Asia	Pakistan	4000	Community-based study	10	90		High
(Bayou, Mashalla, and Thupayagale-Tshweneagae, 2016)	2016-2022	Africa	Ethiopia	870	cross-sectional community-based study design	11	89	85.4	High
(Bello, 2018)	2016-2022	Africa	Nigeria	500	comparative cross-sectional study	54	56	50	Medium
(Bernardes et al., 2014)	2002-2015	South America	Brazil	5067	Population-based cohort	63.3	36.7	82.6	High
(Bintabara, Nakamura, Ntwenya, Seino, and Mpondo, 2019)	2016-2022	Africa	Tanzania	1756	Survey was designed	47.1	52.9		High
(Blackstone, 2019)	2016-2022	Africa	Liberia	5,348	Liberia Demographic and Health Survey	30	70	76	High
(Bobo, Asante, Woldie, and Hayen, 2021)	2016-2022	Africa	Nine East African countries	87068	Demographic and Health Surveys (DHS) of nine East African countries	21	79	54.4	High
(Kohe, 2021)	2016-2022	Africa	Kenya	161	Cross-sectional	35	65		Medium
(da Fonseca, Strufaldi, de Carvalho, and Puccini, 2014)	2002-2015	South America	Brazil	1049	Case-control study			64.4	High
(Defar et al., 2020)	2016-2022	Africa	Ethiopia	764	Service Availability and Readiness Assessment (SARA)	50	50		High
(Delvaux et al., 2008)	2002-2015	Africa	Côte d'Ivoire	606	Before-and-after intervention design	50	50		High
(Denham, Humphrey, and Taylor, 2017)	2016-2022	Europe	Scotland	683	Retrospective case review	97.5	2.5		High
(Do, Wang, Hembling, and Ametepi, 2017)	2016-2022	Africa	Kenya	564	Service Provision Assessment (SPA) surveys	6	94		Medium
(Do et al., 2017)	2016-2022	Africa	Namibia	303	Service Provision Assessment (SPA) surveys	18	82		High
(Doubova, Pérez-Cuevas, Ortiz-Panozo, and Hernández-Prado, 2014)	2002-2015	North America	Mexico	5342	Retrospective cohort study	32.7	67.3	63.5	High
(Duysburgh, Williams, Williams, Loukanova, and Temmerman, 2014)	2002-2015	Africa	Ghana	6	Health facility surveys	72	28		High

(Continued)

Table 1. (Continued)

Author year	Year	Continent	Study area/ Country	Sample	Study design	Good- quality ANC	Poor QANC	4th ANC	Quality
(Duysburgh et al., 2014)	2002-2015	Africa	Ghana	210	Observation studies	67	33		High
(Ejigu, Woldie, and Kifle, 2013)	2002-2015	Africa	Ethiopia	369	Cross-sectional study				Medium
(Ejigu Tafere, Afework, and Yalew, 2018)				823	Facility-based prospective	27.6	72.4		High
(Emiru, Alene, and Debelew, 2020)	2016-2022	Africa	Ethiopia	795	Cross sectional	40	60	10.7	High
(Fesseha, Alemayehu, Etana, Hailelassie, and Zemene, 2014)	2002-2015	Africa	Ethiopia	526	Health institution based cross-sectional study	24.5	75.5		High
(Furqani and Semagga, 2019)	2016-2022	Asia	Indonesia	154	Cross-sectional	39.4	60.6		High
(Gebrekirstos, Wube, Gebremedhin, and Lake, 2021)	2016-2022	Africa	Ethiopia	670	Community-based cross-sectional study	23.13	76.87	40.53	Medium
(Gupta et al., 2014)	2002-2015	Africa	Tanzania	8035	Demographic and Health Surveys	48.9	51.1	37.6	High
(Gwako et al., 2021)	2002-2015	Africa	Kenya	642	Hospital-based multicenter unpaired case-control study	8.7	91.3	51.7	High
(Halle-Ekane et al., 2015)	2002-2015	Africa	Cameroon	840	Cross-Sectional Study	66.7	33.3	58	High
(Heaman et al., 2018)	2016-2022	North America	Canada	70,612	Population-based retrospective cohort stud	87.5	12.5		High
(Hernández-Vásquez, Vargas-Fernández, & Bendezu-Quispe, 2019)	2016-2022	South America	Peru	18,156	Cross-sectional study Demographic and Family Health Survey	56.1	53.9		Medium
(Holand, Fonseca, Drehmer, and Bosa, 2021)	2016-2022	South America	Brazil	868	Cross-sectional study	57	53		High
(Hussen and Worku, 2022)	2016-2022	Africa	Ethiopia	366	Facility-based cross-sectional study	30	70		High
(Joshi, Torvaldsen, Hodgson, and Hayen, 2014)	2002-2015	Asia	Nepal	4,079	Demographic and Health Survey	24.2	75.8	50.0	High
(Kambala et al., 2015)	2002-2015	Africa	Malawi	388	Cross-sectional survey	39.95	60.15	40	High
(Kanyangarara, Munos, and Walker, 2017)	2016-2022	Africa	Sub-Saharan Africa	8742	20 Service Provision Assessment (SPA)	31.2	68.8	24.8	Medium
(Kare, Gujo, and Yote, 2021)	2016-2022	Africa	Ethiopia	372	Facility-based cross-sectional study	41.2	58.8	66.9	High
(Katemba, Bwembya, Hamoonga, Chola, and Jacobs, 2018)	2016-2022	Africa	Zambia	480	Cross-sectional study	47.1	52.9		High
(Khatri, Durham, and Assefa, 2021)	2016-2022	Asia	Nepal	523	Services Provision Assessment.	72	28		High
(Koroma et al., 2017)	2016-2022	Africa	Sierra Leone	486	Cross-sectional survey	47	53		High
(Kumar et al., 2019)	2016-2022	Asia	India	190,898	National Family Health Survey	21	79	51.6	Medium
(Kyei, Chansa, and Gabrysch, 2012)	2002-2015	Africa	Zambia	4,148	National assessment	29	71	60	High

(Continued)



Table 1. (Continued)

Author year	Year	Continent	Study area/ Country	Sample	Study design	Good- quality ANC	Poor QANC	4th ANC	Quality
(Leal, Esteves-Pereira, Viellas, Domingues, and Gama, 2020)	2016-2022	South America	Brazil	19,117	National hospital-based survey	16	84	61.7	High
(Luan Nogueira Bezerra de et al., 2020)	2016-2022	South America	Brazil	235	Cross-sectional study	20.4	79.6		High
(Majrooh, Hasnain, Akram, Siddiqui, and Memon, 2014)	2002-2015	Asia	Pakistan	171	Cross-sectional study	5	95		High
(Marchant et al., 2015)	2002-2015	Africa	Nigeria,	348	Cluster-based household	11	89		Medium
(Marchant et al., 2015)	2002-2015	Africa	Ethiopia	533	Linked cluster-based household surveys	4	96		High
(Marchant et al., 2015)	2002-2015	Asia	India	604	Linked cluster-based household surveys	6	94		High
(McHenga, Burger, and von Fintel, 2019)	2016-2022	Africa	Malawi	8545	Retrospective study	11	89		High
(Mekonnen, Berheto, Ololo, and Tafese, 2017)	2016-2022	Africa	Ethiopia	423	Facility-based cross-sectional study design	31.5	69.5		High
(Merrell and Blackstone, 2020)	2016-2022	Africa	Guinea	2958	Demographic and Health Survey	32	68	51	Medium
(Mirkovic et al., 2017)	2016-2022	North America	Haiti	894	Cross-sectional study design	33	67	36	High
(Morón-Duarte et al., 2021)	2016-2022	South America	Brazil	3923	Population-based birth cohort	24.1	74.9		High
(Muchie, 2017)	2016-2022	Africa	Ethiopia	3694	Mini Demographic and Health Survey	45.7	54.3	33	High
(Naariyong et al., 2012)	2002-2015	Africa	Ghana	600	Cross-sectional study	45	55	75.4	High
(Nikiema, Kameli, Capon, Sondo, and Martin-Prével, 2010)	2002-2015	Africa	Burkina Faso	81	Observation study	10.3	89.7		Medium
(Nyamtema, Bartsch-de Jong, Urassa, Hagen, and van Roosmalen, 2012)	2002-2015	Africa	Tanzania	263	Cross-sectional	22	78		High
(Owili, Muga, Mendez, and Chen, 2019)	2016-2022	Africa	Kenya	1445	Service Provision Assessment (SPA) survey	34.46	65.44		High
(Owili et al., 2019)	2016-2022	Africa	Malawi	2105	Service Provision Assessment (SPA) survey	6.7	93.3		High
(Owili et al., 2019)	2016-2022	Africa	Namibia	880	Service Provision Assessment (SPA) survey	48.07	51.93		High
(Owili et al., 2019)	2016-2022	Africa	Uganda	803	Service Provision Assessment (SPA) survey	2.53	97.47		Medium
(Owili et al., 2019)	2016-2022	Africa	Rwanda	737	Service Provision Assessment (SPA) survey	17.91	81.09		High
(Owili et al., 2019)	2016-2022	Africa	Tanzania	1607	Service Provision Assessment (SPA) survey	19.83	80.17		High
(Ozumba, Onyeneho, Chalupowski, and Subramanian, 2019)	2016-2022	Africa	Nigeria	1,600	Cross-sectional survey of	58.8	41.2		High
(Phillips et al., 2017)	2016-2022	North America	Haiti	583	Observation study	49	51		Medium
(Rahman El Gammal, 2014)	2002-2015	Africa	Egypt	306	Cross-sectional	76.5	23.5		High
(Raru et al., 2022)	2016-2022	Africa	East Africa	46,656	Demographic and Health Survey of six East African Countries	11.16	87.14	48.61	High

(Continued)

Table 1. (Continued)

Author year	Year	Continent	Study area/ Country	Sample	Study design	Good- quality ANC	Poor QANC	4th ANC	Quality
(Rios-Zertuche et al., 2019)	2016-2022	South America (LMI C)	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama a	12662	Constructed quality indicators for maternal and child care	68.8	31.2		High
(Rurangirwa, Mogren, Ntaganira, Govender, and Krantz, 2018)	2016-2022	<b>Africa</b>	Rwanda	605	Facility-based, cross-sectional study	49.18	50.12	16.7	High
(Singh et al., 2022)	2016-2022	Asia	India	190 898	Secondary analysis of the nationally representative survey	23.5	76.5	54.1	Medium
(Singh et al., 2019)	2016-2022	Asia	India	190 898	Secondary analysis of the nationally representative survey	41.12	58.8		High
(Sommer Albert, Younas, and Victor, 2020)	2016-2022	Asia	Pakistan	138	Cross-sectional approach	61	39		High
(Tafere, Afework, and Yalew, 2018)	2016-2022	<b>Africa</b>	Ethiopia	970	Facility-based prospective follow-up study	27.6	72.4		High
(Tekelehaymanot, 2018)	2016-2022	<b>Africa</b>	Ethiopia	370	Facility-based cross-sectional study	24.3	75.7		High
(van der Kooy et al., 2017)	2016-2022	<b>Europe</b>	Netherland	274	Cross-sectional, interview-based survey	68.3	31.7		Medium
(Young et al., 2020)	2016-2022	<b>Africa</b>	Tanzania	3178	Cross-sectional cluster survey	25	75		High

Keynotes: Nine East African countries (Burundi, Zimbabwe, Zambia, Uganda, Tanzania, Rwanda, Malawi, Kenya).

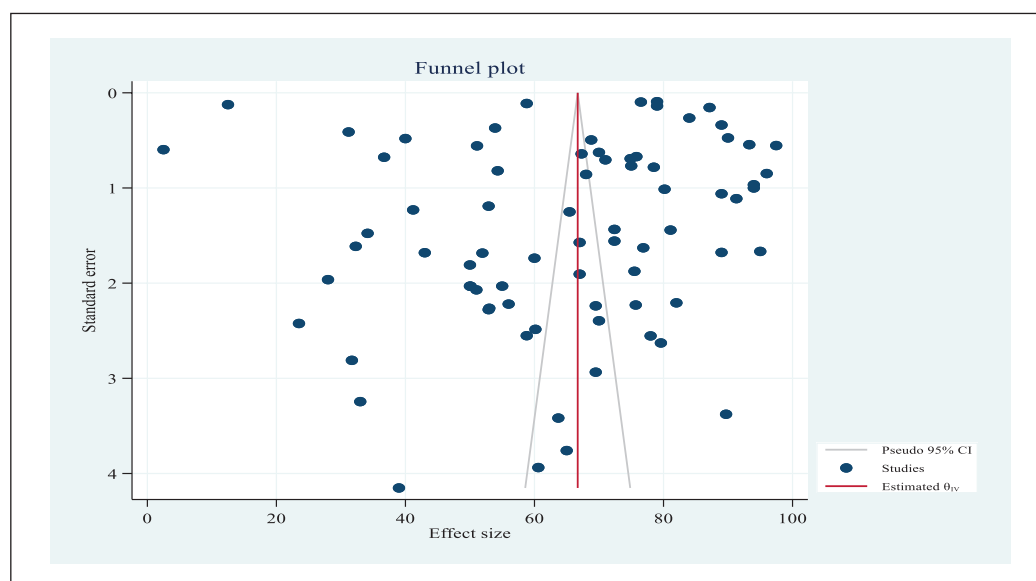
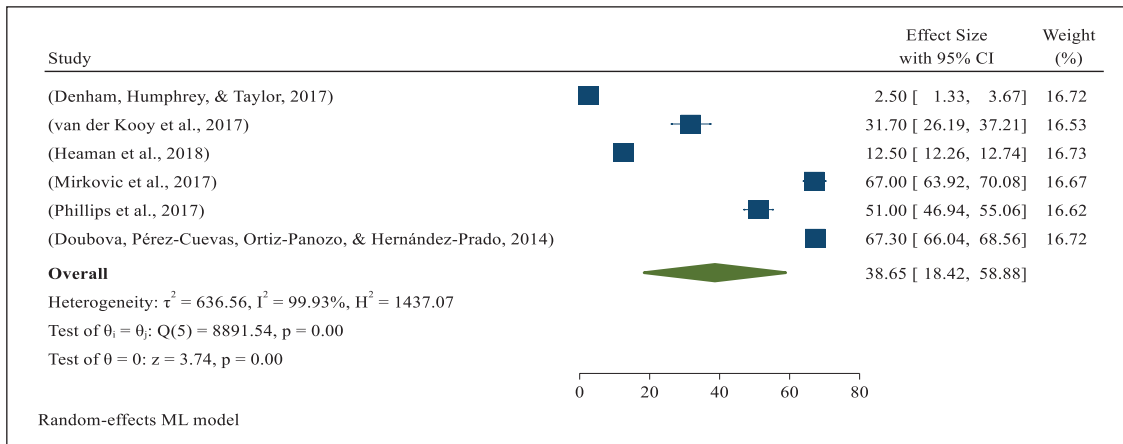
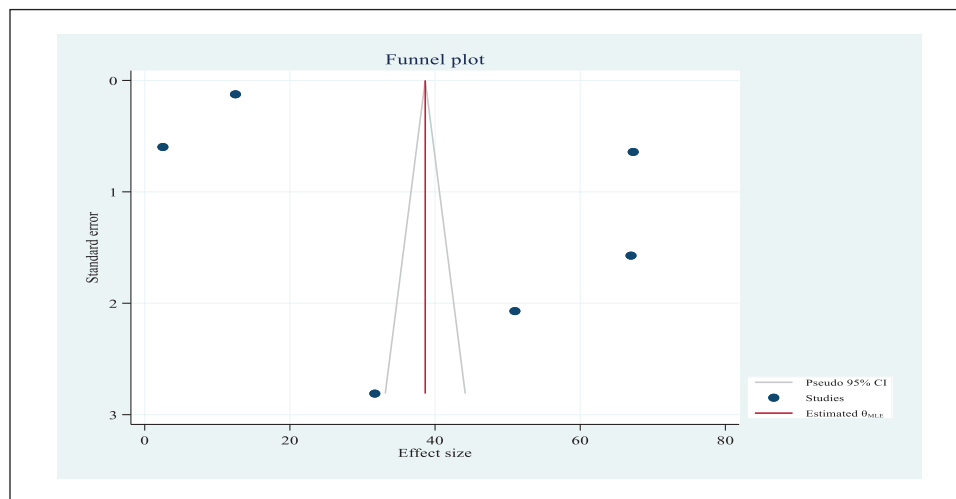


Figure 4. Funnel plot showing the distribution of included studies global pooled prevalence of poor-quality ANC services per 100 pregnant women 2022.





**Figure 8.** Forest plot showing the developed country (North America and Europe) pooled prevalence of poor-quality ANC services per 100 pregnant women in 2022.



**Figure 9.** Funnel plot showing the distribution of included studies of the global pooled prevalence of poor-quality ANC services per 100 pregnant women in 2022.

in Scotland<sup>151</sup> to 67.3% in Mexico.<sup>149</sup> Based on the random-effects model, the pooled poor-quality ANC services in developed countries was 38.65% (95% CI: 18.42%–58.88%) per 100 pregnant women who attended ANC (Figure 8).

There was high heterogeneity among studies ( $I^2=99.93\%$ ,  $p=0.001$ ), and based on the trim-and-fill analysis, the learner estimator imputed zero studies (observed 6 + imputed 0=6 studies); the high-income countries pooled did not change after the trim-and-fill analysis.

Publication bias was checked using a funnel plot, which was objectively verified using Egger's regression test ( $p=0.517$ ) to confirm that there was no publication bias, and funnel plots appeared symmetric for the developed countries pooled with poor-quality ANC services (see Figure 9).

### *Pooled estimates of poor-quality ANC in low and middle-income countries*

Of total, 76 studies were included in the meta-analysis. The majority (70 studies) of the 76 studies included in the meta-analysis were conducted in low- and middle-income countries with a weighted sample size of 861,776 pregnant women of ANC attendants and revealed that 617,031 pregnant women utilized poor-quality ANC services. The prevalence of highly diverse, poor-quality ANC services ranges from 23.5% in Egypt<sup>112</sup> to 97.47% in Uganda.<sup>114</sup>

Based on the random-effects model, the low- and middle-income countries pooled poor-quality ANC services at 66.26% (95% CI: 61.81%–70.71%) with  $I^2=99.95\%$  ( $p=0.001$ ) per 100 pregnant women ANC attended (Figure 10). There was significant heterogeneity among studies

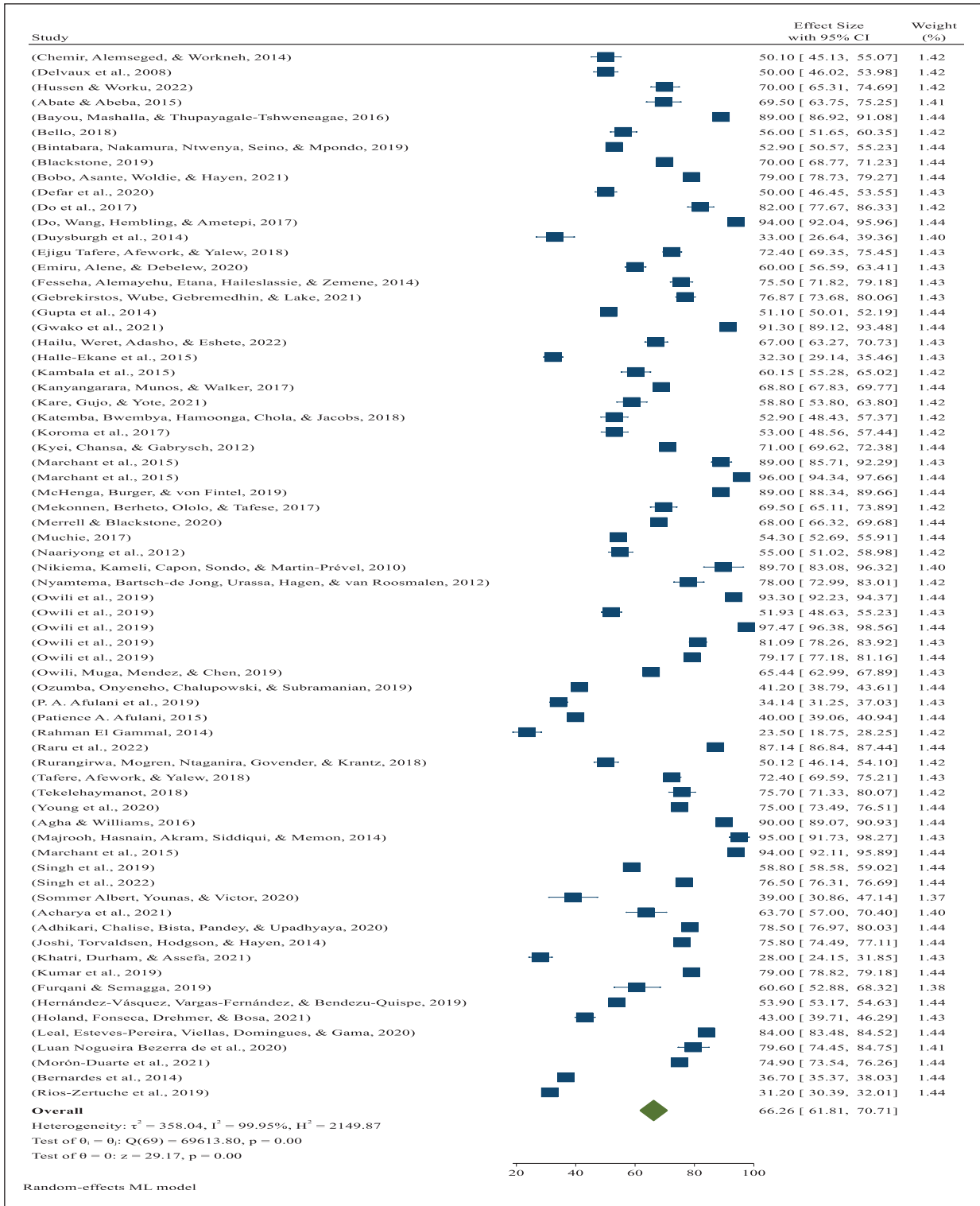
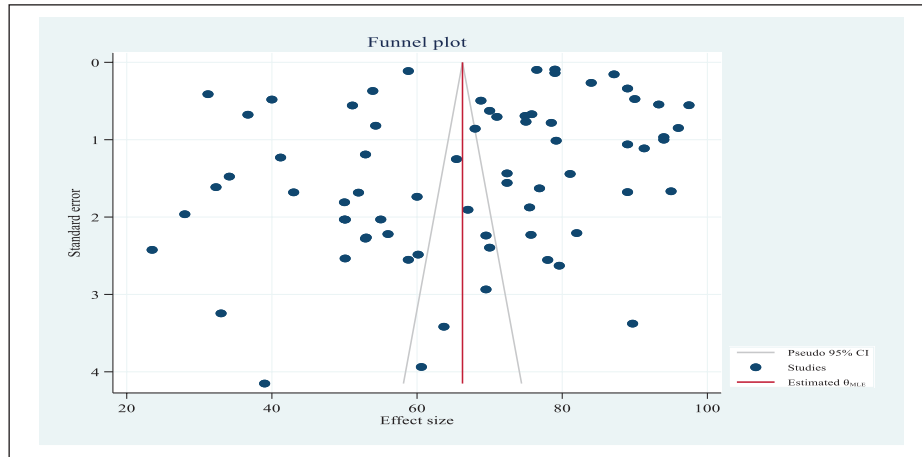


Figure 10. Forest plot showing LMICs pooled prevalence of poor-quality ANC services per 100 pregnant women 2022.

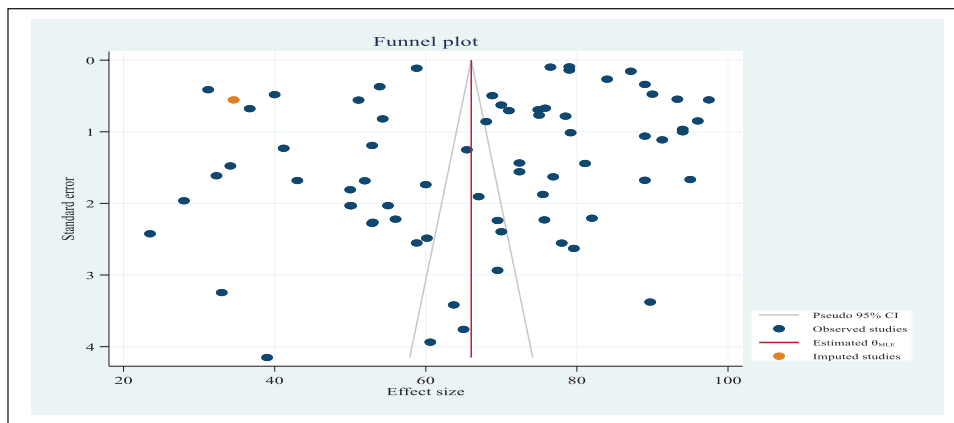
( $I^2=99.95\%$ ,  $p=0.001$ ), and based on the trim-and-fill analysis, the learner estimator imputed 13 studies on the left (70 + imputed 1 = 71 studies), and the low and

middle-income countries (LMICs) pooled estimate was 66.019% (95% CI: 61.563%–70.475%) after trim-and-fill analysis.





**Figure 11.** Funnel plot showing the distribution of included studies LMICs pooled prevalence of poor-quality ANC services per 100 pregnant women 2022.



**Figure 12.** Funnel plot after trim-and-fill analysis of linear estimator in LMICs pooled prevalence of poor-quality ANC services per 100 pregnant women 2022.

Publication bias was checked using funnel plots looking asymmetrically pinpointed to the right and was objectively verified using Egger's regression test to confirm publication bias ( $p=0.0209$ ), which revealed that the current body of literature is detailed in Figure 11.

There was high heterogeneity among studies ( $I^2=99.95\%$ ,  $p=0.001$ ), and based on the trim-and-fill analysis, the learner estimator imputed 13 studies on the left ( $70 + \text{imputed } 1 = 71$  studies); the LMICs pooled estimate became  $66.019\%$  (95% CI:  $61.563\%–70.475\%$ ) after trim-and-fill analysis.

As in Figure 10 belows, the funnel plots appeared symmetric after trim-and-fill analysis of the linear estimator imputed one study on the left global pooled prevalence of quality ANC (Figure 12).

### *Africa continent pooled poor-quality ANC*

Of a total of 70 studies from LMICs, 51 studies conducted in Africa with a weighted sample size of 213,409 pregnant

women of ANC attendants revealed that 160,496 pregnant women utilized poor-quality ANC services, with highly diverse poor-quality ANC service prevalence ranging from 23.5% Egypt<sup>112</sup> to 97.47%.<sup>114</sup>

Based on the random-effects model, the African continent pooled poor-quality ANC services at  $66.66\%$  (95% CI:  $61.70\%–71.62\%$ ) with  $I^2=99.96\%$  ( $p=0.001$ ) per 100 pregnant women ANC attended (Figure 13).

Publication bias was checked using funnel plots looking asymmetrically pinpointed to the left and objectively verified using Egger's regression test. Publication bias was detected ( $p<0.0432$ ), which revealed the current body of literature (Figure 14).

The nonparametric trim-and-fill analysis of the publication bias learner estimator imputed six studies on the right (observed 52 + imputed 6 = 58 studies), and the African continent pooled estimate was  $79.985\%$  (95% CI:  $79.825\%–80.146\%$ ) after trim-and-fill analysis.



**Figure 13.** Forest plot showing Africa continent pooled prevalence of poor-quality ANC services per 100 among pregnant women 2022.

As shown in Figure 15, the funnel plots appeared symmetric after trim-and-fill analysis of the linear estimator, imputing six studies on the right African continent pooled prevalence of quality ANC (Figure 15).

Of the 51 studies conducted in Africa, 15 studies were conducted in Ethiopia with a weighted sample size of 120,31 pregnant women of ANC attendants, revealed that 7989 pregnant women utilized poor-quality ANC services, with

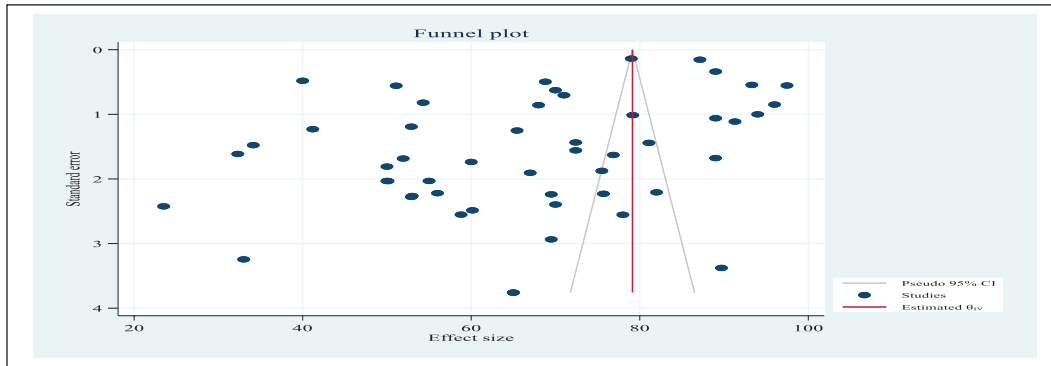


Figure 14. Forest plot showing the pooled prevalence of poor-quality ANC per 100 among pregnant women in Africa.

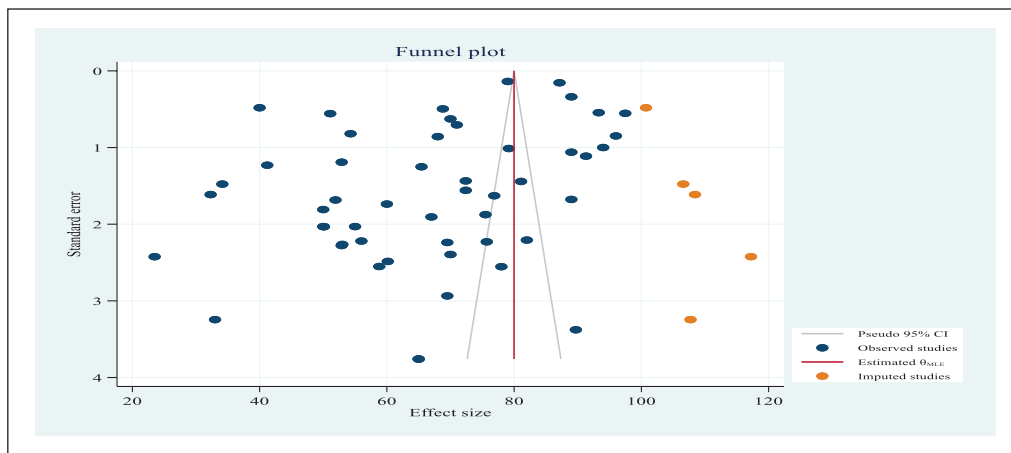


Figure 15. The pooled proportion of poor-quality ANC services in Ethiopia 2022.

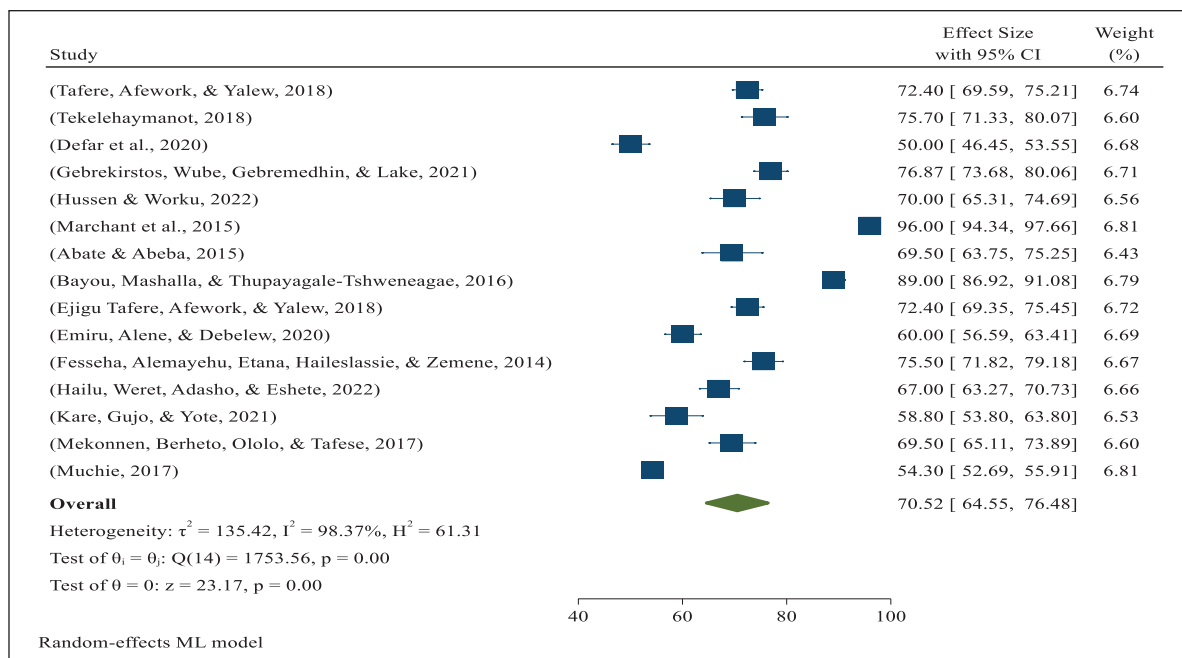
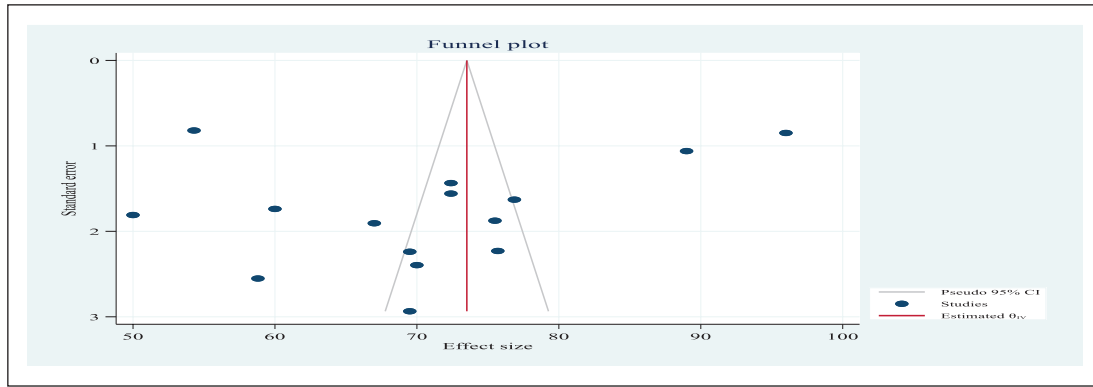


Figure 16. Forest plot showing Ethiopia pooled prevalence of poor-quality ANC services per 100 among pregnant women 2022.



**Figure 17.** Forest plot showing the pooled prevalence of poor-quality ANC per 100 among pregnant women in Africa 2022.

**Table 2.** The summary of the pooled estimates of the AOR per predictors of good-quality antenatal care service in Ethiopia 2022.

Identified predictors	Number of studies	Estimate: 95% CI	Heterogeneity ( $I^2$ )	Heterogeneity ( $p$ -value)
Fourth and above ANC visit	5	2.61(1.37–84)	99.94%	0.00
High wealth index	4	2.72(1.89–55)	99.99%	0.00
Maternal education attainment	5	3.03(2.24–82)	99.95%	0.00
Residence (Urban dwellers)	3	4.06(0.95–17)	99.974%	0.00
Maintained confidentiality	2	2.23(-0.36–82)	99.50%	0.00

highly diverse poor-quality ANC services ranging from 50%<sup>153</sup> to 96%.<sup>124</sup> The pooled prevalence of poor ANC services in Ethiopia was 70.52% (95% CI: 64.55%–76.48%), with significant heterogeneity between studies ( $I^2=98.37%$ ,  $p=0.001$ ) (Figure 16).

Publication bias was checked using funnel plots looking at the asymmetric pin pointed to the left, and it was objectively verified using Egger's regression test and was not able to detect publication bias ( $p < 0.237$ ); however, this was confirmed by Fisher fail safe-N-P (Chi-square test=0.00) analysis findings warrant the acknowledgment of possible publication bias within the article, which revealed the current body of literature (Figure 17).

The nonparametric trim-and-fill analysis of the publication bias learner estimator imputed six studies to the right (16 + imputed 0 = 16 studies), and the Ethiopian pooled estimate became 73.52% (95% CI: 72.784%–74.257%) after trim-and-fill analysis.

### Predictors of good-quality ANC service in Ethiopia

As shown below in Table 2, identified predictors of good-quality ANC service

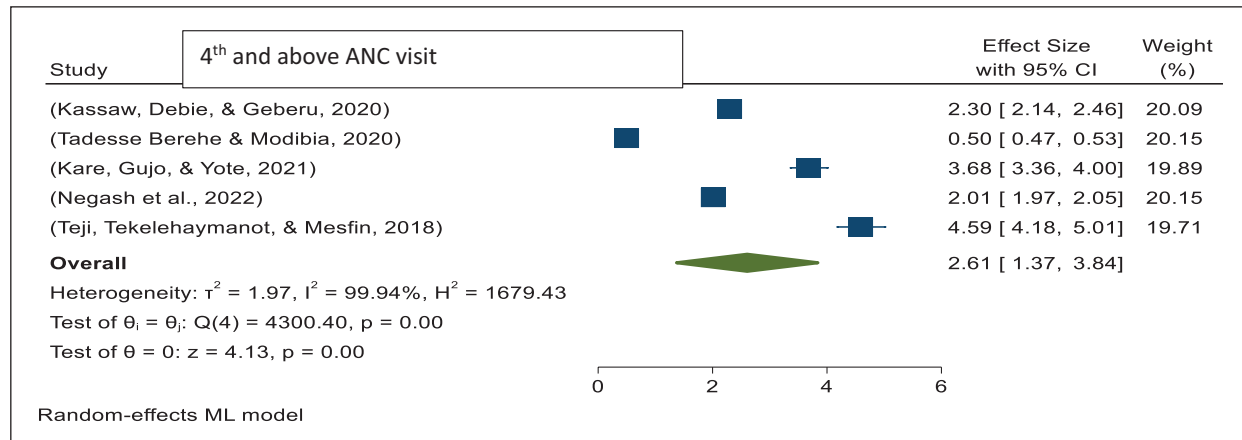
As the table depicted, the identified pooled predictors of good-quality ANC service were the number of ANC visits (fourth and above), family wealth index, maternal education attainment, residence (urban dwellers), and confidentiality maintained during ANC follow-up.

Women who attended the fourth and above ANC visits were identified in five articles,<sup>169–173</sup> with a pooled predictor

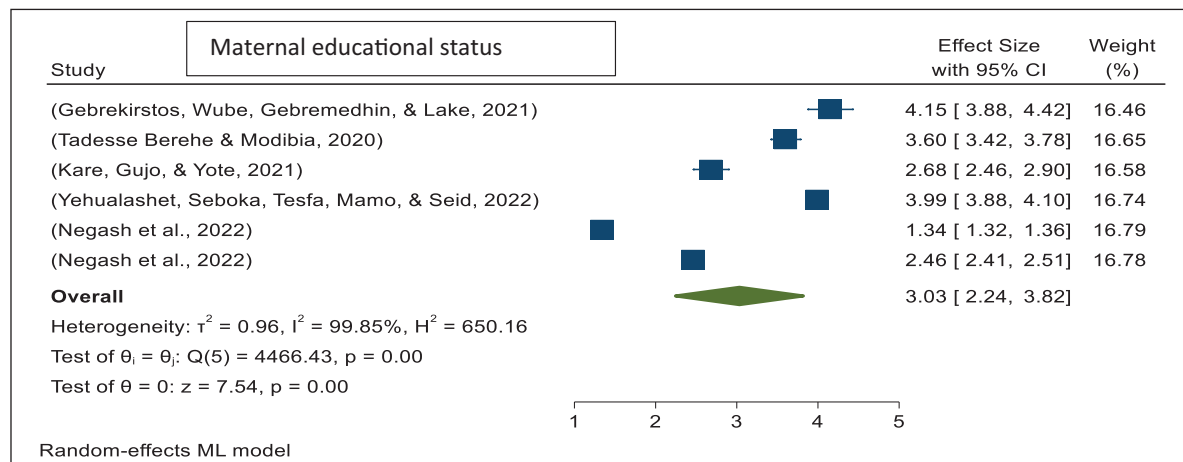
of 2.6 times more likely to receive good-quality ANC services AOR=2.6 and (95% CI: 1.37–3.84).

Maternal educational attainment was identified as a factor recorded in five articles,<sup>39,143,169,171,172</sup> with an overall predicting 3times higher in primary education and more attained women than their counterparts (OR=3.03; 95% CI: 2.24–3.82). High family wealth index status was identified as a predictor reported in four articles,<sup>143,169–171</sup> which predicted 2.72 times higher in the high family wealth index than in women with a low index (OR=2.72 and 95% CI: 1.89–3.55). Another factor that predicted good-quality ANC service utilization was residence (urban dwellers) reported in three original articles,<sup>39,169,172</sup> with an overall prediction 4 times more likely to utilize good-quality ANC services among urban dwellers than rural dwellers (OR=4.06, 95% CI: 0.95–7.17). The last factor associated with the pooled prevalence of good-quality ANC service utilization was maintained confidentiality, as stated in two articles,<sup>140,173</sup> which revealed that 2.23 times more likely to predict good-quality ANC service utilization as compared to perceived not maintained confidentiality during the provision of ANC services (Table 2).

Women who attended the fourth and higher ANC visit were identified in five articles.<sup>169–173</sup> Women who had attended the fourth and above ANC visit were 2.6 times more likely to receive good-quality ANC services AOR=2.6 and (95% CI: 1.37–3.84) (Figure 15) ( $I^2=99.94%$ ,  $p=0.00$ ). To identify factors associated with the source of heterogeneity of pooled predictors of fourth and above ANC visits, meta-regression showed a significant association with sample size, study year, and frequency of good-quality ANC.



**Figure 18.** The pooled odds ratio of forth and above ANC visit with good-quality ANC services in Ethiopia 2022.



**Figure 19.** The pooled odds ratio of maternal education with good-quality ANC services in Ethiopia 2022.

Of the studies identified, fourth and above ANC visits were positively associated with good-quality ANC services, except for one study,<sup>172</sup> which again negatively predicted good-quality ANC services 0.5 times more likely to predict a poor-quality ANC services AOR = 0.5 (95% CI: 0.47–0.53) (see details in Figure 18).

Maternal educational attainment was identified as a factor recorded in five articles.<sup>39,143,169,171,172</sup>

The odds of good-quality ANC service utilization were three times higher in attained primary education and more women than their counterparts (OR = 3.03 (95% CI: 2.24–3.82) (Figure 18) ( $I^2 = 99.85\%$ ,  $p = 0.00$ ). Of the studies identified forth and higher ANC visits were positively associated with the quality of ANC services.

To identify factors associated with the source of heterogeneity of pooled predictors of maternal education, meta-regression showed that it was significantly associated with sample size, study year, and frequency of good-quality ANC (Figure 19).

High family wealth index status was identified as a predictor, which was reported in four articles.<sup>143,169–171</sup> The likelihood of utilizing good-quality ANC services in women with moderate to high family wealth indexes was 2.72 times higher than that in women with low family wealth indexes (OR = 2.72; 95% CI: 1.89–3.55) (Figure 17) with ( $I^2 = 99.89\%$ ,  $p = 0.00$ ). To identify factors associated with the source of heterogeneity of pooled predictors of high family wealth index, meta-regression showed a significant association with sample size, study year, and frequency of good-quality ANC (Figure 20).

Another factor that predicted good-quality ANC service utilization was residence (urban dwellers), which was reported in three original articles.<sup>39,169,172</sup> Urban dwellers women were 4 times more likely to utilize good-quality ANC services than rural dwellers (OR = 4.06; 95% CI: 0.95–7.17) (Figure 18) ( $I^2 = 99.89\%$ ,  $p = 0.00$ ). To identify factors associated with the source of heterogeneity of pooled predictors of maternal residence, meta-regression showed a significant



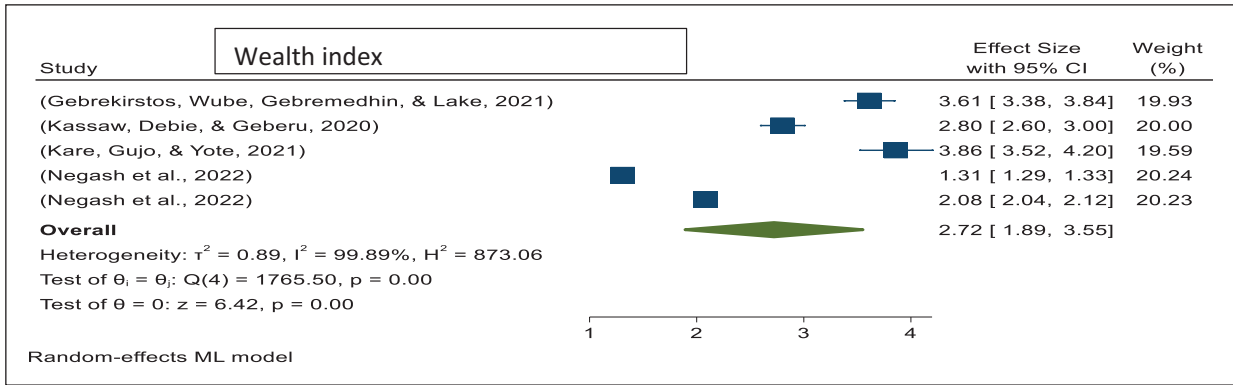


Figure 20. The pooled odds ratio of family wealth indexes with good-quality ANC services in Ethiopia 2022.

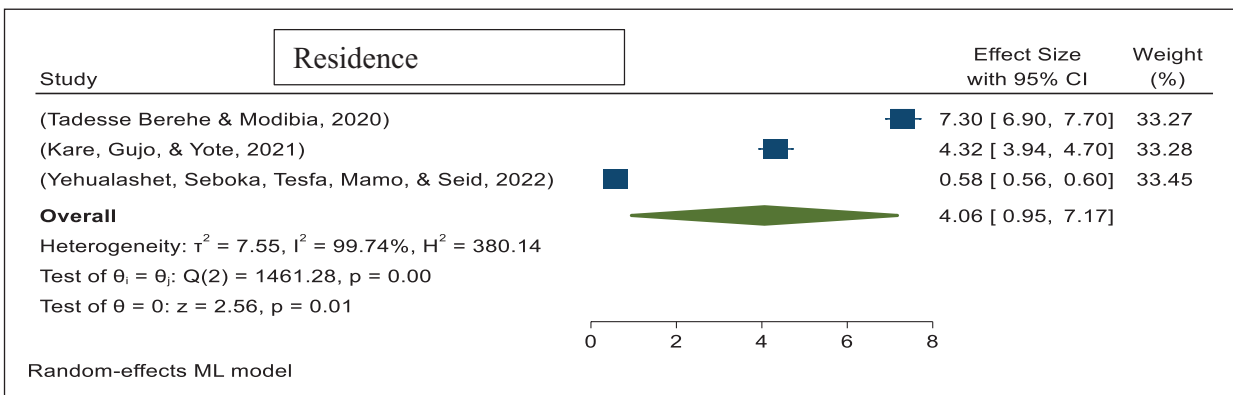


Figure 21. The pooled odds ratio of residences with good-quality ANC services in Ethiopia 2022.

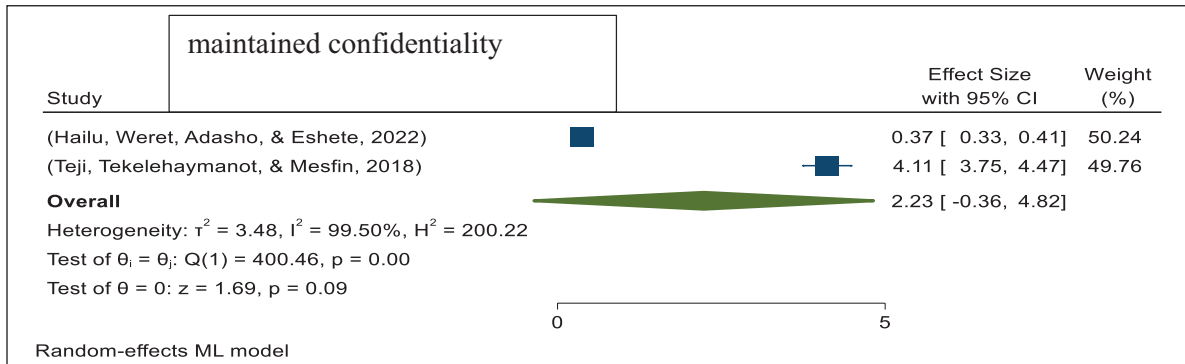


Figure 22. The pooled odds ratio of maintained confidentiality with good-quality ANC services in Ethiopia 2022.

association with sample size and frequency of good-quality ANC (Figure 21).

The last factor associated with the pooled prevalence of good-quality ANC service utilization was confidentiality, as stated in two articles.<sup>140,173</sup> Women who maintained confidentiality were 2.23 times more likely to utilize good-quality ANC services than those who did not maintain confidentiality during ANC service provision (Figure 21). To identify factors associated with the source of heterogeneity of pooled

predictors of maintained confidentiality, meta-regression showed a significant association with sample size and frequency of good-quality ANC (Figure 22).

### Discussion

Quality ANC has been stipulated as a means of achieving the targets of the SDGs 3.1 and 1.2. Poor-quality ANC is linked to significant maternal and infant mortalities.<sup>174,175</sup> There is

evidence that quality ANC can avert 2/3 of the maternal and neonatal health burdens. Inconsistent with evidence showing the benefit of quality ANC, the current study revealed gravely concerning findings.<sup>175</sup> This study estimated the global and regional pooled prevalence of poor-quality ANC services among pregnant women based on global and regional data. The results revealed that the global pooled poor-quality ANC services was 64.28% (95% CI:59.58%–68.98%), with heterogeneity among studies ( $I^2=99.96\%$ ,  $p=0.001$ ). Based on the trim-and-fill analysis learner estimator, 13 studies were imputed and the global pooled estimate was 58.55% (95% CI: 53.61%–63.49%). All studies based on the WHO have defined quality ANC as a major component. This definition has received little attention in the measurement of ANC quality.<sup>14,176</sup> As a result, except for a few empirical investigations, authors considered studies with little variation in the method and approach of quality ANC measures,<sup>32–34,177</sup> findings, supported by review evidence, revealed that poor-quality facility-based care is one of the major contributing factors to the elevated rates of morbidity and mortality among women and newborns in LMIC. Women who perceive the quality of facility-based healthcare to be poor may choose to avoid facilities-based deliveries, which could save their lives.<sup>178</sup>

This study revealed regional and country-level disparities, where pregnant women who resided in Asia, Africa, and South America had the highest prevalence of poor-quality ANC services; subgroup analysis revealed that the pooled prevalence of poor-quality ANC was 70.07%, 66.87%, 57.7%, and 38.6% for Asia, Africa, South America, and Europe and North America, respectively. This regional variation revealed that pregnant women from Asia, Africa, and South America received 74% poorer quality ANC than those from Europe and North America. This evidence is strongly supported by a Lancet Commission study that reported 8.6 million deaths from treatable conditions in LMICs, 60% due to poor-quality care.<sup>179</sup> This finding is comparable with other studies that reported that poor-quality ANC is associated with the economy and literacy level of countries.<sup>180</sup> Other studies have also indicated that pregnant women in low- and middle-income countries receive the lowest quality of ANC. This great regional variation due to perinatal regionalization based on leaving no one behind in European member states was implemented by ‘rationalizing existing healthcare services to ensure that each pregnant woman and newborn infant are cared for in an appropriate facility’. The main goal of regionalization is to minimize differences in outcomes attributable to geographic location while helping to contain rising healthcare costs (through economies of scale).<sup>180</sup> The success of health workers cost depends on rapid policy transition, increased funding, effective use of technology, community engagement, referral linkages, public health services, and sustained political will. India’s experience can guide other low and middle-income countries in achieving universal health coverage.<sup>181</sup> Scientific evidence has proven that high-quality ANC is essential to ensure a

healthy pregnancy for the mother and baby and an effective transition to positive labor and childbirth.<sup>175,180</sup>

‘The World Health Organization (WHO)’ has established a framework containing eight quality domains that should be assessed, improved, and monitored within the health system to ‘improve the quality of maternal and newborn care’. This will be applied across the world’s health systems and should provide a ‘structure for access to high-quality care in the two crucial, interlinked dimensions of provision and experience by focusing on six prioritized areas’: ‘clinical guidelines, standards of care, effective interventions, measures of quality, relevant research, and capacity-building to maintain high-quality services’.<sup>14</sup> The quality of ANC in ‘low- and middle-income countries’ is extremely poor. The pooled estimate was far below the planned value. Therefore, progress has been made with expanding coverage of essential interventions in reproductive, maternal, neonatal, child, and adolescent health worldwide. However, a task shift from coverage to quality care is urgently needed to save millions of lives global mothers.<sup>180</sup> Healthcare providers should prioritize culturally appropriate care for women to optimize reproductive health and improve pregnancy outcomes. Prioritizing pre-conception and prenatal care can reduce costs, improve maternal and fetal outcomes, and promote lifelong health.<sup>182</sup> Studies have revealed that burden of various chronic conditions include hypertension, diabetes, asthma, heart diseases and thyroid disorder have been associated with limited access to quality of care and poor health infrastructures. The authors also highlighted that strengthening primary health systems to enhance clinical condition-related service quality and delivery is imperative.<sup>183,184</sup>

Of total, 51 studies done in Africa continent, 15 studies were conducted in Ethiopia with a weighted sample size of 120,31 pregnant women of ANC attendants revealed that 7989 pregnant women utilized poor-quality ANC services, with highly diverse poor-quality ANC services prevalence ranges from 50%<sup>153</sup> to 96%.<sup>124</sup> The pooled prevalence of poor ANC services in Ethiopia was 70.52% (95% CI: 64.55%–76.48%). This evidence is supported by a national health survey of five African countries, which revealed that more than 40% scored poorly in basic measures of maternal care.<sup>185</sup> The promising goal of Ethiopia’s Ministry of Health is to achieve three zeros from 2021 to 2025, and zero preventable maternal deaths and morbidities are planned to address this problem by enhancing the quality of ANC in Ethiopia.<sup>186</sup>

This meta-analysis identified that the overall pooled predictors of good-quality ANC services were number of ANC visits (fourth and above ANC visits), family wealth index, maternal educational attainment, residence (urban dwellers), and maintained confidentiality during ANC follow-up. These results are supported by the Health Sector Transformation Plan, while other breakthrough studies revealed that health indicators vary significantly by region, place of residence, gender, disability status, education, and socioeconomic status. In general, health benefits are higher for urban dwellers, literates, and wealthier groups.<sup>187,188</sup>

## Strength and limitation

This study was based on individual studies published in English, which may have affected true estimates. The higher heterogeneity observed among the studies might have also affected the estimates.

We attempted to address the high publication bias that may have affected the true estimates in the current study using trim-and-fill analysis. However, the authors were unsure whether the high publication bias was due to the presence of substantial heterogeneity among the studies or unresearched/unpublished studies. Finally, this study should be interpreted with caution, considering the limitations of the data available at the time of publication. These findings should be considered when interpreting the results of this meta-analysis. Although this does not necessarily invalidate our conclusions, publication bias and heterogeneity of the studies are inevitable, regardless of how we try to treat them statistically. Authors would like our readers to consider that the studies included in this meta-analysis are heterogeneous.

## Conclusions

The pooled estimate revealed that nearly two-thirds of pregnant women worldwide received poor-quality ANC services. The study found regional and country-level disparities in the quality of ANC services for pregnant women. Ethiopia, Asia, Africa, and South America, where poor-quality ANC services were provided for more than two-thirds to three-fourths of the ANC attendants. Thus, policymakers and health planners should prioritize the quality of ANC services as current international and national public health agendas to reduce maternal and neonatal mortality and morbidities as per the sustainable development goals plan.

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## Author contributions

DBD conceptualized, designed, and drafted the manuscript. DBD and FTT performed article search, data extraction, and quality assessment. DBD and FTT conducted data analysis and wrote the manuscript. ASB, AT and GM have reviewed the manuscript. All authors read, reviewed, and approved the final manuscript.

## Availability of data and materials

All data generated or analyzed during this study are included in this article and its supplemental information files.

## Declaration of conflicting interests

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

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## Ethical approval

Not applicable.

## Informed consent

Not applicable.

## ORCID iDs

Dereje Bayissa Demissie  <https://orcid.org/0000-0003-1006-4318>  
Firew Tiruneh Tiyare  <https://orcid.org/0000-0001-5170-7610>

## Supplemental material

Supplemental material for this article is available online.

## References

1. Carlsen L and Bruggemann R. The 17 United Nations' sustainable development goals: a status by 2020. *Int J Sustain Develop World Ecol* 2022; 29(3): 219–229.
2. Sachs J, Kroll C, Lafortune G, et al. *Sustainable development report 2022*. Oxford: Cambridge University Press, 2022.
3. Sharma B, Raina A, Kumar V, et al. Counting stillbirth in a community-to understand the burden. *Clin Epidemiol Global Health* 2022; 14: 100977.
4. Mergl R, Quaat SM, Edeler L-M, et al. Grief in women with previous miscarriage or stillbirth: a systematic review of cross-sectional and longitudinal prospective studies. *Eur J Psychotraumatol* 2022; 13(2): 2108578.
5. Asim M, Karim S, Khwaja H, et al. The unspoken grief of multiple stillbirths in rural Pakistan: an interpretative phenomenological study. *BMC Women's Health* 2022; 22(1): 1–11.
6. Renfrew MJ, McFadden A, Bastos MH, et al. Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care. *Lancet* 2014; 384(9948): 1129–1145.
7. Aderoba AK and Adu-Bonsaffoh K. Antenatal and postnatal care. *Obstetr Gynecol Clin* 2022; 49(4): 665–692.
8. Gaur BPS, Vasudevan J and Pegu B. Group antenatal care: a paradigm shift to explore for positive impacts in resource-poor settings. *J Prevent Med Public Health* 2021; 54(1): 81.
9. Zanonato G, Msolomba R, Guarenti L, et al. Antenatal care in developing countries: the need for a tailored model. *Semin Fetal Neonatal Med* 2006; 11(1): 15–20.
10. Sharma J, O'Connor M and Rima Jolivet R. Group antenatal care models in low-and middle-income countries: a systematic evidence synthesis. *Reprod Health* 2018; 15(1): 1–12.
11. Kearns A, Caglia J, ten Hoope-Bender P, et al. Antenatal and postnatal care: a review of innovative models for improving availability, accessibility, acceptability and quality of services in low-resource settings. *BJOG* 2016; 123(4): 540–548.
12. Owili PO, Muga MA, Mendez BR, et al. Quality of care in six sub-Saharan Africa countries: a provider-based study on adherence to WHO's antenatal care guideline. *Int J Qual Health Care* 2019; 31(1): 43–48.

13. Denham S, Humphrey T and Taylor R. Quality of care provided in two Scottish rural community maternity units: a retrospective case review. *BMC Pregn Childbirth* 2017; 17(1): 1–11.
14. World Health Organization. Standards for improving quality of maternal and newborn care in health facilities, <https://iris.who.int/bitstream/handle/10665/249155/9789241511216-eng.pdf?sequence=1%0Ahttp://www.who.int/iris/handle/10665/249155> (2016, accessed on 12 November 2022).
15. Kohe AD. *Quality of antenatal care services and pregnancy outcomes among patients with pre-eclampsia with severe features managed at Kenyatta National Hospital*. Australia: Uon, 2021.
16. Kearns A, Caglia JM, ten Hoop-Bender P, et al. Antenatal and postnatal care: a review of innovative models for improving availability, accessibility, acceptability and quality of services in low-resource settings. *BJOG* 2016; 123(4): 540–548.
17. Morón-Duarte LS, Ramirez Varela A, Segura O, et al. Quality assessment indicators in antenatal care worldwide: a systematic review. *Int J Qual Health Care* 2019; 31(7): 497–505.
18. Afulani PA, Buback L, Essandoh F, et al. Quality of antenatal care and associated factors in a rural county in Kenya: an assessment of service provision and experience dimensions. *BMC Health Serv Res* 2019; 19(1): 684.
19. Ansu-Mensah M, Danquah FI, Bawontuo V, et al. Quality of care in the free maternal healthcare era in sub-Saharan Africa: a scoping review of providers' and managers' perceptions. *BMC Pregn Childbirth* 2021; 21(1): 220.
20. Delvaux T, Konan JP, Aké-Tano O, et al. Quality of antenatal and delivery care before and after the implementation of a prevention of mother-to-child HIV transmission programme in Côte d'Ivoire. *Trop Med Int Health* 2008; 13(8): 970–979.
21. Katemba BM, Bwembya P, Hamoonga TE, et al. Demand side factors associated with quality antenatal care services: a case study of Lusaka District, Zambia. *Front Public Health* 2018; 6: 285.
22. Lake EA, Demissie BW, Gebeyehu NA, et al. Knowledge and practice of mothers towards sunshine exposure of their children in Ethiopia: a systematic review and meta-analysis. *BMC Pediatr* 2022; 22(1): 1–11.
23. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med* 2009; 151(4): 264–269.
24. Munn Z, Moola S, Lisy K, et al. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. *Int J Evid Based Healthcare* 2015; 13(3): 147–153.
25. Belur J, Tompson L, Thornton A, et al. Interrater reliability in systematic review methodology: exploring variation in coder decision-making. *Sociol Methods Res* 2021; 50(2): 837–865.
26. Moola S, Munn Z, Tufanaru C, et al. *Chapter 7: systematic reviews of etiology and risk*. Joanna Briggs Institute Reviewer's Manual. Adelaide, South Australia: The Joanna Briggs Institute, 2017, p. 5.
27. Lin L and Chu H. Quantifying publication bias in meta-analysis. *Biometrics* 2018; 74(3): 785–794.
28. Sterne JA and Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. *J Clin Epidemiol* 2001; 54(10): 1046–1055.
29. Rücker G, Schwarzer G, Carpenter JR, et al. Undue reliance on I<sup>2</sup> in assessing heterogeneity may mislead. *BMC Med Res Methodol* 2008; 8(1): 79.
30. Higgins JP and Thompson SG. Quantifying heterogeneity in a meta-analysis. *Statist Med* 2002; 21(11): 1539–1558.
31. Shi L and Lin L. The trim-and-fill method for publication bias: practical guidelines and recommendations based on a large database of meta-analyses. *Medicine* 2019; 98(23): e15987.
32. Afulani PA. Rural/urban and socioeconomic differentials in quality of antenatal care in Ghana. *PLoS One* 2015; 10(2): e0117996.
33. Arsenault C, Jordan K, Lee D, et al. Equity in antenatal care quality: an analysis of 91 national household surveys. *Lancet Global Health* 2018; 6(11): e1186–e1195.
34. Katemba BM, Bwembya P, Hamoonga TE, et al. Demand side factors associated with quality antenatal care services: a case study of Lusaka District, Zambia. *Front Public Health* 2018; 6: 285.
35. Munn Z, Moola S, Riitano D, et al. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. *Int J Health Policy Manag* 2014; 3(3): 123.
36. Zhou H, Wang A, Huang X, et al. Quality antenatal care protects against low birth weight in 42 poor counties of Western China. *PLoS One* 2019; 14(1): e0210393.
37. Yesuf EA and Calderon-Margalit R. Disparities in the use of antenatal care service in Ethiopia over a period of fifteen years. *BMC Pregnancy Childbirth* 2013; 13(1): 1–10.
38. Yeneneh A, Alemu K, Dadi AF, et al. Spatial distribution of antenatal care utilization and associated factors in Ethiopia: evidence from Ethiopian demographic health surveys. *BMC Pregnancy Childbirth* 2018; 18(1): 242.
39. Yehualashet DE, Seboka BT, Tesfa GA, et al. Determinants of optimal antenatal care visit among pregnant women in Ethiopia: a multilevel analysis of Ethiopian mini demographic health survey 2019 data. *Reprod Health* 2022; 19(1): 1–8.
40. Woyessa AH and Ahmed TH. Assessment of focused antenatal care utilization and associated factors in Western Oromia, Nekemte, Ethiopia. *BMC Res Notes* 2019; 12(1): 277.
41. Wagnaw F, Dessie G, Alebel A, et al. Does short message service improve focused antenatal care visit and skilled birth attendance? A systematic review and meta-analysis of randomized clinical trials. *Reprod Health* 2018; 15(1): 191.
42. van Heurn LJ, Coumans A, Haak MC, et al. Factors associated with poor outcome in fetuses prenatally diagnosed with sacrococcygeal teratoma. *Prenat Diagn* 2021; 41(11): 1430–1438.
43. Uldbjerg CS, Schramm S, Kaducu FO, et al. Perceived barriers to utilization of antenatal care services in northern Uganda: a qualitative study. *Sex Reprod Healthcare* 2020; 23: 100464.
44. Tsegaye S, Yibeltal K, Zelealem H, et al. The unfinished agenda and inequality gaps in antenatal care coverage in Ethiopia. *BMC Pregnancy Childbirth* 2022; 22(1): 1–10.
45. Tran TK, Gottvall K, Nguyen HD, et al. Factors associated with antenatal care adequacy in rural and urban contexts—results from two health and demographic surveillance sites in Vietnam. *BMC Health Serv Res* 2012; 12: 40.
46. Torrent A, Manrique G, Gómez-Castelló T, et al. Sonologist's characteristics related to a higher quality in fetal nuchal translucency measured in primary antenatal care centers. *Prenat Diagn* 2019; 39(10): 934–939.
47. Tomasi E, Fernandes PA, Fischer T, et al. [Quality of prenatal services in primary healthcare in Brazil: indicators and social inequalities]. *Cad Saude Publica* 2017; 33(3): e00195815.



48. Thongmixay S, Schoneveld T, Vongxay V, et al. Quality of family planning services for women of reproductive age in Lao PDR. *Global Health Action* 2020; 13(Sup2): 1788261.
49. Tetui M, Ekirapa EK, Bua J, et al. Quality of antenatal care services in eastern Uganda: implications for interventions. *Pan Afr Med J* 2012; 13: 27.
50. Teshome A, Birara M and Rominski SD. Quality of family planning counseling among women attending prenatal care at a hospital in Addis Ababa, Ethiopia. *Int J Gynaecol Obstetr* 2017; 137(2): 174–179.
51. Teshale AB, Tesema GA and Amo-Adjei J. Prevalence and associated factors of delayed first antenatal care booking among reproductive age women in Ethiopia; a multilevel analysis of EDHS 2016 data. *PLoS One* 2020; 15(7): e0235538.
52. Sharma A, Rana SK, Prinja S, et al. Quality of Health Management Information System for Maternal and Child Health Care in Haryana State, India. *PLoS One* 2016; 11(2): e0148449.
53. Salasibew MM, Filteau S and Marchant T. A qualitative study exploring newborn care behaviours after home births in rural Ethiopia: implications for adoption of essential interventions for saving newborn lives. *BMC Pregnancy Childbirth* 2014; 14: 412.
54. Salah AMA. Antenatal factors associated with low birthweight in the Gaza Strip: a matched case-control study. *Lancet* 2018; 391: S2.
55. Rios-Zertuche D, Zúñiga-Brenes P, Palmisano E, et al. Methods to measure quality of care and quality indicators through health facility surveys in low- and middle-income countries. *Int J Qual Health Care* 2019; 31(3): 183–190.
56. Renfrew MJ, McFadden A, Bastos MH, et al. Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care. *Lancet (London, England)* 2014; 384(9948): 1129–1145.
57. Phommachanh S, Essink DR, Jansen M, et al. Improvement of quality of antenatal care (ANC) service provision at the public health facilities in Lao PDR: perspective and experiences of supply and demand sides. *BMC Pregnancy Childbirth* 2019; 19(1): 255.
58. Ozumba BC, Onyeneho NG, Chalupowski M, et al. Inequities in access to maternal health care in Enugu State: implications for universal health coverage to meet vision 2030 in Nigeria. *Int Quart Commun Health Educ* 2019; 39(3): 163–173.
59. Ntambue AM, Malonga FK, Dramaix-Wilmet M, et al. Better than nothing? maternal, newborn, and child health services and perinatal mortality, Lubumbashi, democratic republic of the Congo: a cohort study. *BMC Pregnancy Childbirth* 2016; 16: 89.
60. Nisar YB, Aurangzeb B, Dibley MJ, et al. Qualitative exploration of facilitating factors and barriers to use of antenatal care services by pregnant women in urban and rural settings in Pakistan. *BMC Pregnancy Childbirth* 2016; 16: 42.
61. Mosoro E, Wilson AN, Homer CSE, et al. Assessing the quality of antenatal corticosteroids in low- and middle-income countries: a systematic review. *PLoS One* 2020; 15(12): e0243034.
62. Morón-Duarte LS, Ramirez Varela A, Segura O, et al. Quality assessment indicators in antenatal care worldwide: a systematic review. *Int J Qual Health Care* 2019; 31(7): 497–505.
63. Mizumoto BR, Moreira BM, Santoro-Lopes G, et al. Quality of antenatal care as a risk factor for early onset neonatal infections in Rio de Janeiro, Brazil. *Brazil J Infect Dis* 2015; 19(3): 272–277.
64. Melaku YA, Weldearegawi B, Tesfay FH, et al. Poor linkages in maternal health care services-evidence on antenatal care and institutional delivery from a community-based longitudinal study in Tigray region, Ethiopia. *BMC Pregnancy Childbirth* 2014; 14: 418.
65. Manzi A, Nyirazinyoye L, Ntaganira J, et al. Beyond coverage: improving the quality of antenatal care delivery through integrated mentorship and quality improvement at health centers in rural Rwanda. *BMC Health Serv Res* 2018; 18(1): 136.
66. Manithip C, Edin K, Sihavong A, et al. Poor quality of antenatal care services – is lack of competence and support the reason? An observational and interview study in rural areas of Lao PDR. *Midwifery* 2013; 29(3): 195–202.
67. Malin AJ, Busgang SA, Cantoral AJ, et al. Quality of prenatal and childhood diet predicts neurodevelopmental outcomes among children in Mexico City. *Nutrients* 2018; 10(8): 1093.
68. Luan Nogueira Bezerra M, Lima SP, Joymara Railma, Gomes A, et al. Factors associated to the prenatal of puerperal women in a university hospital from the Rio Grande do Norte State. *Revis Pesquisa Cuidado Fundam* 2020; 12: 1201–1207.
69. Leta M, Adem S and Daniel B. Assessment of quality antenatal care-linked HIV counseling and testing as an intervention for prevention of mother-to-child transmission of HIV at government health facilities in Harari region, Eastern Ethiopia. *SAGE Open Med* 2021; 9: 20503121211047757.
70. Lechthaler F, Abakar MF, Schelling E, et al. Bottlenecks in the provision of antenatal care: rural settled and mobile pastoralist communities in Chad. *Trop Med Int Health* 2018; 23(9): 1033–1044.
71. Larson E, Hermosilla S, Kimweri A, et al. Determinants of perceived quality of obstetric care in rural Tanzania: a cross-sectional study. *BMC Health Serv Res* 2014; 14: 483.
72. Lansky S, de Lima Friche AA, da Silva AAM, et al. Birth in Brazil survey: neonatal mortality, pregnancy and childbirth quality of care. *Cad Saude Publica* 2014; 30(Suppl 1): S1–S15.
73. Koblinsky M, Moyer CA, Calvert C, et al. Quality maternity care for every woman, everywhere: a call to action. *Lancet (London, England)* 2016; 388(10057): 2307–2320.
74. Khan REA, Ahmad TI, Noreen S, et al. Factors associated with the quality of Antenatal Care (ANC) services use in Bahawalpur. *J Pak Med Assoc* 2020; 70(12(b)): 2457–2459.
75. Kemp L, Bruce T, Elcombe EL, et al. Quality of delivery of “right@home”: implementation evaluation of an Australian sustained nurse home visiting intervention to improve parenting and the home learning environment. *PLoS One* 2019; 14(5): e0215371.
76. Hodgins S and D’Agostino A. The quality-coverage gap in antenatal care: toward better measurement of effective coverage. *Global Health Sci Pract* 2014; 2(2): 173–181.
77. Heaman MI, Sword WA, Akhtar-Danesh N, et al. Quality of prenatal care questionnaire: instrument development and testing. *BMC Pregnancy Childbirth* 2014; 14: 188.
78. Gold M, Krissik T and Mittler J. Quality improvement in Medicaid managed care: experience of the best clinical and



- administrative practices initiative. *Jt Comm J Qual Patient Saf* 2006; 32(2): 81–91.
79. França GV, Restrepo-Méndez MC, Maia MF, et al. Coverage and equity in reproductive and maternal health interventions in Brazil: impressive progress following the implementation of the Unified Health System. *Int J Equity Health* 2016; 15(1): 149.
  80. Fisseha G, Berhane Y, Worku A, et al. Quality of the delivery services in health facilities in Northern Ethiopia. *BMC Health Serv Res* 2017; 17(1): 1–7.
  81. Emiru AA, Alene GD and Debelew GT. Women's satisfaction with the quality of antenatal care services rendered at public health facilities in Northwest Ethiopia: the application of partial proportional odds model. *BMJ Open* 2020; 10(9): e037085.
  82. Duysburgh E, Zhang WH, Ye M, et al. Quality of antenatal and childbirth care in selected rural health facilities in Burkina Faso, Ghana and Tanzania: similar finding. *Trop Med Int Health* 2013; 18(5): 534–547.
  83. Duysburgh E, Williams A, Williams J, et al. Quality of antenatal and childbirth care in northern Ghana. *BJOG* 2014; 121(Suppl 4): 117–126.
  84. Choe SA, Kim J, Kim S, et al. Do antenatal care visits always contribute to facility-based delivery in Tanzania? A study of repeated cross-sectional data. *Health Policy Plan* 2016; 31(3): 277–284.
  85. Chetty T, Yapa HMN, Herbst C, et al. The MONARCH intervention to enhance the quality of antenatal and postnatal primary health services in rural South Africa: protocol for a stepped-wedge cluster-randomised controlled trial. *BMC Health Serv Res* 2018; 18(1): 625.
  86. Brabin L, Verhoeff FH, Kazembe P, et al. Improving antenatal care for pregnant adolescents in southern Malawi. *Acta Obstet Gynecol Scand* 1998; 77(4): 402–409.
  87. Bobo FT, Asante A, Woldie M, et al. Poor coverage and quality for poor women: inequalities in quality antenatal care in nine East African countries. *Health Policy Plan* 2021; 36(5): 662–672.
  88. Blank A, Prytherch H, Kaltschmidt J, et al. “Quality of prenatal and maternal care: bridging the know-do gap” (QUALMAT study): an electronic clinical decision support system for rural Sub-Saharan Africa. *BMC Med Inform Decis Mak* 2013; 13: 44.
  89. Blackstone SR. Evaluating antenatal care in Liberia: evidence from the demographic and health survey. *Women Health* 2019; 59(10): 1141–1154.
  90. Berhane B, Gebrehiwot H, Weldemariam S, et al. Quality of basic emergency obstetric and newborn care (BEmONC) services from patients' perspective in Adigrat town, Eastern zone of Tigray, Ethiopia. 2017: a cross sectional study. *BMC Pregnancy Childbirth* 2019; 19(1): 190.
  91. Bello OO. Quality of antenatal care: comparison between secondary and tertiary health facilities in Ibadan, Nigeria. *Open J Obstetr Gynecol* 2018; 8(06): 559.
  92. Ayalew F, Eyassu G, Seyoum N, et al. Using a quality improvement model to enhance providers' performance in maternal and newborn health care: a post-only intervention and comparison design. *BMC Pregnancy Childbirth* 2017; 17(1): 115.
  93. Attanasio L and Kozhimannil KB. Patient-reported communication quality and perceived discrimination in maternity care. *Med Care* 2015; 53(10): 863–871.
  94. Asrese K. Quality of intrapartum care at health centers in Jabi Tehinan district, North West Ethiopia: clients' perspective. *BMC Health Serv Res* 2020; 20(1): 439.
  95. Ashraf F, Thaver IH, Imtiaz F, et al. Quality assessment of focused antenatal care service delivery in tertiary care health facility. *J Ayub Med Coll Abbottabad* 2017; 29(2): 219–224.
  96. Arroyave L, Saad GE, Victora CG, et al. A new content-qualified antenatal care coverage indicator: development and validation of a score using national health surveys in low- and middle-income countries. *J Global Health* 2021; 11: 04008.
  97. Ansari N, Manalai P, Maruf F, et al. Quality of care in early detection and management of pre-eclampsia/eclampsia in health facilities in Afghanistan. *BMC Pregnancy Childbirth* 2019; 19(1): 36.
  98. Alyahya MS, Khader YS, Batieha A, et al. The quality of maternal-fetal and newborn care services in Jordan: a qualitative focus group study. *BMC Health Serv Res* 2019; 19(1): 425.
  99. Young MR, Morof D, Lathrop E, et al. Beyond adequate: factors associated with quality of antenatal care in western Tanzania. *Int J Gynecol Obstetr* 2020; 151(3): 431–437.
  100. van der Kooy J, Birnie E, Valentine NB, et al. Quality of perinatal care services from the user's perspective: a Dutch study applies the World Health Organization's responsiveness concept. *BMC Pregnancy Childbirth* 2017; 17(1): 327.
  101. Torlesse H, Benedict RK, Craig HC, et al. The quality of maternal nutrition and infant feeding counselling during antenatal care in South Asia. *Matern Child Nutr* 2021; 17(3): e13153.
  102. Tesfaye T. Assess quality of antenatal care services in rural health centers in Bursa Woreda, Sidama Zone, Southern Nations Nationalities People's Region, Ethiopia, 2014: Addis Ababa University. Doctoral dissertation, Addis Ababa University, <http://thesisbank.jhia.ac.ke/8119/> (2014, accessed on 20 September 2022).
  103. Tekelehaymanot G. Assessment of quality of antenatal care service provision and associated factor at governmental health facilities of Harar Town, Eastern Ethiopia, 2017. *J Gen Pract* 2018; 6(4): 367.
  104. Tafere TE, Afework MF and Yalew AW. Does antenatal care service quality influence essential newborn care (ENC) practices? In Bahir Dar City Administration, North West Ethiopia: a prospective follow up study. *Ital J Pediatr* 2018; 44(1): 105.
  105. Sword W, Heaman M, Biro MA, et al. Quality of prenatal care questionnaire: psychometric testing in an Australia population. *BMC Pregnancy Childbirth* 2015; 15: 214.
  106. Sommer Albert J, Younas A and Victor G. Quality of antenatal care services in a developing country: a cross-sectional survey. *Creat Nurs* 2020; 26(1): e25–e34.
  107. Singh L, Dubey R, Singh S, et al. Measuring quality of antenatal care: a secondary analysis of national survey data from India. *BJOG* 2019; 126(Suppl 4): 7–13.
  108. Singh L, Bube R, Singh PK, et al. Coverage of quality maternal and newborn healthcare services in India: examining drop-outs, disparity and determinants. *Ann Global Health* 2022; 88(1): 39.
  109. Sharma PK, Ghosh S, Prabhakar V, et al. Improving quality of antenatal care services in a high case load tertiary care teaching hospital (Ganesh Shankar Vidyarthi Memorial (GSVM)

- Medical College) in Kanpur, Uttar Pradesh, India. *BMJ Open Qual* 2022; 11(Suppl 1): e001446.
110. Rurangirwa AA, Mogren I, Ntaganira J, et al. Quality of antenatal care services in Rwanda: assessing practices of health care providers. *BMC Health Serv Res* 2018; 18(1): 865.
  111. Raru TB, Mamo Ayana G, Bahiru N, et al. Quality of antenatal care and associated factors among pregnant women in East Africa using demographic and health surveys: a multilevel analysis. *Women Health* 2022; 18: 17455065221076731.
  112. Rahman El and Gammal HA. Dimensions of quality of antenatal care service at Suez, Egypt. *J Family Med Prim Care* 2014; 3(3): 238–242.
  113. Phillips E, Stoltzfus RJ, Michaud L, et al. Do mobile clinics provide high-quality antenatal care? A comparison of care delivery, knowledge outcomes and perception of quality of care between fixed and mobile clinics in central Haiti. *BMC Pregnancy Childbirth* 2017; 17(1): 361.
  114. Owili PO, Muga MA, Mendez BR, et al. Quality of care in six sub-Saharan Africa countries: a provider-based study on adherence to WHO's antenatal care guideline. *Int J Qual Health Care* 2019; 31(1): 43–48.
  115. Nyamtema AS, Bartsch-de Jong A, Urassa DP, et al. The quality of antenatal care in rural Tanzania: what is behind the number of visits? *BMC Pregnancy Childbirth* 2012; 12: 70.
  116. Nikiema L, Kameli Y, Capon G, et al. Quality of antenatal care and obstetrical coverage in rural Burkina Faso. *J Health Popul Nutr* 2010; 28(1): 67–75.
  117. Naariyong S, Poudel KC, Rahman M, et al. Quality of antenatal care services in the Birim North District of Ghana: contribution of the community-based health planning and services program. *Matern Child Health J* 2012; 16(8): 1709–1717.
  118. Muchie KF. Quality of antenatal care services and completion of four or more antenatal care visits in Ethiopia: a finding based on a demographic and health survey. *BMC Pregnancy Childbirth* 2017; 17(1): 300.
  119. Morón-Duarte LS, Varela AR, Bertoldi AD, et al. Quality of antenatal care and its sociodemographic determinants: results of the 2015 Pelotas birth cohort, Brazil. *BMC Health Serv Res* 2021; 21(1): 1070.
  120. Mirkovic KR, Lathrop E, Hulland EN, et al. Quality and uptake of antenatal and postnatal care in Haiti. *BMC Pregnancy Childbirth* 2017; 17(1): 52.
  121. Merrell LK and Blackstone SR. Women's empowerment as a mitigating factor for improved antenatal care quality despite impact of 2014 Ebola Outbreak in Guinea. *Int J Environ Res Public Health* 2020; 17(21): 8172.
  122. Mekonnen N, Berheto TM, Ololo S, et al. Quality of antenatal care services in demba gofa woreda, gamo gofa zone, rural Ethiopia. *Health Sci J* 2017; 11(3): 17.
  123. McHenga M, Burger R and von Fintel D. Examining the impact of WHO's focused antenatal care policy on early access, underutilisation and quality of antenatal care services in Malawi: a retrospective study. *BMC Health Serv Res* 2019; 19(1): 295.
  124. Marchant T, Tilley-Gyado RD, Tessema T, et al. Adding content to contacts: measurement of high quality contacts for maternal and newborn health in Ethiopia, north east Nigeria, and Uttar Pradesh, India. *PLoS One* 2015; 10(5): e0126840.
  125. Majrooh MA, Hasnain S, Akram J, et al. Coverage and quality of antenatal care provided at primary health care facilities in the 'Punjab' province of 'Pakistan'. *PLoS One* 2014; 9(11): e113390.
  126. Leal MDC, Esteves-Pereira AP, Viellas EF, et al. Prenatal care in the Brazilian public health services. *Revis Saúde Pública* 2020; 54: 08.
  127. Kyei NN, Chansa C and Gabrysch S. Quality of antenatal care in Zambia: a national assessment. *BMC Pregnancy Childbirth* 2012; 12: 151.
  128. Kumar G, Choudhary TS, Srivastava A, et al. Utilisation, equity and determinants of full antenatal care in India: analysis from the National Family Health Survey 4. *BMC Pregnancy Childbirth* 2019; 19(1): 327.
  129. Koroma MM, Kamara SS, Bangura EA, et al. The quality of free antenatal and delivery services in Northern Sierra Leone. *Health Res Policy Syst* 2017; 15(Suppl 1): 49.
  130. Khatri RB, Durham J and Assefa Y. Utilisation of quality antenatal, delivery and postnatal care services in Nepal: an analysis of service provision assessment. *Global Health* 2021; 17(1): 102.
  131. Kare AP, Gujo AB and Yote NY. Quality of antenatal care and associated factors among pregnant women attending government hospitals in Sidama Region, Southern Ethiopia. *SAGE Open Med* 2021; 9: 20503121211058055.
  132. Kanyangara M, Munos MK and Walker N. Quality of antenatal care service provision in health facilities across sub-Saharan Africa: evidence from nationally representative health facility assessments. *J Global Health* 2017; 7(2): 021101.
  133. Kambala C, Lohmann J, Mazalale J, et al. How do Malawian women rate the quality of maternal and newborn care? Experiences and perceptions of women in the central and southern regions. *BMC Pregnancy Childbirth* 2015; 15(1): 169.
  134. Joshi C, Torvaldsen S, Hodgson R, et al. Factors associated with the use and quality of antenatal care in Nepal: a population-based study using the demographic and health survey data. *BMC Pregnancy Childbirth* 2014; 14(1): 94.
  135. Hussen MA and Worku BT. Quality of antenatal care service and factors associated with client satisfaction at Public Health Facilities of Bele Gasgar District. *J Patient Exp* 2022; 9: 23743735221083163.
  136. Holand BL, Fonseca SG, Drehmer M, et al. Adequacy of prenatal care considering nutritional assistance in Southern Brazil: maternal cohort study. *Cad Saude Publica* 2021; 37(6): e00130320.
  137. Hernández-Vásquez A, Vargas-Fernández R and Bendezu-Quispe G. Factors associated with the quality of prenatal care in Peru. *Rev Peru Med Exp Salud Publica* 2019; 36(2): 178–187.
  138. Heaman MI, Martens PJ, Brownell MD, et al. Inequities in utilization of prenatal care: a population-based study in the Canadian province of Manitoba. *BMC Pregnancy Childbirth* 2018; 18(1): 430.
  139. Halle-Ekane GE, Fotabong C, Njotang P, et al. Quality of antenatal care and outcome of pregnancy in a semi-urban area in Fako Division, Cameroon: a cross-sectional study. *Women Health Open J* 2015; 1(2): 31–39.
  140. Hailu GA, Weret ZS, Adasho ZA, et al. Quality of antenatal care and associated factors in public health centers in Addis Ababa, Ethiopia, a cross-sectional study. *PLoS One* 2022; 17(6): e0269710.

141. Gwako GN, Were F, Obimbo MM, et al. Association between utilization and quality of antenatal care with stillbirths in four tertiary hospitals in a low-income urban setting. *Acta Obstetr Gynecol Scand* 2021; 100(4): 676–683.
142. Gupta S, Yamada G, Mpembeni R, et al. Factors associated with four or more antenatal care visits and its decline among pregnant women in Tanzania between 1999 and 2010. *PLoS One* 2014; 9(7): e101893.
143. Gebrekirstos LG, Wube TB, Gebremedhin MH, et al. Magnitude and determinants of adequate antenatal care service utilization among mothers in Southern Ethiopia. *PLoS One* 2021; 16(7): e0251477.
144. Furqani D and Semagga N. Factors related to the quality of antenatal care based on the complete scope of the examination of pregnant women in the Health Center at Palopo City. *J Health Sci Prevent* 2019; 3(3S): 84–9.
145. Fesseha G, Alemayehu M, Etana B, et al. Perceived quality of antenatal care service by pregnant women in public and private health facilities in Northern Ethiopia. *Am J Health Res* 2014; 2(4): 146–151.
146. Emiru AA, Alene G and Debelew GT. Women's satisfaction with the quality of antenatal care services rendered at public health facilities in Northwest Ethiopia: the application of partial proportional odds model. *BMJ Open* 2020; 10(9): e037085.
147. Ejigu Tafere T, Afework MF and Yalew AW. Antenatal care service quality increases the odds of utilizing institutional delivery in Bahir Dar city administration, North Western Ethiopia: a prospective follow up study. *PLoS One* 2018; 13(2): e0192428.
148. Ejigu T, Woldie M and Kifle Y. Quality of antenatal care services at public health facilities of Bahir-Dar special zone, Northwest Ethiopia. *BMC Health Serv Res* 2013; 13: 443.
149. Doubova SV, Pérez-Cuevas R, Ortiz-Panozo E, et al. Evaluation of the quality of antenatal care using electronic health record information in family medicine clinics of Mexico City. *BMC Pregnancy Childbirth* 2014; 14: 168.
150. Do M, Wang W, Hembling J, et al. Quality of antenatal care and client satisfaction in Kenya and Namibia. *Int J Qual Health Care* 2017; 29(2): 183–193.
151. Denham S, Humphrey T and Taylor R. Quality of care provided in two Scottish rural community maternity units: a retrospective case review. *BMC Pregnancy Childbirth* 2017; 17(1): 198.
152. Defar A, Getachew T, Taye G, et al. Quality antenatal care services delivery at health facilities of Ethiopia, assessment of the structure/input of care setting. *BMC Health Serv Res* 2020; 20(1): 485.
153. Defar A, Getachew T, Taye G, et al. Quality antenatal care services delivery at health facilities of Ethiopia, assessment of the structure/input of care setting. *BMC Health Serv Res* 2020; 20(1): 1–9.
154. Dauletyarova MA, Semenova YM, Kaylubayeva G, et al. Are Kazakhstani women satisfied with antenatal care? Implementing the WHO tool to assess the quality of antenatal services. *Int J Environ Res Public Health* 2018; 15(2): 325.
155. da Fonseca CRB, Strufaldi MWL, de Carvalho LR, et al. Adequacy of antenatal care and its relationship with low birth weight in Botucatu, São Paulo, Brazil: a case-control study. *BMC Pregnancy Childbirth* 2014; 14(1): 255.
156. Chukwuma A, Wosu AC, Mbachu C, et al. Quality of antenatal care predicts retention in skilled birth attendance: a multilevel analysis of 28 African countries. *BMC Pregnancy Childbirth* 2017; 17(1): 152.
157. Chemir F, Alemseged F and Workneh D. Satisfaction with focused antenatal care service and associated factors among pregnant women attending focused antenatal care at health centers in Jimma town, Jimma zone, South West Ethiopia; a facility based cross-sectional study triangulated with qualitative study. *BMC Res Notes* 2014; 7: 164.
158. Biswas TK, Sujon H, Rahman MH, et al. Quality of maternal and newborn healthcare services in two public hospitals of Bangladesh: identifying gaps and provisions for improvement. *BMC Pregnancy Childbirth* 2019; 19(1): 488.
159. Bintabara D, Nakamura K, Ntwenya J, et al. Adherence to standards of first-visit antenatal care among providers: a stratified analysis of Tanzanian facility-based survey for improving quality of antenatal care. *PLoS One* 2019; 14(5): e0216520.
160. Billah SM, Saha KK, Khan ANS, et al. Quality of nutrition services in primary health care facilities: implications for integrating nutrition into the health system in Bangladesh. *PLoS One* 2017; 12(5): e0178121.
161. Biadgo A, Legesse A, Estifanos AS, et al. Quality of maternal and newborn health care in Ethiopia: a cross-sectional study. *BMC Health Serv Res* 2021; 21(1): 1–10.
162. Bernardes ACF, da Silva RA, Coimbra LC, et al. Inadequate prenatal care utilization and associated factors in São Luís, Brazil. *BMC Pregnancy Childbirth* 2014; 14(1): 266.
163. Bayou YT, Mashalla YS and Thupayagale-Tshweneagae G. The adequacy of antenatal care services among slum residents in Addis Ababa, Ethiopia. *BMC Pregnancy Childbirth* 2016; 16(1): 1–10.
164. Arroyave L, Saad GE, Victora CG, et al. A new content-qualified antenatal care coverage indicator: development and validation of a score using national health surveys in low-and middle-income countries. *J Global Health* 2021; 11: 04008.
165. Agha Sa and Williams E. Quality of antenatal care and household wealth as determinants of institutional delivery in Pakistan: results of a cross-sectional household survey. *Reprod Health* 2016; 13(1): 84.
166. Adhikari M, Chalise B, Bista B, et al. Sociodemographic correlates of antenatal care visits in Nepal: results from Nepal Demographic and Health Survey 2016. *BMC Pregnancy Childbirth* 2020; 20(1): 1–513.
167. Acharya Y, James N, Thapa R, et al. Content of antenatal care and perception about services provided by primary hospitals in Nepal: a convergent mixed methods study. *Int J Qual Health Care* 2021; 33(2): mzab049.
168. Abate TM and Abeba A. Evaluation of the quality of antenatal care (ANC) service at higher 2 health center in Jimma, South West Ethiopia. *Open Access Lib J* 2015; 2(04): 1.
169. Kare AP, Gujo AB and Yote NY. Quality of antenatal care and associated factors among pregnant women attending government hospitals in Sidama Region, Southern Ethiopia. *SAGE Open Med* 2021; 9: 20503121211058055.
170. Kassaw A, Debie A and Geberu DM. Quality of prenatal care and associated factors among pregnant women at public health facilities of Wogera District, Northwest Ethiopia. *J Pregnancy* 2020; 2020: 9592124.

171. Negash WD, Fetene SM, Shewarega ES, et al. Multilevel analysis of quality of antenatal care and associated factors among pregnant women in Ethiopia: a community based cross-sectional study. *BMJ Open* 2022; 12(7): e063426.
172. Tadesse Berehe T and Modibia LM. Assessment of quality of antenatal care services and its determinant factors in public health facilities of Hossana town, Hadiya zone, Southern Ethiopia: a longitudinal study. *Adv Public Health* 2020; 2020: 5436324.
173. Teji DK, Tekelehaymanot G and Mesfin DF. Assessment of quality of antenatal care service provision and associated factor at governmental health facilities of Harar Town, Eastern Ethiopia, 2017. *J Gener Pract* 2018; 04: 1–9.
174. World Health Organization. *WHO recommendations on antenatal care for a positive pregnancy experience*. Geneva, Switzerland: World Health Organization, 2016.
175. World Health Organization. *Maternal health: fact sheet on Sustainable Development Goals (SDGs): health targets*. Geneva, Switzerland: World Health Organization. Regional Office for Europe, 2017.
176. World Health Organization. *WHO recommendations on antenatal care for a positive pregnancy experience: summary: highlights and key messages from the World Health Organization's 2016 global recommendations for routine antenatal care*. Geneva, Switzerland: World Health Organization, 2018.
177. Woyessa AH and Ahmed TH. Assessment of focused antenatal care utilization and associated factors in Western Oromia, Nekemte, Ethiopia. *BMC Res Notes* 2019; 12(1): 1–7.
178. Austin A, Langer A, Salam RA, et al. Approaches to improve the quality of maternal and newborn health care: an overview of the evidence. *Reprod Health* 2014; 11(2): 1–9.
179. Kruk ME, Larson E and Twum-Danso NA. Time for a quality revolution in global health. *Lancet Global health* 2016; 4(9): e594–e596.
180. Europe W. *Fact sheets on sustainable development goals: health targets*. Geneva, Switzerland: WHO, 2017.
181. Lahariya C. Health and wellness centers to strengthen primary health care in India: concept, progress and ways forward. *Indian J Pediatr* 2020; 87(11): 916–929.
182. Pai H, Tayade S, Sharma S, et al. Pre-conceptional and antenatal care for improved newborn and child survival in India: a review. *Indian J Pediatr* 2023; 90(Suppl 1): 10–19.
183. Malla S, Agiwal V and Chaudhuri S. Multimorbidity among pregnant women in India: national and state-level burden and socio-demographic variations. *Prevent Med Res Rev* 2024; 10: 4103.
184. Basu S, Maheshwari V, Gokalani R, et al. Prevalence and predictors of gestational diabetes mellitus and overt diabetes in pregnancy: a secondary analysis of nationwide data from India. *Prevent Med Res Rev* 2024; 1(1): 52–8.
185. Kruk ME, Leslie HH, Verguet S, et al. Quality of basic maternal care functions in health facilities of five African countries: an analysis of national health system surveys. *Lancet Global Health* 2016; 4(11): e845–e855.
186. Ministry of Health. Ethiopia: Reproductive health strategic plan 2021–2025, <https://share-netinternational.org/resources/reproductive-health-strategic-plan/> (2022, accessed on 12 December 2022).
187. Bobo FT, Yesuf EA and Woldie M. Inequities in utilization of reproductive and maternal health services in Ethiopia. *Int J Equity Health* 2017; 16(1): 1–8.
188. FMOH. *Health Sector Transformation Plan II (HSTP II) 2020/21–2024/25*. FMOH, 2021.