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Utilization of maternal healthcare services in low- and middle-income countries: a systematic review and meta-analysis

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Abstract

Background Maternal mortality is a critical public health issue, especially in low- and middle-income countries (LMICs). Maternal healthcare services (MHS), including antenatal care (ANC) visits, skilled birth attendants (SBA), institutional delivery (ID), and postnatal care (PNC), are crucial policy priorities to address maternal mortality and improve pregnancy outcomes. This systematic review and meta-analysis aimed to provide a comprehensive, quantitative analysis of MHS utilization among women in LMICs.

Methods We conducted a comprehensive search on PubMed, Scopus, Web of Science, CINAHL, and SocINDEX to gather relevant studies on the utilization of MHS in LMICs conducted between January 2015 and December 2024. These were then synthesized both quantitatively and qualitatively and random-effect models were employed to obtain pooled estimates.

Results A total of 145 studies included in this review. Coverage of at least one ANC visit (ANC1), at least four ANC visits (ANC4), SBA, ID and PNC were reported in 66, 108, 42, 63, and 37 studies respectively and for these studies pooled prevalences of ANC1, ANC4, SBA, ID, and PNC were found 85.0% (95% CI 81.2–88.1%), 50.8% (95% CI 46.4–55.2%), 65.6% (95% CI 58.7–71.9%), 66.9% (95% CI 60.3–72.9%), and 48.9% (95% CI 41.7–56.2%), respectively, with high heterogeneity among the studies ($I^2 > 99.0\%$). Results obtained from the sub-group analysis revealed that the prevalence of MHS indicators was higher in the South and Southeast Asia (SSEA) region compared to Sub-Saharan Africa (SSA), except for ID, e.g., SBA prevalence in SSEA was 70.1% (95% CI 60.4–78.3%) whereas for SSA it was 64.0% (95% CI 53.3–73.6%). The prevalence of all MHS indicators was higher for studies with primary data than those with secondary data, except for ANC4 and PNC. Overall, associations were reported between MHS utilization and women's age, education level, household socioeconomic status, place of residence, decision-making power, and exposure to mass media.

Conclusion High heterogeneity among studies infer possible disparities in MHS utilization at both global and national levels. Hence, it is crucial for policies to prioritize enhancing effective coverage, narrowing disparities, and improving care quality in alignment with the Sustainable Development Goals.

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Keywords Maternal healthcare services, Inequality, Significant factors, LMICs, Utilization, Meta-analysis

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Introduction

Maternal mortality is unacceptably high and remains a major public health challenge worldwide, particularly in low- and middle-income countries (LMICs) [1–3]. Nearly one maternal fatality happens every two minutes, amounting to approximately 800 maternal deaths each day due to complications of pregnancy and childbirth [3, 4]. Almost 95% of all maternal deaths in 2020 occurred in LMICs [3]. Thus, maternal health is prioritized and discussed in the United Nations (UN) Sustainable Development Goals (SDGs) [2, 5].

Maternal health refers to the health of women during pregnancy, childbirth, and the postnatal period [6]. Maternal healthcare services (MHS) are integral to the mother and child's health [7–10]. These services include antenatal care (ANC) visits to skilled health professionals during pregnancy, skilled birth attendants (SBA) at the time of delivery, institutional delivery (ID), and postnatal care (PNC) immediately after delivery [7]. Effective use of MHS has been demonstrated to reduce maternal mortality and morbidity rates [11–14].

Although developed countries have widespread access to crucial healthcare services for women, these services often remain out of reach for women in many LMICs, particularly in Sub-Saharan Africa (SSA) and South and Southeast Asia (SSEA) [15]. Disparities in socioeconomic factors, such as levels of education and wealth acquisition, play a significant role in determining access to these vital healthcare services [16]. Despite the fact maternal mortality reduced significantly worldwide between 2000 and 2015, the numbers have been stagnant when averaging rates of reduction between 2016 and 2022 [17]. The gap in maternal deaths is high between developed and developing countries—up to 33% in 2017 [18].

Reducing maternal and child morbidity and mortality and improving reproductive, maternal, newborn, and child health were top priorities of the global health agenda in the Millennium Development Goals (MDGs) [19]. During the era of the MDGs, coverage of reproductive, maternal, newborn, and child health has improved due to several effective interventions that helped to reduce maternal and child morbidity and mortality in LMICs [20]. Despite these improvements, progress in achieving MDG 4 and 5 (to improve child survival and reduce maternal death) fell short of expectations, and LMICs still account for 95% of all maternal deaths [3, 21, 22]. Consequently, in September 2015, the United Nations General Assembly Summit Global Developmental Agenda proposed the SDGs [23]. Sustainable Development Goal 3 (SDG- 3) sets targets related to maternal health. These include target 3.1, aiming for an average global maternal mortality ratio (MMR) of less than 70 deaths per 100,000 births by 2030 and target 3.8, aiming to achieve universal health coverage (UHC) [24]. Though deaths from complications during pregnancy, childbirth, and the postnatal period have declined significantly in the last two decades, at an average reduction of just under 3% per year progress is still far too slow to achieve SDG- 3 [25, 26]. According to World Health Organization (WHO) data, most maternal deaths occurred due to women's inability to receive MHS from well-trained and skilled health professionals [3]. So, SDG- 3 cannot be accomplished without ensuring access to reproductive, maternal, and newborn healthcare for all women during and after childbirth [3, 6]. Increasing health resources and research on this issue and appropriate intervention in LMICs, remain urgent priorities related to the global responsibility for reducing the burden of maternal and child mortality [27, 28].

There is a need to aggregate, systematically review, and conduct a meta-analysis of the utilization of MHS among women in LMICs, leveraging the most up-to-date data. While certain systematic reviews and meta-analyses have been conducted for a single MHS indicator targeting specific countries/regions, a comprehensive analysis across multiple indicators and countries/regions in LMICs is yet to be undertaken [29–36]. Therefore, this systematic review and meta-analysis aim to provide pooled estimates of MHS utilization and to identify the predictors that were reported to be associated with the utilization of MHS in LMICs.

Materials and methods

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 guidelines were followed to design and report this systematic review and meta-analysis (Table S1 of Supplementary file 1) [37] and registered with PROSPERO (Ref. no. CRD42023401745).

Inclusion and exclusion criteria

The inclusion criteria for this systematic review and meta-analysis were (i) study population: reproductive age of women/mothers from LMICs (ii) outcome: utilization of MHS including ANC (at least one ANC visit; ANC1 and at least four ANC visits; ANC4), SBA, ID and PNC, (iii) exposure variables: exposure to sociodemographic variables such as education, place of residence, wealth status etc. (iv) study type: used a quantitative, observational, randomized control trial, cohort study, and/or mixed method study design and, (v) peer-reviewed journal articles published in English between January 2015 and December 2024 and data used/or collected were not older than 2015. The LMICs were selected based on the World Bank country classifications [38]. Articles were excluded if they were not focused on the utilization of MHS, were not available

in English, or were outside the defined time frame. We further excluded articles that were on the utilization of MHS in upper-middle-income countries [39].

Sources of information and search strategy

For this systematic review and meta-analysis, in December 2024, an updated search was conducted systematically through electronic databases including PubMed, Web of Science, Scopus, CINAHL, and SocINDEX, considering publications for the period January 2015 to December 2024. We considered this period since we intended to investigate the MHS utilization in LMICs during the SDG era following the Millennium Development Goals. Under the guidance of the research librarian, we carried out a search using combinations of the following search words where major concepts were combined by Boolean operators (AND, OR): "Maternal health" OR "maternal healthcare service" OR "maternal healthcare services" OR "maternal health care service" OR "maternal health care services" OR "maternity health" OR "reproductive health" OR "obstetric care" OR "antenatal care" OR "postpartum care" OR "prenatal care" OR "skilled birth attendant" OR "institutional delivery" OR "postnatal care" OR "childbearing" OR "pregnan*"AND "risk factors" OR "risk markers" OR predictors OR prevalence OR "social determinants" OR "socio economic factor" OR "socio economic factors" OR "socio demographic factor" OR "Socio demographic factors" OR "demographic factors" OR "socio-economic factors" OR "socio-demographic factors" OR education OR "level of education" OR "attainment of education" OR "place of residence" OR "living area" OR wealth OR "wealth index" OR age OR "age at first birth" OR occupation OR "respondent occupation" OR "working status" OR "number of children" OR "number of children ever born" OR "partner education" OR "partner occupation" OR empowerment OR autonomy OR "decision making power" AND "Developing countries" OR "low-income countries" OR "low- and middle-income countries" OR LMIC OR LMICs OR "underdeveloped countries". The full list of search words and their codes in databases are listed in Table S2 of Supplementary file 1. Additionally, we searched Google Scholar to obtain relevant articles identified from the reference list of the selected articles that were not captured by electronic searches. Finally, only peer-reviewed journal articles that collected/used data not older than 2015 were included. As our primary objective was to evaluate the usage of MHS based on recent data, our particular emphasis was on examining the state of MHS during the SDG era, which commenced in September 2015.

Selection process of the studies

In this systematic review and meta-analysis, we followed four steps. In the first step, all peer-reviewed articles were initially screened by title for potential inclusion by the first author (AB). Afterwards, the titles and abstracts were made available online to all authors through EndNote 20 file share by the first author for review. These articles were independently screened by abstract by two authors (AB and JB, AB and EV and AB and RKB). No automated software was used. Following a discussion, any discrepancies were resolved, and the articles accepted by both authors based on the abstracts were retained for full review. Whenever necessary, the third author (JB) resolved conflicts between the first two authors.

Data extraction

From each article, we extracted publication details (author names, title, year of publication), study source country and region, study design (cross-sectional, randomized control trial, cohort study, and mixed method study design), data source/type (primary or secondary), study participants and sample size, age range, data collection method (questionnaire/and personal interview/and focus group discussion), coverage of MHS utilization, and associated factors/exposures (Supplementary file 2). For interventional studies, only baseline information was considered. The data were extracted by two authors independently (AB and JB) using an extraction form developed in-house and checked by the third author (RKB).

Quality assessment of the included studies

The National Institutes of Health (NIH) quality assessment tools were used to assess the quality of the included studies [40]. From NIH, four distinct quality assessment tools were employed, as per the study designs of the selected studies. These tools evaluated the observational cohort and cross-sectional studies, controlled intervention studies, before-after (pre-post) studies with no control group, and case–control studies. The criteria of these tools are given in Supplementary file 3. According to these criteria, the studies were rated as "poor", "fair", or "good" [40]. The quality assessment was conducted by two authors independently (AB and JB) and conflicted ratings were independently assessed by the third author. The quality assessment results of each article are presented in Supplementary file 3.

Data synthesis and statistical analyses

Logit transformation and inverse variance methods were used to stabilize the variance of the raw data for the meta-analysis of proportions [41]. We used restricted maximum-likelihood (REML) random-effects meta-analysis

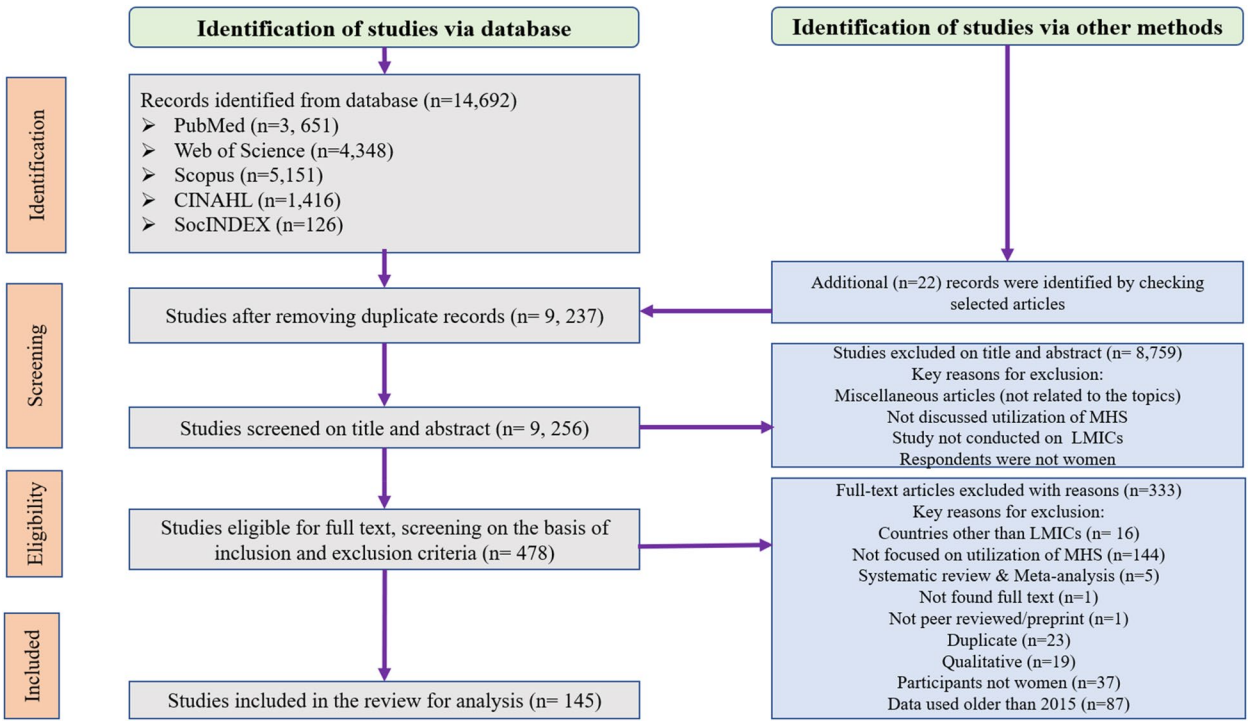

Fig. 1 PRISMA flow diagram describing the selection of studies included in the systematic review and meta-analysis [37]

to pool the raw data for each outcome, and the Clopper-Pearson interval to calculate the confidence interval (CI) for each variable [42]. The I^2 statistic was used to assess the statistical heterogeneity [43]. Egger regression and trim-and-fill method to adjust for funnel plot was used to assess publication bias [44]. Sensitivity analysis was performed using the leave-out-one method to assess the influence of each study on the overall pooled effect estimate [45, 46]. A series of random-effects models were employed for sub-group analysis of proportions. We used Cochran's Q test to compare the heterogeneity in different populations. All statistical tests were two-tailed. The analyses were performed using R software (version 4.2.2) and the "meta" package (version 6.5–0).

Results

Search results

We retrieved 14,692 articles from the biomedical databases and an additional 22 articles were identified through references of the selected articles. After removing 5455 duplicates, 9237 records remained. After screening for titles and abstracts, 8759 publications were excluded for not meeting the inclusion criteria, such as, not focusing on MHS, not including data from LMICs, data collected/used by those older than 2015, and where the study respondents were not women (Fig. 1).

Therefore, 478 records were eligible for full-text review. Full-text review led to the exclusion of 333 articles, of which 144 articles did not focus on MHS, 16 used non-LMICs data, 37 used male respondents, 19 were qualitative, 87 used data older than 2015, one had full-text missing (despite contacting authors multiple times), one was not peer reviewed and 5 was found systematic review and meta-analysis, as well as 23 duplicated articles due to different name combinations of authors in the database. Finally, we included 145 articles for this systematic review and meta-analysis.

Characteristics of the included studies

In Supplementary file 2, we presented a summary of information for all included studies. The countries included in this study were grouped by region based on Demographic and Health Surveys (DHS) [47]. Out of 145 studies, 88 (60.7%) were based on data from the SSA region [48–135] and 42 (29.0%) of the studies reported on the SSEA region [136–177]. There were 15 (10.3%) studies conducted on mixed/multiple and other regions [178–192]. The highest number of studies ($n=39$) were based on Ethiopia. Out of 145 studies, 90 (62.1%) studies used secondary data, and the remaining 55 (37.9%) studies used primary data. Over half of the secondary data sources used in the studies were from DHS and multiple indicator cluster surveys (MICS) ($n=86$). Among

Table 1 Pooled prevalence of MHS in LMICs

Variable	No. of studies (with MHS coverage)	Pooled prevalence (95% CI)	Minimum prevalence (95% CI)	Maximum prevalence (95% CI)	Quantifying heterogeneity		*Q* statistics (*p*-value)
					τ^2 (95% CI)	I^2 (%)	
ANC1	66	85.0 (81.2, 88.1)	46.1 (42.3, 50.0)	98.7 (98.7, 98.8)	1.22 (0.89, 1.81)	99.9	84,538.1 (< 0.001)
ANC4	108	50.8 (46.4, 55.2)	10.5 (8.0, 13.4)	90.9 (89.7, 92.0)	0.87 (0.68, 1.17)	100.0	249,820.9 (< 0.001)
SBA	42	65.6 (58.7, 71.9)	16.2 (15.4, 17.1)	93.6 (92.9, 94.3)	0.94 (0.64, 1.54)	100.0	537,714.3 (< 0.001)
ID	63	66.9 (60.3, 72.9)	11.3 (10.6, 12.1)	99.8 (99.7, 100)	1.34 (0.99, 2.09	100.0	393,017.0 (< 0.001)
PNC	37	48.9 (41.7, 56.2)	14.3 (11.2, 17.9)	85.0 (81.9, 87.8)	0.82 (0.54, 1.40)	100.0	147,604.2 (< 0.001)

the studies that used primary data, around three-fourths of the studies (n= 42, 76.4%) used structured questionnaires to collect the data. The majority studies (n= 134, 91.7%) were cross-sectional, observational and quantitative, with three studies using cross-sectional and mixed-method study designs [67, 103, 171], and the remaining eight studies [68, 72, 98, 101, 159–161, 177] were interventional (randomized controlled trial, pre-post, case–control, longitudinal, and follow-up).

We have extracted baseline information for this systematic review and meta-analysis from the interventional studies. We gathered information on MHS coverage from all selected articles (Supplementary file 2). The coverage of at least one antenatal care visit (ANC1) was found about half of the studies (n= 66, 45.5%), coverage of at least four ANC visits (ANC4) was found in 108 (74.5%) studies, coverage of SBA was found in 42 (29.0%) studies, coverage of ID was found in 63 (43.4%) studies and coverage of PNC was found in 37 (25.5%) studies. In 50 of the 145 studies, ANC was the only indicator, in 12 studies SBA was the only indicator, in 25 studies ID was the only indicator and in nine studies PNC was the only indicator. In the remaining (n= 49, 33.8%) studies, MHS were used as indicators (ANC, SBA, ID, PNC) combinedly with different combinations. For instance, in 11 articles ANC, ID, and PNC were used as indicators while in four articles, all MHS (ANC, SBA, ID, and PNC) were used as indicators. More than three-fourths of the studies (n= 118, 81.4%) considered women aged between 15 and 49 years, with the remaining (n= 27, 18.6%) studies considering different age groups. For instance, one study considered young women aged between 15 and 24 years [61].

Quality assessment (risk of bias)

Of 145 studies, 130 (89.7%) were rated as good, while 12 (8.3%) were rated as fair, and three (2.1%) were rated as poor (Supplementary file 3). The major shortcomings of the three poor rated studies were as follows: inability to describe the sample properly, the study did not examine different levels of the exposure associated with the outcome variable, exposure measures (independent variables) were not clearly defined and were not valid and reliable and the confounders were not measured and adjusted statistically between exposure and outcome [147, 180]. These are some important criteria followed by the NIH tool for observational cohort and cross-sectional study design. Finally, the authors agreed to include these two studies given they fulfilled the inclusion criteria, although they have some limitations. Detailed quality assessment of each study was tabulated in Supplementary file 3.

Status of MHS

Prevalence of at least one antenatal care visit (ANC1) and at least four antenatal care visits (ANC4)

From 66 studies that reported the prevalence of at least one antenatal care visit (ANC1), we found that the prevalence of ANC1 ranged from 46.1% to 98.7% with the overall pooled prevalence of 85.0% (95% CI 81.2–88.1%) with a high degree of heterogeneity among the studies (I^2= 99.9%) and there exists variability in the effect size across studies (τ^2 = 1.22; 95% CI =0.89, 1.81) (Table 1, Fig. S1a of Supplementary file 4). The lowest coverage of ANC1 (46.1%) was found in Dembecha District, Northwest Ethiopia [86]. On the other hand, the highest coverage of ANC1 (98.7%) was found in India [101]. The point prevalence of ANC1 visits showed a significant difference among the 66 studies (Q= 84,538.1, p< 0.001), as shown in Table 1.

From Table 1 and forest plot (Fig. S1b of Supplementary file 4) it was also observed that among the 108 studies, the point prevalence of at least four antenatal care visits (ANC4) ranged from 10.5 to 90.9%. The minimum coverage of ANC4 was found in Mizan-Aman town,

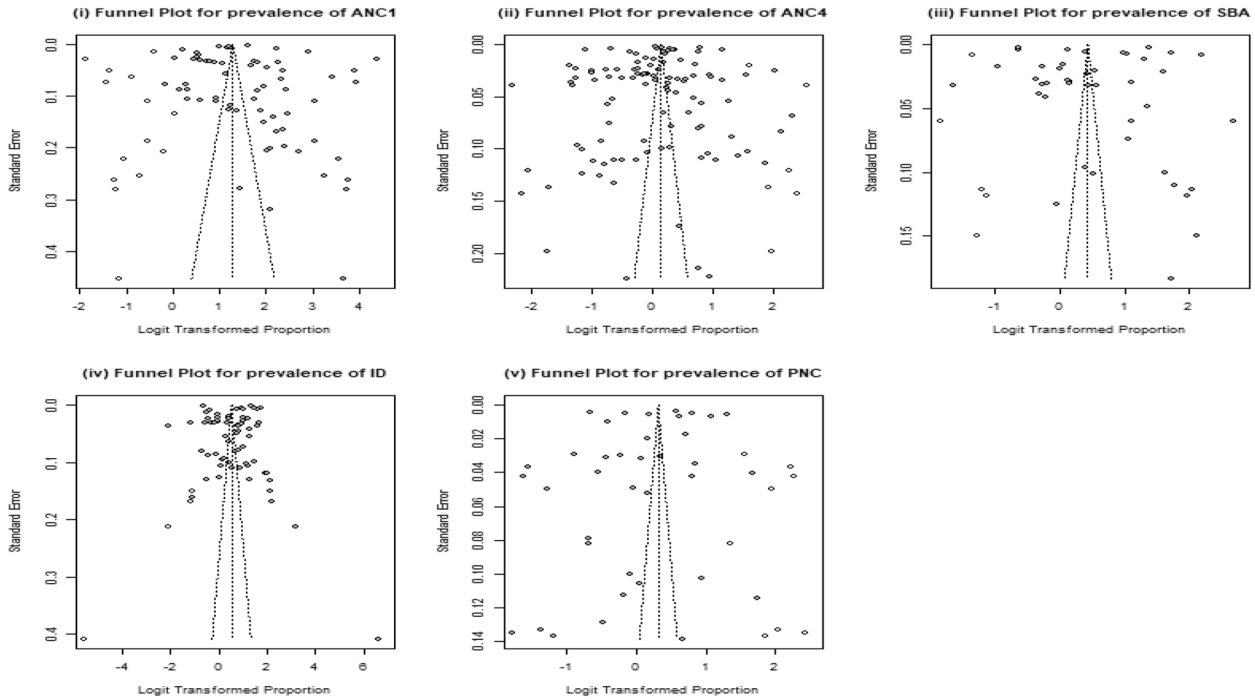

Fig. 2 Funnel plots for MHS

Southwest Ethiopia [119] and the highest coverage was found in Indonesia [145].The overall pooled prevalence was found 50.8% (95% CI 46.4–55.2%) with a high degree of heterogeneity and variability in the effect size among the studies (I^2 = 100.0%, τ^2 = 0.87; 95% CI =0.68, 1.17). The point prevalence of ANC4 visits showed a significant difference among the 108 studies (Q = 249,820.9, p < 0.001).

Prevalence of skilled birth attendant (SBA), Institutional delivery (ID), and postnatal care (PNC)

Forest plot (Fig. S2a of Supplementary file 4) and Table 1 showed that the overall pooled prevalence of SBA was 65.6% (95% CI 58.7–71.9%) and the point prevalence of SBA ranged from 16.2 to 93.6% across the 42 studies and there exists variability in the effect size and high heterogeneity among the studies (τ^2 = 0.94; 95% CI =0.64, 1.54, I^2 = 100.0%). The lowest coverage of SBA was found in Tanzania [133] and the highest coverage in Zimbabwe [88]. The point prevalence of SBA showed a significant difference among the 42 studies (Q = 537,714.3, p < 0.001).

Figure S2b of Supplementary file 4 and Table 1 reported that the overall pooled prevalence of ID was 66.9% (95% CI 60.3–72.9%) and point prevalence of ID ranged from 11.3 to 99.8% across the 63 studies. The lowest prevalence of ID was observed in a study conducted in Ethiopia [49] and the highest prevalence was observed in a study conducted in Rwanda [84]. The point prevalence of ID showed a significant difference among the 53 studies (Q = 393,017.0, p < 0.001), as shown in Table 1.

On the other hand, the overall pooled prevalence of PNC was 48.9% (95% CI 41.7–56.2%) and the point prevalence of PNC ranged from 14.3 to 85.0% across the 37 studies with high heterogeneity (I^2 = 100.0%) (Table 1, Fig. S2c of Supplementary file 4). The minimum prevalence of PNC was found in Nawalparasi District, Nepal [151] and the maximum prevalence was found in Mangochi District, Malawi [100]. The point prevalence of PNC showed a significant difference among the 37 studies (Q = 147,604.2, p < 0.001).

Publication bias

To assess publication bias among the studies included in the meta-analysis, both funnel plots and Egger's tests were conducted. In Fig. 2, the nearly symmetrical visual inspections of the funnel plots (Fig. 2i −v) showed the absence of publication bias and trim-and-fill method adjusted in the studies and found most of the studies were in the top tier of the plots, indicating the larger sample studies with a lower standard error were over-represented versus those with smaller sample sizes in the bottom of the plots. From the results of Egger's regression test for asymmetry, no significant publication bias was observed (p > 0.05) (Table 2).

Table 2 Egger's regression test results

Outcomes	Egger's linear regression test of funnel plot asymmetry			
	β	S.E. (β)	*t*	*p*-value
ANC1	3.58	5.19	0.69	0.074
ANC4	− 2.04	5.74	− 0.36	0.723
SBA	3.20	22.34	0.14	0.887
ID	4.36	12.02	0.36	0.720
PNC	− 7.38	13.64	− 0.54	0.592

Sensitivity analysis

Statistical diagnostics or sensitivity analyses need to be performed to investigate the validity and robustness of the meta-analysis. In this study, we employed the leave-one-out method for sensitivity analysis [45, 46]. Suppose the number of studies is k for each indicator. First, remove the second of the *K* studies and conduct the meta-analysis on the remaining *K*− 1 studies, continue this process until there are *K* distinct meta-analyses (each with *K*− 1 studies). This systematic process has been done for all indicators (ANC1, ANC4, SBA, ID, and PNC) and the results highlighting the meta-analysis's sensitivity for pooled effect estimate to individual study exclusions (Fig. S8a, b and Fig. S9a −c) of Supplementary file 4). The results of the *K* meta-analyses in the leave-one-out method were found to be consistent for the pooled prevalence of ANC1 (0.85, 95% CI =0.81, 0.88), ANC4 (0.51, 95% CI =0.46, 0.55), SBA (0.66, 95% CI =0.59, 0.72), ID (0.67, 95% CI =0.60, 0.73), and PNC (0.49, 95% CI =0.42, 0.56), which indicates that the overall meta-analysis was robust [45].

Subgroup analysis for region and data source

Sub-group analysis results presented in forest plots (Fig. S3, Fig. S4, Fig. S5, Fig. S6, and Fig. S7 of Supplementary file 4) and Table 3 revealed that the prevalence of ANC1, ANC4, SBA, and PNC were higher for SSEA compared to the prevalence in SSA. For instance, the prevalence of SBA in SSEA was 70.1% (95% CI 60.4 −78.3%), whereas for SSA it was 64.0% (95% CI 53.3 −73.6%) with high heterogeneity and variability in the effect size within the groups (SSEA; I^2= 100.0, τ^2 = 0.72, and SSA; I^2= 99.9%, τ^2 = 1.14). Only the prevalence of ID was slightly higher at 68.1% (95% CI 58.4 −76.4%) in SSA, compared to SSEA at 66.0% (95% CI 58.4 −72.8%). This difference was not statistically significant (Q= 0.13, p= 0.920) (Fig. S6a of Supplementary file 4 and Table 3).

From the sub-group analysis of data sources, it was found that the average sample size for the studies conducted using primary data for different outcome variables varies from 600 to 872 with high variance (Table 3). Among the studies conducted on primary data, the prevalence of ANC1, SBA and ID were comparatively higher than the prevalence reported in the studies conducted using secondary data (Supplementary file 4, Fig. S3b, Fig. S5b, Fig. S6b and Table 3). For instance, the prevalence of SBA in studies with primary data sources was found 78.5% (95% CI 70.2–85.0%), while in studies with secondary data, it was 60.3% (95% CI 52.0–60.0%) and the difference between groups is significant (Q= 9.72, p= 0.002). However, the opposite result was observed for ANC4 and PNC. For instance, the prevalence of PNC for studies from primary data sources was 44.3%, (95% CI 31.9–57.4%), which was comparatively less than the prevalence of PNC for studies with secondary data 51.4%, (95% CI 42.6–60.0%) (Fig. S7b of Supplementary file 4 and Table 3).

Factors associated with the utilization and inequality in the coverage of MHS

From Table 4, it was observed that the most common significant factors associated with utilization of MHS (ANC, SBA, ID and PNC) are women's age, level of education, household wealth, place of residence, decision-making power, and access to mass media. In this study, out of 145 articles, 95 used the utilization of ANC as an outcome variable and reported the factors significantly associated with the utilization of ANC.

Table 4 reported that a total of 64 studies used women's age as a predictor, of which 34 (53.1%) found that women's age is significantly associated with the utilization of ANC whereas 87.1% of the studies (61 out of 70) reported mothers' education as a significant predictor of the utilization of ANC. A total of 55 studies used household wealth index as a predictor of ANC, of which 52 (94.5%) found that wealth index was significantly associated with the use of ANC services. There was a significant association between utilization of ANC and women's place of residence found in 39 out of 49 studies. Of studies that used decision-making power as a predictor, 85.7% reported that greater decision-making power enhances women's empowerment regarding maternal health and increases the likelihood that women would access ANC visits. A total of 31 studies used access to mass media as a predictor, of which 24 (77.4%) studies found that women with mass media exposure were more likely to utilize ANC services compared to their counterparts. Inequalities regarding the utilization of ANC and associated factors were reported in 12 studies (Supplementary file 2).

A total 38 of the 109 studies used the utilization of SBA as an outcome variable. It was observed that 22 studies used women's age as a predictor for utilization of SBA, of which 16 (72.7%) found that women's age was significantly associated with utilization of SBA. Maternal

Table 3 Subgroup analysis results of the prevalence of MHS indicators for region and data source

Outcome	Group	Sub-group	No. of studies	Total sample size (average sample size)	Pooled prevalence (95% CI)	Quantifying heterogeneity		*Q* statistics (*p*-value)
						Overall	Groupwise	
						τ^2 (95%CI), I^2 (%)	τ^2; I^2 (%)	
ANC1	Region	SSA	47	820,905 (17,466)	83.9 (79.1–87.8)	1.27 (0.92, 1.89), 99.9	1.23, 99.9	1.18 (0.277)
		SSEA	16	859,051 (53,691)	88.3 (80.8–93.1)		1.37, 99.9	
	Data source	Primary	33	25,186 (763)	87.5 (83.0–91.0)	1.23 (0.89, 1.81), 99.9	1.27, 100.0	2.50 (0.114)
		Secondary	33	2,180,527 (66,077)	82.1 (75.7–87.1)		1.06, 98.8	
ANC4	Region	SSA	66	783,066 (15,661)	47.6 (42.0–53.2)	0.90 (0.70, 1.22), 99.9	0.86, 100.0	2.47 (0.116)
		SSEA	36	1,096,344 (47,667)	61.7 (51.0–71.4)		0.94, 99.9	
	Data source	Primary	43	30,182 (862)	50.4 (42.4–58.4)	0.87 (0.68, 1.17), 100.0	1.15, 99.3	0.02 (0.892)
		Secondary	65	2521,007 (61,488)	51.0 (46.0–56.2)		0.71, 100.0	
SBA	Region	SSA	22	372,457 (16,930)	64.0 (53.3–73.6)	0.96 (0.63, 1.63), 100.0	1.14, 99.9	0.76 (0.382)
		SSEA	15	550,381 (36,692)	70.1 (60.4–78.3)		0.72, 100.0	
	Data source	Primary	11	7049 (641)	78.5 (70.2–85.0)	0.94 (0.64, 1.54), 100.0	0.54, 97.6	9.72 (0.002)
		Secondary	31	3,203,477 (103,338)	60.3 (52.0–68.0)		0.90, 100.0	
ID	Region	SSA	41	316,396 (7717)	68.1 (58.4–76.4)	1.38 (1.02, 2.18)	1.85, 99.9	0.13 (0.721)
		SSEA	19	136,2006 (71,685)	66.0 (58.4–72.8)		0.52, 99.9	
	Data source	Primary	28	24,429 (872)	68.2 (60.0–75.7)	1.34 (1.00, 2.09), 100.0	0.99, 98.8	0.14 (0.712)
		Secondary	35	2,384,091 (68,117)	65.9 (55.7–74.8)		1.68, 100.0	
PNC	Region	SSA	20	231,964 (11,598)	46.5 (36.6–56.6)	0.89 (0.57, 1.56), 100.0	0.86, 99.9	0.36 (0.549)
		SSEA	13	694,191 (533,399)	51.6 (38.4–64.7)		0.98, 100.0	
	Data source	Primary	13	4803 (600)	44.3 (31.9–57.4)	0.82 (0.54, 1.40), 100.0	0.94, 98.6	0.77 (0.380)
		Secondary	24	758,633 (50,576)	51.4 (42.6–60.0)		0.77, 100.0	

education was used as a predictor in 24 studies, of these 23 (95.8%) found that maternal education was significantly associated with the utilization of SBA. Out of 22 studies, the wealth index was found to be a significant predictor in the utilization of SBA in 20 studies. Out of 16 studies, 14 (83.3%) found that women's place of residence was significantly associated with the utilization of SBA. Furthermore, out of 10 studies, 8 (66.0%) found that the decision-making power of women has a positive impact on the coverage of SBA, as shown in Table 4. Mass media was used as a predictor of SBA in 15 studies of them 14 (93.3%) studies reported that access to mass media was significantly associated with the utilization of SBA. Ten studies evaluated the disparities in the use of SBA and identified the factors associated with these inequalities (Supplementary file 2).

Other important significant predictors of MHS are; age at first birth, parity, distance to health facility, unintended pregnancy, region, health insurance, number of children, birth order, partner education, husband occupation, child marriage, knowledge of ANC, knowledge of danger sign during pregnancy, marital status, physical violence, caste, skilled ANC, birth spacing, unintended pregnancy, sociocultural empowerment, information technology, internet use, mobile money use, and investment cash approach, ANC visits, health education, community-based program, religion, age at first marriage, family size, sex of household head, ethnicity, aware of postpartum danger sign, visited by health worker, knowledge of PNC, availability and readiness of healthcare facilities, availability of community health worker, type of SBA etc.

In this review, 58 studies used ID as an outcome variable and of these studies, 37 have used women's age as a predictor for the utilization of ID, of which about half (43.2%) found maternal age was a significant predictor for the utilization of ID. Of the 47 studies that used maternal education as a predictor, 41 (87.2%) found that it was one of the significant factors for the utilization of ID. Additionally, 30 studies included the wealth index as a predictor, of which 29 (96.7%) found that it was significantly associated with the utilization of ID. Furthermore, 31 studies used place of residence as a predictor, of which 25 (80.6%) identified this was significantly associated with the utilization of ID. Another 22 and nine studies respectively used access to mass media and the decision-making power of women as predictors of ID. Of them nearly 77.3% and about half (44.4%) studies respectively found that women with greater access to mass media

Table 4 Socio-demographic factors associated with the utilization of MHS (ANC, SBA, ID, and PNC)

Factor Outcome variable	Women age		Education		Wealth index		Place of residence		Decision making power		Access to mass media	
	Used as predictor	Found associated (%)	Used as predictor	Found associated (%)	Used as predictor	Found associated (%)	Used as predictor	Found associated (%)	Used as predictor	Found associated (%)	Used as predictor	Found associated (%)
ANC	64	34 (53.1)	70	61 (87.1)	55	52 (94.5)	49	39 (79.6)	14	12 (85.7)	31	24 (77.4)
SBA	22	16 (72.7)	24	23 (95.8)	22	20 (90.9)	16	14 (87.5)	10	8 (0.80)	15	14 (93.3)
ID	37	16 (43.2)	47	41 (87.2)	30	29 (96.7)	31	25 (80.6)	9	4 (44.4)	22	17 (77.3)
PNC	21	9 (42.9)	23	17 (73.9)	21	18 (85.7)	16	10 (62.5)	11	8 (72.7)	15	9 (60.0)

and higher decision-making authority were more likely to receive ID services (Table 4). In this review, 9 studies examined the inequalities in the utilization of ID services, focusing on the factors responsible for these disparities (Supplementary file 2).

In this study, 37 studies have used the utilization of PNC as an outcome variable. It was observed that 21 studies used women's age as a predictor for the utilization of PNC, of which about half (42.9%) found that women's age was significantly associated with the utilization of PNC. Furthermore, out of 23 studies where women's education was considered as a predictor of the utilization of PNC, 17 (73.9%) identified it as a significant predictor. Moreover, 21 studies used the wealth index as a predictor, of which 18 (85.7%) found household wealth was significantly associated with the utilization of PNC. In Table 4, it was observed that 16, 15, and 11 studies, respectively, employed women's place of residence, access to mass media, and decision-making power as predictors for predicting the utilization of PNC services. Among these, 10 (62.5%), nine (60.0%), and 7 (72.7%) studies found a statistically significant association between these predictors and the utilization of PNC services. In this systematic review, five studies evaluated the inequalities in the utilization of PNC and identified the factors accountable for these inequalities (Supplementary file 2).

Other socioeconomic, demographic and community factors that have been found to be significantly associated with the utilization of MHS were the age of women at first birth, parity, distance to the health facility, unintended pregnancy, region, health insurance, number of children, birth order, partner education, husband occupation, sex of household head, child marriage, knowledge of ANC, knowledge of danger sign during pregnancy, marital status, physical violence, caste, skilled ANC, birth spacing, sociocultural empowerment, information technology, availability and readiness of healthcare facilities, internet use, mobile money use, investment cash approach, ANC visits, health education, community-based program, religion, age at first marriage, family size, ethnicity, awareness of postpartum danger sign, mode of delivery, visited by health worker, knowledge of PNC, availability of community health worker, and type of SBA as indicated in Table 4 and Supplementary file 3.

Discussion

This systematic review and meta-analysis aimed to provide pooled estimates of MHS utilization and to identify the predictors that are associated with the utilization of MHS in LMICs. A total of 145 studies were reviewed, and overall results indicate that the pooled prevalence of ANC4 and PNC utilization was around 50%, whereas for SBA and ID, it was over 65%. Notably, there was substantial heterogeneity among studies, with a wide range of coverage reported. In the sub-group analysis, it was observed that the prevalence of all MHS indicators was higher in the SSEA region compared to SSA, except for ID. For studies utilizing primary data sources, the prevalence of all MHS indicators was higher than those with secondary data, except for PNC. The analysis revealed high heterogeneity among the studies and significant differences between the sub-groups. The study also identified the most common significant factors associated with utilization of MHS including women's age, maternal education, household wealth index, women's place of residence, decision-making power of women, and access to mass media. Several factors including parity, distance to health facilities, knowledge of danger signs during pregnancy and use of information technology were also found to be significantly associated with MHS. Women and their husbands with higher education, greater wealth, urban residence, decision-making autonomy and mass media access were more likely to use maternal healthcare services. Conversely, higher parity, perceived distance to health facilities, and limited knowledge of pregnancy danger signs were associated with lower utilization of MHS.

Antenatal care

In this review, significant heterogeneity was observed in utilization of ANC among the studies and significant differences were found in the utilization of ANC between sub-groups of SSA and SSEA regions, along with significant differences between studies from primary data sources and secondary data sources. The wide range of MHS prevalence and high heterogeneity among the studies suggest that the utilization of ANC varies greatly between regions, across countries and within countries, indicating high inequality. The coverage of ANC for several countries, including Indonesia, Gambia, Nepal, and India, was found to be higher than the pooled prevalence. However, certain countries had lower coverage than the pooled prevalence, including Afghanistan, Pakistan, Nigeria, and Ethiopia. Past studies observed persistent variation between countries, for instance, the prevalence of ANC in Sierra Leone was 90.7%, while in Ethiopia it was recorded at 32.0%, with these inequalities mainly attributed to the socio-economic status, education level, empowerment of women, and distance from the health facility [193–195], which is consistent with our findings.

The variation of the prevalence of ANC among different studies with primary data is one of the indications of within-country variation. Previous studies on primary data supported this variation due to different study areas, education levels, and socioeconomic status within the countries [29, 196], which is consistent with the results of

our sub-group analysis. Similar to our findings, previous studies reported a significant variation in the occurrence of ANC across the various regions of Ethiopia [33, 197].

Prior research regarding the coverage of ANC between African countries and Asian countries has also shown notable disparities [16, 195], which is also consistent with our results. These variations could be associated with the diversity of circumstances, including maternal healthcare services provided across public and private sectors [193]. For instance, Victora et al. [198] reported that the private sector provided a greater quality of healthcare services in comparison to the public sector.

The variations across regions could potentially be explained by differences in healthcare service levels and specific commitments to maternity care [2]. Nations like Afghanistan, Chad, Ethiopia, and Guinea, which lag considerably behind others in terms of coverage, must make substantial advancements to attain the associated SDGs by 2030 [179]. Also, several nations within the Middle East, South Asia, and Central Asia have undergone significant instances of national political disruption over the past decade [178]. Political instability is known to have a detrimental impact on healthcare systems, resulting in unfavorable indicators for maternal and child health [178].

To address financial obstacles to healthcare access in LMICs, one potential approach is to broaden the scope of health insurance coverage for disadvantaged individuals [193]. Additionally, the introduction of supplementary financing initiatives could help alleviate costs linked to patient referrals. Interventions focused on the supply side, tailored to the specific needs and resources of a particular locality, such as Colombia's "Salud a su casa," have demonstrated their effectiveness in diminishing socioeconomic disparities in maternal and child mortality [199].

Past studies provided support for the notion that women above the age of 20, possessing primary to higher education, residing in urban areas, exhibiting high decision-making power, and having access to mass media were more likely to access ANC services [29, 33]. Typically, women of high socioeconomic status are capable of covering the expenses of medical and non-medical services, as well as the opportunity costs associated with MHS [200]. The utilization of ANC services showed a positive correlation with the richer to richest household wealth index [148]. Conversely, mothers who reported inadequate ANC services often attributed this deficiency to a lack of financial resources required for accessing such care [150]. In some nations, ANC services are provided free of charge [201]. Nonetheless, this approach doesn't entirely eradicate the problem of underutilization of ANC services due to ongoing obstacles related to both direct expenses (consultation and medication) and indirect costs (transportation and waiting time) [201]. Furthermore, educated women residing in urban areas had improved access to health facilities and greater availability of health-related information [138]. The frequency of ANC visits can be influenced by empowering women through educational advancements and augmenting their authority in decision-making processes [33]. Hence, health promotion efforts should be directed towards women with limited education, aiming to raise their awareness regarding the significance of ANC services [61].

Skilled birth attendant

This systematic review focused on utilization of MHS in LMICs during the SDG era and revealed a high degree of heterogeneity among the studies with a wide range of coverage for pooled and sub-group prevalence of SBA. Zimbabwe exhibited the highest coverage of SBA, while Ethiopia had the lowest coverage. This indicates inequalities between countries in the utilization of SBA and is consistent with previous research [187, 202].

This review indicates that some LMICs such as Ethiopia, Nepal, Nigeria, Bangladesh, and Mali did not meet the expected coverage in the utilization of SBA and exhibited rates lower than the pooled prevalence. Conversely, certain LMICs such as Indonesia, Zimbabwe, Malawi, Cameroon, and Burkina Faso performed comparatively well in the utilization of SBA and reported rates higher than the pooled prevalence, which indicates the presence of significant disparities between countries in the coverage of SBA. These findings are consistent with previous studies, such as in Afghanistan, Bahrain, Gambia, and the Democratic Republic of the Congo [193, 195].

Similar to our findings, prior studies consistently affirmed the existence of disparities in the prevalence of SBA between SSA and SSEA, and among high-income and low-income countries [195, 203]. Previous studies also demonstrated that disparities in the utilization of SBA were particularly pronounced among African and Asian nations, with SBA prevalence being lower than the global average within these regions [195]. Generally, the prevalence of SBA usage was lower for African countries in contrast to their Asian counterparts with similar per capita GDP (Gross Domestic Product) [195]. This discrepancy could potentially be attributed to distinctions in national macroeconomic objectives and divergent priorities in health and disease control strategies within these two regions [195].

Multiple previous studies on Ethiopia, Zimbabwe, Mali, and Myanmar reported the disparities in coverage of SBA within these countries, particularly concerning factors such as geographic location, wealth, education levels and

the state of the health systems [66, 88, 113, 149]. Women with higher levels of education are considered to possess a superior knowledge regarding contemporary medical treatments and health services, empowering them to effectively manage their health [200].

Wealth status plays a pivotal role in the uneven coverage of SBA, as households within the lowest wealth quintile often lack the financial means to afford services like SBA, opting instead for services from traditional birth attendants (TBAs), who have been providing economical care within their localities for an extended duration [204]. Within rural regions, the quality of healthcare services might fall short of desired standards due to extended travel distances or investing more time in commuting due to the absence of accessible transportation options and the state of road conditions [205, 206]. Other studies conducted in LMICs also reported that women who can access mass media, thus enabling them to receive health education messages and programs, as well as those aged over 20 years, exhibit a higher likelihood of opting for SBA during childbirth [207, 208]. Hence, increasing overall SBA utilization relies on eradicating disparities across all levels of development of a country related to the healthcare system [195].

Institutional delivery

To improve maternal and child health, a significant focus should be placed on promoting ID services [209]. Delivering a child within a healthcare facility under the guidance and supervision of medically trained personnel enhances child survival rates and decreases the likelihood of maternal mortality [210]. In this study, sub-group analysis found significant differences in the utilization of ID among the broad regions SSA and SSEA and among the studies with primary and secondary data sources. High heterogeneity and wide ranges of coverage indicates that there exists an uneven utilization of ID among different countries and regions.

Based on our findings, certain countries like Afghanistan, Nigeria, Bangladesh, Ethiopia, Nepal, and Angola were lagging behind the pooled prevalence of ID. Conversely, countries such as Rwanda, India, Benin, Uganda, and Ghana were ahead of the pooled prevalence and demonstrated comparatively better performance. Like our review, other studies also demonstrated similar variations in utilization of ID services in LMICs, such as Ethiopia having a much lower prevalence, while Rwanda showed a much higher prevalence [202, 211]. Another prior study encompassing 74 LMICs found that utilization of ID varies significantly among different countries, with the lowest prevalence observed in Chad and the highest in Armenia [211]. Disparities in the utilization of ID in LMICs have also been observed between high- and low-income countries, urban and rural sub-populations, as well as among educated and non-educated groups [202, 212]. Women who have high decision-making power and access to mass media were also found to be more likely to utilize ID [35, 36].

On a global scale, the expenditure on primary healthcare in most LMICs is significantly lower compared to that of numerous developed nations [213]. But many LMICs are making strides in improving access to maternal healthcare, including ID, by increasing their health budgets. For instance, the sustained commitment to allocate a larger portion of Zimbabwe's GDP to healthcare expenditure appears to play a role in mitigating socioeconomic disparities and enhancing the extent of maternal healthcare coverage [213].

Major hindrances to expanding ID coverage include insufficient public investments in healthcare infrastructure in rural zones and a scarcity of skilled healthcare professionals [214]. Furthermore, in rural regions, the geographical aspect of access to healthcare services could hold greater significance compared to urban areas with well-established transportation infrastructure. In such contexts, individuals seeking services might need to cover considerable distances on foot and/or allocate more time for their journeys [205]. In contrast, within urban settings, a higher percentage of women were educated and had more decision-making authority, heightened self-worth, and increased self-confidence, leading to better utilization of healthcare facility deliveries compared to their rural counterparts [215].

The household wealth index plays a crucial role in determining ID service utilization [79], since women with financial constraints might choose non-facility delivery if they perceive the costs of ID to be unaffordable [79, 216]. Women with higher levels of education (secondary and above) exhibited approximately four times the likelihood of ID utilization in comparison to those who lacked literacy skills [215]. Encouraging the enrollment of young girls in schools and dedicating additional resources to adult education are vital measures for granting illiterate women the chance to pursue formal education [216]. So, to promote the utilization of ID and reduce disparities of coverage both within and between countries, interventions should prioritize disadvantaged groups [209].

Postnatal care

In many LMICs, there is insufficient emphasis on postnatal care, resulting in a low prevalence of PNC among postpartum women [51]. This study revealed that the prevalence of PNC in LMICs was about 50% with high heterogeneity among studies and prevalence varying highly across the countries. It was observed that Zimbabwe, Indonesia, India, and Uganda have a higher

prevalence of PNC compared to the pooled prevalence, whereas countries like Ethiopia, Rwanda, and Nigeria exhibit a lower prevalence than the pooled prevalence. The significant variations in the prevalence of PNC and the heterogeneity among studies highlighted the presence of inequalities in PNC coverage among region and countries. Past studies reported similar variations in the prevalence of PNC in different LMICs including Kenya, Nigeria, Zambia, India and in Ethiopia [193, 217]. Studies conducted on various regions of Ethiopia have reported different prevalence rates of PNC, and these rates also vary from the national level coverage [52, 218]. The disparities in the coverage of PNC between and within countries could be due to socioeconomic status, education levels, geographical location, distance from health facilities, place of residence and variations in intervention programs [179, 217].

In support of this study's findings, previous studies have consistently shown that women of older age, higher education, belonging to higher social status, residing in urban areas, having higher decision-making power, and having access to mass media are significantly more likely to access PNC services [34, 61, 217]. This suggests, that educated and empowered women possess heightened decision-making authority, the freedom to make choices, the ability to make informed decisions, and are willing to take on responsibility for interventions [193]. Furthermore, women with higher education tend to be perceived as having enhanced access to healthcare information, and they exhibit greater health literacy. They also tend to possess more accurate and comprehensive understandings of diseases, their complications, and the available treatments [217].

Additionally, women exposed to mass media exhibit higher probabilities of utilizing maternal healthcare services. This phenomenon can be attributed to the fact that exposure to mass media informs women about the significance of maternal healthcare utilization, as well as the potential complications or repercussions for both the mother and child that can arise when maternal healthcare is not accessed [193]. In contrast to women residing in rural regions, urban women generally enjoy greater access to postnatal care services and various urban advantages, including increased exposure to health promotion initiatives [219]. Within rural regions, there is a need for enhancements in the quantity of primary healthcare facilities, the delivery of high-quality postnatal care services, and the availability of public transportation [52]. The integration of innovative approaches, such as telehealth and telemedicine, could play a crucial role in overcoming geographical obstacles and enhancing access to specialized medical care.

PNC services exhibited relatively high coverage rates among women with elevated socioeconomic status [51]. Generally, women from higher socioeconomic backgrounds are part of households capable of bearing the financial burdens associated with medical, non-medical, and opportunity costs linked to postnatal care [200]. Moreover, these women might possess comparatively greater empowerment and autonomy that can play a role in augmenting awareness and shaping an individual's behavior through interactions within their social and community circles [220]. Equitable distribution of PNC service facilities is imperative, and services should be accessible without bias to all geographical regions, economic strata, and ethnic communities [217].

Overall, the utilization of MHS was found to be uneven, with varying coverage among broad global regions and between and within countries. Thus, it could be beneficial to create distinct regions based on MHS progress, similar to the regions used by organizations such as the WHO, International Monetary Fund (IMF), or World Bank. This approach may help in designing targeted interventions and strategies for improving MHS in specific areas and countries. Increasing international collaboration is necessary to support low-performing countries and help them get on track, by enhancing both the quality and coverage of MHS interventions to achieve SDGs by 2030. LMICs facing limited access and coverage of MHS could derive advantages from adopting effective intervention programs that have been successfully implemented in nations with extensive MHS accessibility. For instance, in some countries, delivery by SBAs outside health facilities has been promoted [221]. In the Philippines, "birthing homes" supervised by public or private healthcare establishments offer comprehensive birthing services, encompassing antenatal, spontaneous vaginal delivery, and postnatal care, with a special focus on serving rural and underprivileged communities [20, 214]. These services are delivered by accredited healthcare personnel, typically midwives with a minimum of 2 years of training [221, 222]. In Indonesia, the scenario is analogous, though the training program's duration is 1 year [222]. In contrast, Azerbaijan employs a system referred to as "feldsher-accoucher points", where mid-level healthcare providers specializing in primary healthcare in rural regions are responsible for assisting home deliveries [202].

Strength of the study

The primary strength of this study lies in its comprehensive approach, as it considers all four crucial indicators of MHS (ANC, SBA, ID, and PNC) for LMICs around the globe. In contrast, most systematic reviews have previously focused on examining only one indicator and

restricted their analysis to a single, specific country [29–36]. Secondly, by employing an extensive search strategy, we identified pertinent studies and ultimately conducted an analysis of a substantial number of research papers ($n = 145$). Thirdly, the study included a comparative analysis of the MHS status among countries and regions. Furthermore, from the selected studies, potential and highly significant predictors of MHS utilization were identified and thoroughly discussed.

Limitations

Despite our efforts to conduct a rigorous systematic review and meta-analysis on MHS utilization in LMICs, there are some limitations to this study. Firstly, it is important to note that over 90% of the studies included in this research are cross-sectional. This characteristic of the data limits to establishment of cause-effect relationships between variables. Secondly, a notable aspect of the included studies is the participation of women who had given birth within the past 2 to 5 years preceding the survey who may have been subject to recall bias. Thirdly, the lack of sufficient studies from all regions and self-administered cities or regions could potentially impact the generalizability of this study. Additionally, the presence of significant heterogeneity across studies and a wide range of coverage undermines the pooled estimate of MHS [29]. While sub-group analysis was conducted based on region and data source, the potential sources of heterogeneity were not identified in the study.

Conclusion and recommendations

While coverage of MHS in LMICs improved in some regions, many regions, are not on trackto reach the targets set by the SDGs for achieving the minimum coverage by 2030. Furthermore, considerable disparities continue to exist in many countries across SSA and SSEA. Inequalities in the coverage of MHS exist both at the global and national levels, stemming from factors such as geographical location, socioeconomic status, and educational level. Achieving the SDG target of a global maternal mortality ratio (MMR) of less than 70 per 100,000 live births may not be accomplished without addressing and reducing disparities in the coverage of MHS among regions and within and between countries. Therefore, effective interventions should be tailored separately for global, regional, national, and community contexts in alignment with the SDGs.

Abbreviations

ANC	Antenatal care
ANC1	At least one antenatal care visit
ANC4	At least four antenatal care visits
CI	Confidence interval
DHS	Demographic and Health Surveys
SBA	Skilled birth attendant
ID	Institutional delivery
PNC	Postnatal care
LMICs	Low-and middle-income countries
MDGs	Millennium development goals
MHS	Maternal healthcare services
MICS	Multiple indicator cluster surveys
MMR	Maternal mortality ratio
NIH	National Institutes of Health
REML	Restricted maximum-likelihood
SSA	Sub-Saharan Africa
SSEA	South and Southeast Asia
SDGs	Sustainable Development Goals
SDG- 3	Sustainable Development Goal 3
UN	United Nations
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13643-025-02832-0.

Supplementary Material 1. Table S1: PRISMA (2020) Checklist. Table S2: Search strategy

Supplementary Material 2: Summary of the selected studies

Supplementary Material 3: National Institute of Health (NIH) Quality Assessment tool for the Crosssectional and Observational Studies

Supplementary Material 4. Figure S1: Forest plots for the pooled prevalence of at least one antenatal care visit (ANC1) and at least four antenatal care visits (ANC4). Figure S2: Forest plots for the pooled prevalence of skilled birth attendant (SBA), institutional delivery (ID) and postnatal care (PNC). Figure S3: Forest plots for the prevalence of at least one antenatal care visit (ANC1) by region and data source. Figure S4: Forest plots for the prevalence of at least four antenatal care visits (ANC4) by region and data source. Figure S5: Forest plots for the prevalence of skilled birth attendant (SBA) by region and data source. Figure S6: Forest plots for the prevalence of institutional delivery (ID) by region and data source. Figure S7: Forest plots for the prevalence of postnatal care (PNC) by region and data source. Figure S8: Forest plots of leave-one-out method for at least one antenatal care visit (ANC1) and at least four antenatal care visits (ANC4). Figure S9: Forest plots of leave-one-out method for skilled birth attendant (SBA), institutional delivery (ID) and postnatal care (PNC)

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Authors' contributions

AB and JB defined the scope of the research subject. AB, JB, EK, and RKB developed the search strategy. AB and JB undertook the search and reviewed the literature. AB and JKB summarized the search findings. AB drafted the manuscript. EK, JB, and RKB provided substantial input in the design stages of the review, critically reviewed the manuscript, and helped shape the final version of the manuscript. All authors approved the final manuscript.

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Data availability

All data generated or analyzed during this study are included in this article and supplementary files.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent of publication
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Competing interests
The authors declare that they have no conflicts of interest.

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