



OPEN Inequalities in the completion of maternal continuum of care in Ethiopia using the 2019 mini-Ethiopian demographic and health survey

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The maternal continuum of care (CoC) is comprehensive healthcare provided for women during pregnancy, childbirth, and postpartum. Equitable maternal CoC can reduce the risk of maternal and neonatal mortality. We examined inequalities in the completion of maternal continuum of care, and factors associated with CoC among reproductive age women in Ethiopia using the 2019 mini-Ethiopian Demographic and Health Survey (mini-EDHS). The concentration curve and concentration curve index were used to examine socioeconomic inequalities in maternal CoC. Odds ratios were used to assess associations, with significance at $p < 0.05$. Overall, 23.97% (95% CI 21.63–26.48) of women completed maternal continuum of care. There was pro-rich inequality in the completion of maternal CoC in Ethiopia (Concentration index: 0.244 (95% CI 0.177–0.311, $p \leq 0.001$)), rural resident (Concentration index: 0.146 (95% CI 0.087–0.205, $p \leq 0.001$)), and urban resident (Concentration index: 0.154 (95% CI 0.045–0.263, $p \leq 0.01$)). Being urban resident (adjusted odds ratio (AOR) = 1.59, 95% CI 1.09–2.33), attaining secondary (AOR = 1.67, 95% CI 1.19–2.33), or higher education (AOR = 1.93, 95% CI 1.30–2.87), and early initiation of antenatal care (AOR = 1.97, 95% CI 1.61–2.41) were positively associated with the completion of maternal CoC. However, belonging to pastoral region (Afar or Somali) (AOR = 0.46, 95% CI 0.28–0.77), belonging to poorest (AOR = 0.58, 95% CI 0.37–0.92) or middle (AOR = 0.62, 95% CI 0.40–0.96) wealth quintile, not being informed about obstetric danger signs (AOR = 0.54, 95% CI 0.43–0.66), and blood pressure not being measured (AOR = 0.53, 95% CI 0.32–0.85) were negatively associated with maternal CoC. The results of this study revealed that completion of the maternal continuum of care was low in Ethiopia and there was a significant inequality in the completion of maternal CoC across wealth status, place of residence, and educational status. Targeted strategies are needed to improve maternal healthcare utilization among disadvantaged women, particularly those in rural areas, with low education, and from poor households. Interventions should focus on improving access, promoting early and high-quality ANC, and providing culturally tailored services.

Keywords Inequality, Continuum of maternal health care, Ethiopia, Mini-EDHS

Abbreviations

AIC	Akaike information criteria
ANC	Antenatal care
AOR	Adjusted odds ratio
CBHI	Community based health insurance
CI	Confidence interval
CoC	Continuum of care

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DHS	Demographic health survey
EA	Enumerated area
EDHS	Ethiopian demographic health survey
HH	House hold
ICC	Intra-class correlation coefficient
MOR	Median odds ratio
OR	Odd ratio
PCV	Proportional change in variance
PNC	Postnatal care
RR	Risk ratio
SD	Standard deviation
SDGs	Sustainable development goals
SNNPR	Southern nations nationalities and peoples' region
WHO	World Health Organization

Equity in maternal health care is a key to achieve sustainable development goal (SDG) # 3¹. Inequality in health is defined as countable variations in health across different subgroups of the population². Inequalities in maternal health due to healthcare access limitations are unjust and avoidable³. To minimize these inequalities, Ethiopia designed multiple initiatives, including following fee-exemption policies, strengthening community-based health services⁴, scaling up community-based health insurance (CBHI)⁵, and expanding primary health care⁶. Despite these efforts, studies suggested the persistence of inequities in maternal service utilization^{7,8}, even with an increasing trend between 2000 and 2016⁹.

Narrowing disparities in access to maternal health services reduces maternal mortality¹⁰. Maternal death from pregnancy complications is not merely a health issue. It is also social injustice and gender inequality¹¹. Around 80% of maternal mortality and many causes of neonatal death are preventable and curable¹². The burden of maternal death is higher in low-income countries and substantially affects the disadvantaged population¹³. According to the World Health Organization (WHO) report, 287,000 maternal deaths were reported globally in 2020, and sub-Saharan Africa shares 70% of the burden. Ethiopia had more than 10,000 maternal deaths in 2020¹⁴. An estimated 69% of maternal deaths occur in health facilities, while 17% take place at home and 13.6% occur en route to a health facility¹⁵.

The WHO launched a continuum of care (CoC) to improve maternal and neonatal health¹⁶. Maternal CoC is care provided during pregnancy, birth, and postnatal period^{17,18}. The approach facilitates the delivery of appropriate intervention at the right time¹⁹ to reduce maternal and neonatal deaths and disabilities¹⁸. However, existing studies suggest the presence of inequalities in the completion of maternal CoC^{20,21}. Women who belong to the wealthier quintile, live in urban, attend higher education levels, and have access to mass media tend to complete maternal CoC more than their counterparts^{21,22}.

Previous studies have focused on the magnitude and factors affecting maternal health services utilization for specific services^{23–25}, lacking information on the full package of interventions starting from ANC to institutional birth and PNC. Other studies focused on maternal CoC were conducted in specific areas and did not provide nationally representative evidence, with relatively small sample sizes^{26–28}. However, studies focusing on and analyzing Ethiopian Demographic Health Survey (EDHS) data on CoC completion and dropout^{29–31} did not encompass the concept of inequality. Furthermore, studies focusing on inequality have identified inequalities in separate maternal healthcare services rather than adopting the continuum or integrated approach^{8,9,32}. A few studies have examined inequalities in the continuum of maternal health care³³, yet lack detailed information about inequalities in maternal CoC. Therefore, to fill these gaps, this study aims to determine population-based inequalities and factors associated with the completion of maternal CoC using the most recent population-based 2019 mini-EDHS. The findings of this study will help policymakers and program planners in developing systematic policies, strategies, and programs to benefit the disadvantaged subgroups of women.

The maternal CoC approach facilitates the delivery of appropriate intervention at the right time¹⁹ to reduce maternal and neonatal deaths and disabilities¹⁸. However, existing studies have indicated the presence of inequalities in maternal CoC completion among women in different socioeconomic and demographic subgroups in sub-Saharan Africa²⁰. Therefore, acknowledging the existence of health inequity and monitoring progress and trends over time are priority actions in addressing inequality³.

Methods and materials

Study design and setting

This study used the 2019 mini-EDHS data, which used a population-based cross-sectional design³⁴. This study used the 2019 mini-EDHS dataset, collected through a population-based cross-sectional design. Data access is open for research, with permissions waived for approved studies, obtainable through DHS Program registration (<https://dhsprogram.com>). We accessed the official DHS Program permission letter, confirming authorized data use and adherence to ethical guidelines. We accessed the data on 11/10/2022. The 2019 mini-EDHS is the second mini-EDHS conducted in the country, next to the 2014 mini-EDHS.

Study population

All women aged 15–49 who lived in the selected enumerated areas, gave birth within five years before the 2019 mini-EDHS, and who had at least one ANC visit for their last child were the study population.

Inclusion and exclusion criteria

This study included women who gave birth 5 years before the 2019 mini-EDHS and had at least one ANC visit. Women who had missing data for the outcome variables were excluded from the analysis.

Sample size determination and sampling procedure

From a total of 8885 interviewed reproductive age group women, 3979 women gave birth five years before the survey, of which 1061 women had no ANC during their last pregnancy³⁴. Hence, we included 2,918 reproductive-age group women with weighed samples of 2913 women in the final analysis. The mini-EDHS used a stratified two-stage cluster sampling technique. Urban and rural areas in each region of Ethiopia were stratified and separated. Population census was used as a sampling frame for the first stage of sample selection and has information about the enumeration areas (EAs), the estimated number of households, and the type of residence³⁴ (Fig. 1).Fig. 1

Measurements

The dependent variable in this study was the completion of maternal continuum of care. Women who had at least four ANC visits, gave birth at the health facility, and received at least one PNC services (before or after discharge from the health institution within six weeks after giving birth) were coded as a complete continuum of care. Incomplete CoC declared that women who started ANC service failed to receive any of the three services (ANC⁴⁺, institutional delivery, and PNC)²⁹.

We broadly categorized the independent variables into community-level and individual-level factors. The community-level factors included region (regional administrations) and place of residence (urban vs rural). The individual-level factors included socio-demographic and economic, obstetrics, and service-related factors. Socio-demographic and economic factors included age, marital status, religion, educational status, sex of household head, wealth index, and community-based health insurance coverage. Obstetric factors included parity and age at first birth. Service-related factors included first ANC initiation, informed on pregnancy danger signs, blood pressure measured, and blood and urine samples taken.

Operational definitions

Completed continuum of maternal health care: If the women had four or more ANC visits, institutional birth, and at least one PNC within six weeks after giving birth³¹.

Antenatal care service utilization: Women having at least one antenatal care visit³⁵.

Institutional birth: Births that occur in the health facility³⁴.

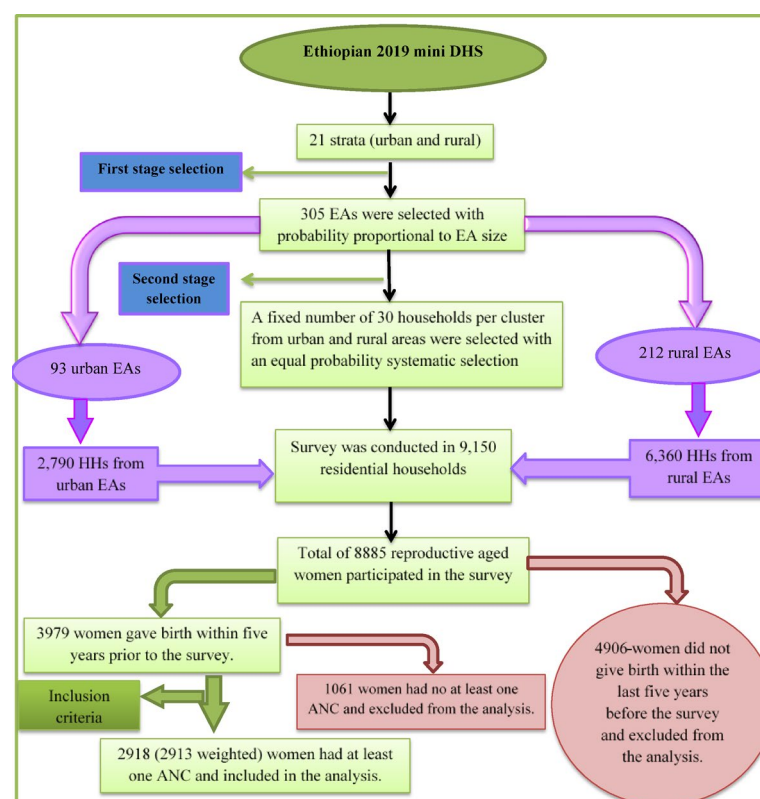


Fig. 1. Sampling procedures of the Ethiopian 2019 mini-Demographic and Health Survey. EAs, enumeration areas; HHs, households; ANC, antenatal care.

Types of society: Pastoralist (comprising regional administrations that include Afar and Somali); agrarian (encompassing Tigray, Amhara, Oromia, Benishangul, Southern Nations, Nationalities and Peoples' Region SNNPR); and city dweller (Addis Ababa, Dire Dawa, and Harar)^{36–38}.

Parity: The total number of children ever born from women; and considered as primiparous if women have one child, multiparous if women have two to four children, and grand-multiparous if women have five and above children^{17,29}.

Timing of first ANC visit: Time when pregnant women visit the health facility for the first time; and considered as early if the women received ANC service within the first 12 weeks and late if the women received ANC service after 12 weeks of gestation³⁹.

Data processing and analysis

A STATA format of the 2019 mini-EDHS datasets was downloaded, extracted, cleaned, recoded, and analyzed. All the descriptive and inequality analyses were weighted to compensate for the unequal probability of selection between the strata. The complex nature of the data was adjusted by introducing cluster to the multilevel model.

The concentration curve shows inequality by plotting the cumulative proportion of the continuum of maternal care (y-axis) against the cumulative proportion of the population (x-axis) among the possible socioeconomic factors. The concentration index is defined as twice the area between the concentration curve and the line of equality (the 45-degree line). It takes a value between -1 and $+1$. The convention is that the index becomes 0 in the absence of inequality in the completion of maternal CoC, and the concentration curve lies on the line of equity. The index takes a negative value when the curve lies above the line of equality, which indicates a disproportionate concentration of the health variable among the disadvantaged, and the index takes a positive value when it lies below the line of equality⁴⁰.

The concentration index (C) can be computed as follows.

$$C = \frac{2}{\mu} \text{cov}(h, r)$$

where h is the healthcare outcome of interest (i.e., completion of maternal CoC), μ is the mean of h and r , and r is the rank of an individual living standards variable. We used 95% CIs for the concentration index.

We determined the concentration curve for only four (Tigray, Amhara, Oromia, SNNPR) regions with adequate sample size. Despite Addis Ababa having a relatively sufficient sample size, the income distribution of the participants was predominantly concentrated in the richer and richest subgroups. Hence, we opted to exclude them from this particular analysis.

Due to the hierarchical nature of demographic and health survey data, women within the same cluster may exhibit greater similarity than those in different cluster. Such inherent clustering can potentially violate the assumption of independence and equal variance across clusters. This assumption was checked using the intra-class correlation coefficient (ICC), which shows the proportion of the total variance in the completion of maternal CoC attributable to clustering. Multilevel logistic regression model is preferred over single-level logistic regression to appropriately account for this clustering effect.

A total of four models were fitted. The first model (null model) was fitted without any predictor. The ICC in the null model was 25.9% (0.259). The second model was fitted with community-level factors alone. The third model was fitted with individual-level factors alone. The fourth model was fitted with both individual and community-level factors.

Both bi-variable and multivariable analyses were employed. Variables with P -value ≤ 0.25 in the bi-variable two-level binary logistic regression were candidates for the multivariable model. However, some variables like marital status and CBHI were considered important variables and forced into the final multivariable multilevel logistic regression model. Adjusted Odds Ratio (AOR) with a 95% Confidence Interval (CI) and $p < 0.05$ in the final multivariable model was used to declare statistically significant.

Results

Community level factors

More than one-third of the respondents (37%) were from the Oromia region, followed by 19.1% from the Southern Nations, Nationalities, and Peoples' Region (SNNPR). The fewest respondents were from the Harari region (0.3%), followed by Dire Dawa and Gambela regions (0.6%); 70.3% of respondents were rural residents (Table 1).

Individual level factors

Socio-demographic and economic status

The mean ($\pm$ standard deviation (SD)) age of the respondents was 27.5 (± 0.15) years, with 53.0% falling within of 25–34 age category. The majority, 94.3% of the participants, were married, 41.8% identified themselves as Orthodox Christian religion followers, and 44.0% reported never attending formal education. Additionally, 87% of households were headed by men, 33.8% belonged to the lowest wealth quintile, and 30% were enrolled in CBHI. Moreover, 84.2% of women with no formal education, 86.4% of those in the lowest wealth quintile, and 77.8% of women not enrolled in CBHI did not complete the maternal CoC (Table 2).

Maternal obstetrics and service related factors

Nearly half, 47% of respondents were multiparous, 40% gave their first birth before the age of 18 years, 62.7% started ANC late, 60% were informed about pregnancy danger signs, and 88.1% reported their blood pressure was measured. Regarding laboratory testing, 78.8% reported their blood sample received, while 73.8% reported

Variables			Continuum of care		
			Incomplete, <i>n</i> (%)	Complete, <i>n</i> (%)	Total, <i>n</i> (%)
1	Region	Tigray	160 (5.5)	110 (3.8)	270 (9.3)
		Afar	26 (0.9)	6 (0.2)	32 (1.1)
		Amhara	524 (18.0)	187 (6.4)	711 (24.4)
		Oromia	877 (30.1)	199 (7.0)	1076(37.1)
		Somali	59 (2.0)	4 (0.1)	63 (2.1)
		Benishangul	27 (0.9)	12 (0.4)	39 (1.3)
		SNNPR	452 (15.5)	106 (3.6)	558 (19.1)
		Gambela	13 (0.5)	3 (0.1)	16 (0.6)
		Harari	7 (0.2)	2 (0.1)	9 (0.3)
		Addis Adaba	59 (2.0)	62 (2.1)	121 (4.1)
		Dire Dawa	11 (0.4)	7 (0.2)	18 (0.6)
2	Residence	Urban	552 (18.9)	313 (10.8)	865 (29.7)
		Rural	1663 (57.1)	385 (13.2)	2,048 (70.3)

Table 1. Completion of the continuum of maternity care by community-level factors of reproductive age women in Ethiopia, 2019 (*n* = 2913).

Variables			Continuum of care		
			Incomplete, <i>n</i> (%)	Complete, <i>n</i> (%)	Total, <i>n</i> (%)
1	Age in years	15–24	543 (18.6)	214 (7.4)	757 (26.0)
		25–34	1198 (41.1)	347 (11.9)	1545 (53.0)
		35–49	474 (16.3)	137 (4.7)	611 (21.0)
2	Marital status	Single	9(0.3)	4(0.1)	13(0.4)
		Married	2085(71.6)	660(22.7)	2745(94.3)
		Widowed	24(0.8)	2(0.1)	26(0.9)
		Divorced	97(3.3)	32 (1.1)	129 (4.4)
3	Religion	Orthodox	845 (29.0)	372 (12.8)	1217 (41.8)
		Protestant	660 (22.6)	133 (4.6)	793 (27.2)
		Muslim	682 (23.4)	190 (6.5)	872 (29.9)
		Others*	28 (1.0)	3 (0.1)	31 (1.1)
4	Educational status	No formal education	1076 (37.0)	202 (7.0)	1278 (44.0)
		Primary	856 (29.3)	294 (10.1)	1150 (39.4)
		Secondary	199 (6.8)	134 (4.6)	333 (11.4)
		Higher	84 (2.9)	68 (2.3)	152 (5.2)
5	Sex of the household head	Male	1941 (66.6)	590 (20.3)	2531 (86.9)
		Female	274 (9.4)	108 (3.7)	382 (13.1)
6	Wealth status	Poorest	357 (12.3)	40 (1.4)	397 (13.7)
		Poorer	493 (16.9)	94 (3.2)	587 (20.1)
		Middle	482 (16.5)	107 (3.7)	589 (20.2)
		Richer	441 (15.1)	135 (4.7)	576 (19.8)
		Richest	442 (15.2)	322 (11.0)	764 (26.2)
7	Enrolled in CBHI	No	1592 (54.6)	454 (15.6)	2046 (70.2)
		Yes	623 (21.4)	244 (8.4)	867 (29.8)

Table 2. Completion of the continuum of maternity care by individual-level factors of socio-demographic and economic factors of reproductive age women in Ethiopia, 2019 (*n* = 2913).

their urine samples received for investigation during ANC visits. Furthermore, 81.5% of women whose age at first birth was below 18, 82.8% of those who initiated ANC late, and 82.6% of grand multiparous women did not complete maternal CoC (Table 3).

Dropout rate of components of maternal continuum of care

From a total of 2913 weighted samples of women who had at least one ANC visit, 1225 (42%) dropped out during ANC follow-up, having had less than four ANC visits. Of the 1688 women who had four or more ANC visits, 445 (26.4%) women dropped out and gave birth at home. Of the remaining 1243 women who gave birth at the

Variables		Continuum of care		
		Incomplete, <i>n</i> (%)	Complete, <i>n</i> (%)	Total, <i>n</i> (%)
Maternal obstetric factors				
Parity	Primiparous	443 (15.2)	245 (8.4)	688 (23.6)
	Multiparous	1062 (36.4)	303 (10.5)	1365 (46.9)
	Grand-multiparous	710 (24.4)	150 (5.1)	860 (29.5)
Age at first birth	< 18	948 (32.5)	215 (7.4)	1163 (39.9)
	≥ 18	1267 (43.5)	483 (16.6)	1750 (60.1)
Service-related factors				
ANC Initiation	Early	704 (24.1)	384 (13.2)	1088 (37.3)
	Late	1511 (51.9)	314 (10.8)	1825 (62.7)
Told about danger sign	No	997 (34.2)	170 (5.8)	1167 (40.0)
	Yes	1218 (41.8)	528 (18.2)	1746 (60.0)
Blood pressure measured	No	304 (10.4)	43 (1.5)	347 (11.9)
	Yes	1911 (65.6)	655 (22.5)	2566 (88.1)
Blood sample taken	No	554 (19.0)	63 (2.2)	617 (21.2)
	Yes	1661 (57.0)	635 (21.8)	2296 (78.8)
Urine sample taken	No	689 (23.7)	73 (2.5)	762 (26.2)
	Yes	1526 (52.3)	625 (21.5)	2151 (73.8)

Table 3. Completion of maternal continuum of care by maternal obstetric factors and service provided for reproductive age women in Ethiopia, 2019 (n = 2913).

health facility, 545 (56.2%) women did not receive one PNC checkup. Overall, from the total of 2913 women who booked for ANC, 2215 (76.03%) missed at least one service from ANC, birth, or postnatal care (Fig. 2).

Utilization of components of continuum of maternal health care

Out of the total respondents, 23.97% (95% CI 21.63, 26.48) of women completed the continuum of maternal health care in Ethiopia. Specifically, 58% completed ANC4⁺, 64.6% of women gave birth at a health facility, and 38.48% had at least one postnatal care (Fig. 3).

Inequalities in the completion of continuum of care

From 865 urban and 2048 rural residents surveyed, (36.18%) of urban and (18.79%) of rural residents completed the maternal continuum of care. Residence-based relative inequality in the completion of maternal continuum of care was 1.93.

The proportion of women who completed the maternal CoC in the Tigray was 40.74%, while it was 18.46% in the Oromia. Region-based absolute inequality in the completion of maternal continuum of care was 22.28 percentage points.

In Tigray, 50.70% of women from the rich subgroup and 28.40% from the poor subgroup completed maternal CoC care. Similarly, in the Oromia, 25.40% of women from the rich subgroup and 10.40% from the poor subgroup completed maternal CoC. Regarding urban and rural residence, in Tigray, 62.10% of urban women and 30.60% of rural women completed maternal CoC. In Oromia, 25.00% of urban women and 31.60% of rural women completed maternal CoC. In SNNPR, 14.30% of rural women and 16.70% of urban women completed maternal CoC.

Residence-based relative inequality in the completion of maternal CoC was 2.21 in SNNPR, 2.03 in Tigray and 1.49 in Oromia. Wealth-based relative inequality in the completion of the maternal continuum of care was 2.44 in Oromia, 2.38 in Amhara and 1.78 in Tigray (Fig. 4).

There was wealth-based pro-rich inequality in the completion of maternal CoC in Ethiopia (Concentration index: 0.244 (95% CI 0.177, 0.311)).

The positive concentration index for ANC 4⁺, institutional birth, and completion of CoC confirm the existence of pro-rich distribution. However, the concentration index for PNC was insignificant among urban residents, indicating no difference in the utilization of PNC services among urban resident women who belong to different socioeconomic statuses. The negative concentration index for ANC < 4 and home birth indicate poor women disproportionately received incomplete ANC and gave birth at home. Except for home birth and ANC 4⁺ there is a slight to large inequality among rural residents than urban. Wealthier urban and rural resident women completed maternal CoC more than poor women (Fig. 5).

Education-related absolute inequality for the completion of maternal continuum of care among women who attended higher education (44.7%) and had no formal education (15.8%) was 28.9 percentage points (Fig. 6).

The concentration curve for all selected regions lay below the line of equity, confirming that completion of continuum of care was disproportionately concentrated among women from wealthier households (Fig. 7).

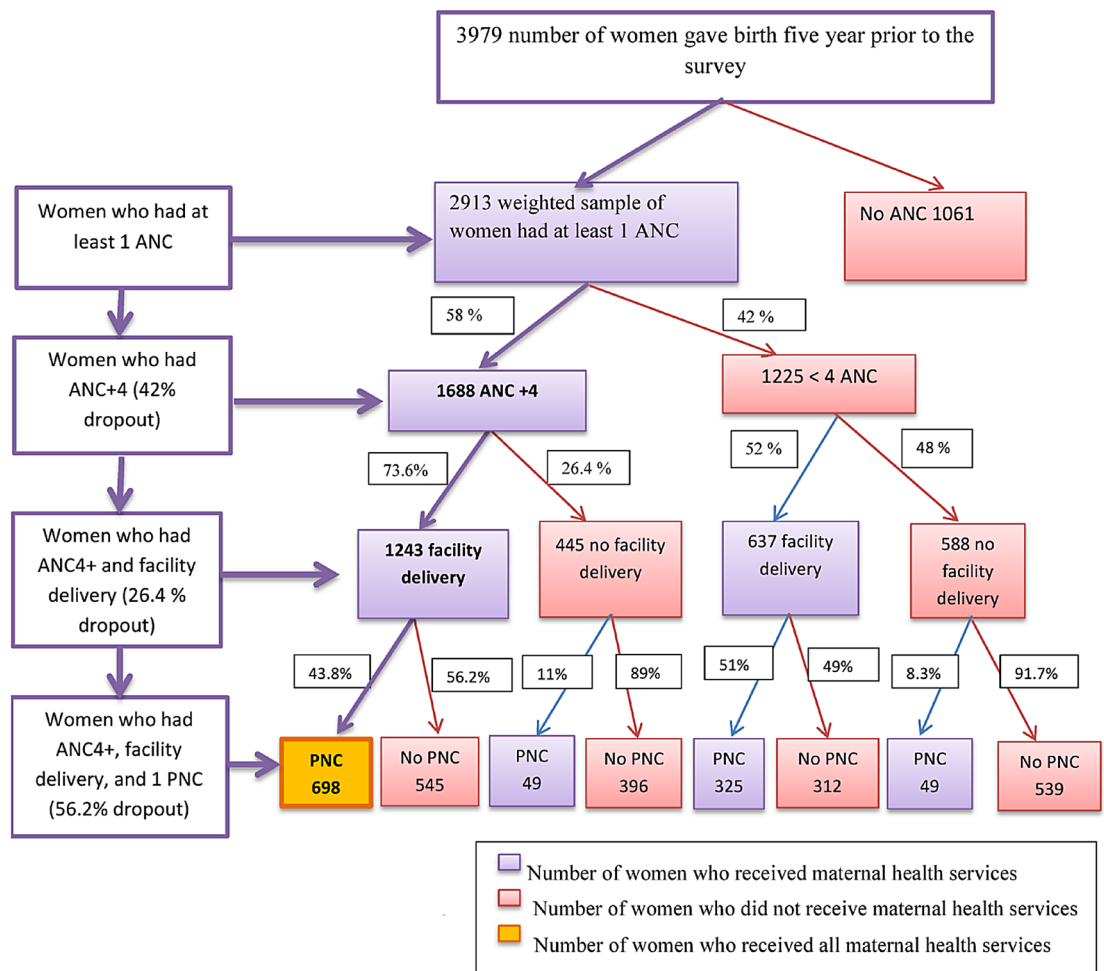


Fig. 2. Diagram shows prevalence and dropout of components of continuum of maternal health services among reproductive age women in Ethiopia, 2019. ANC, antenatal care; PNC, postnatal care.

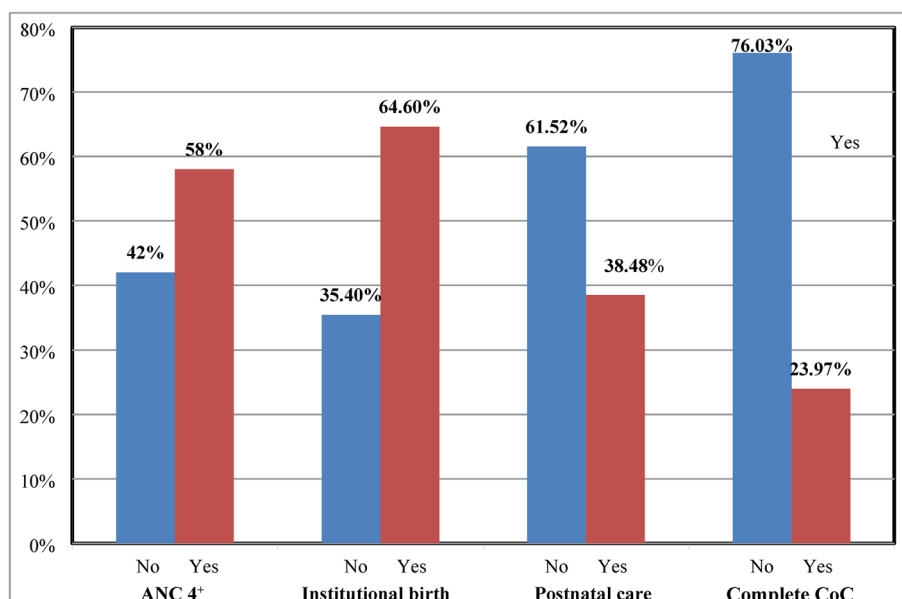


Fig. 3. Overall utilization of components of continuum of maternal health care services in Ethiopia, 2019.

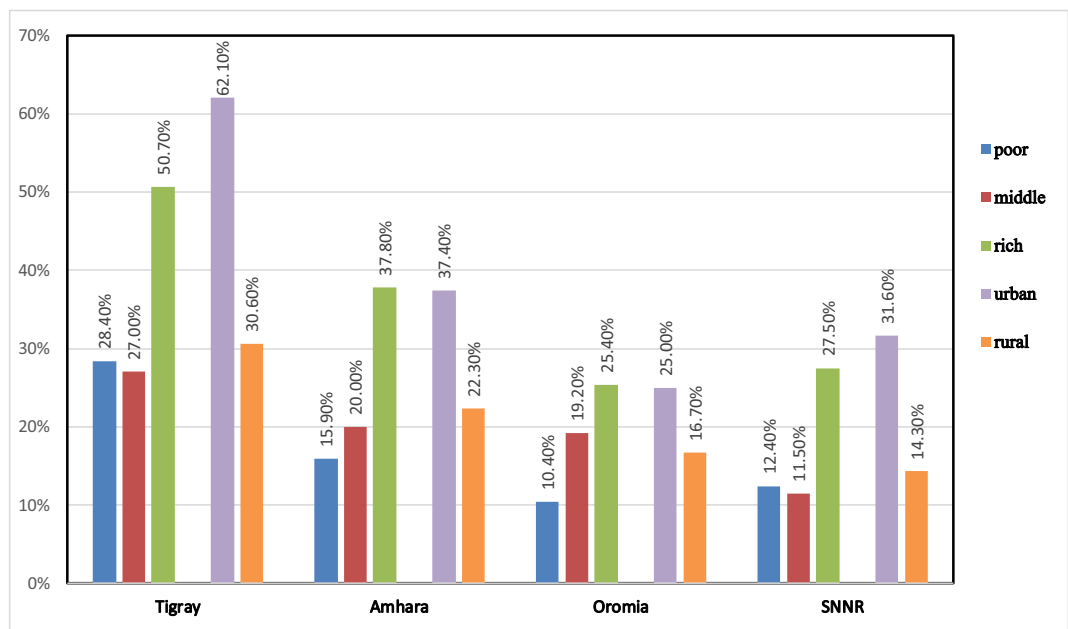


Fig. 4. Percentages of women who completed continuum of maternal health care in each subgroup of wealth status and residence, mini-EDHS 2019.

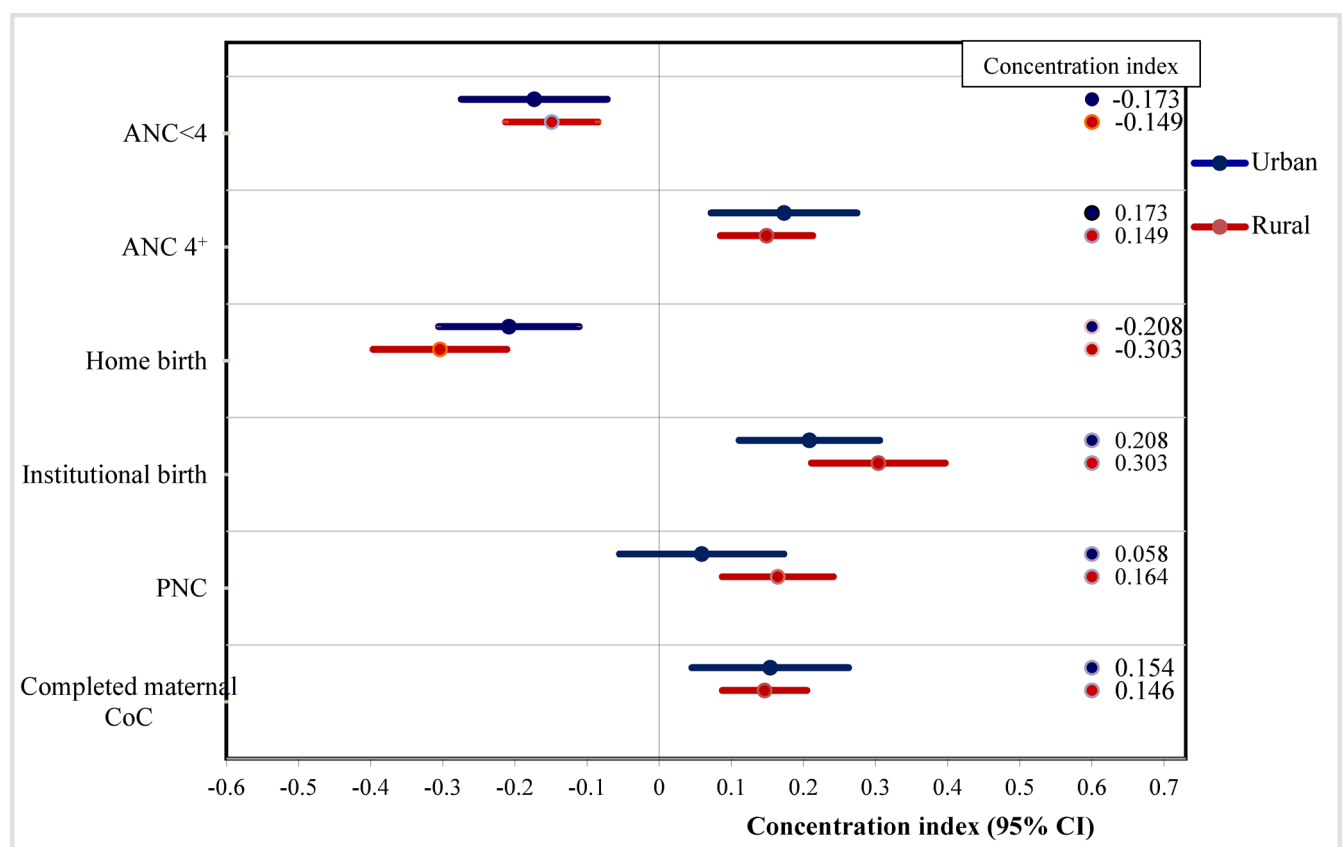


Fig. 5. Concentration indexes that show socioeconomic inequalities in maternal health service utilization and completion of continuum of care, mini-EDHS 2019.

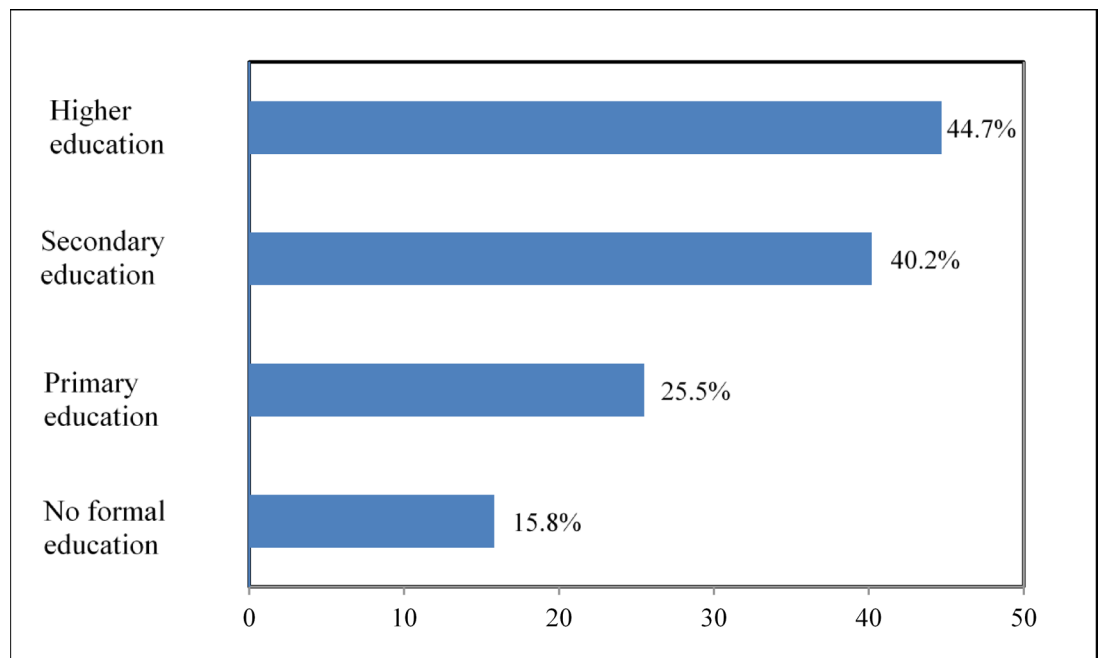


Fig. 6. Percentages of women who completed continuum of maternal health care by their educational status, mini-EDHS 2019.

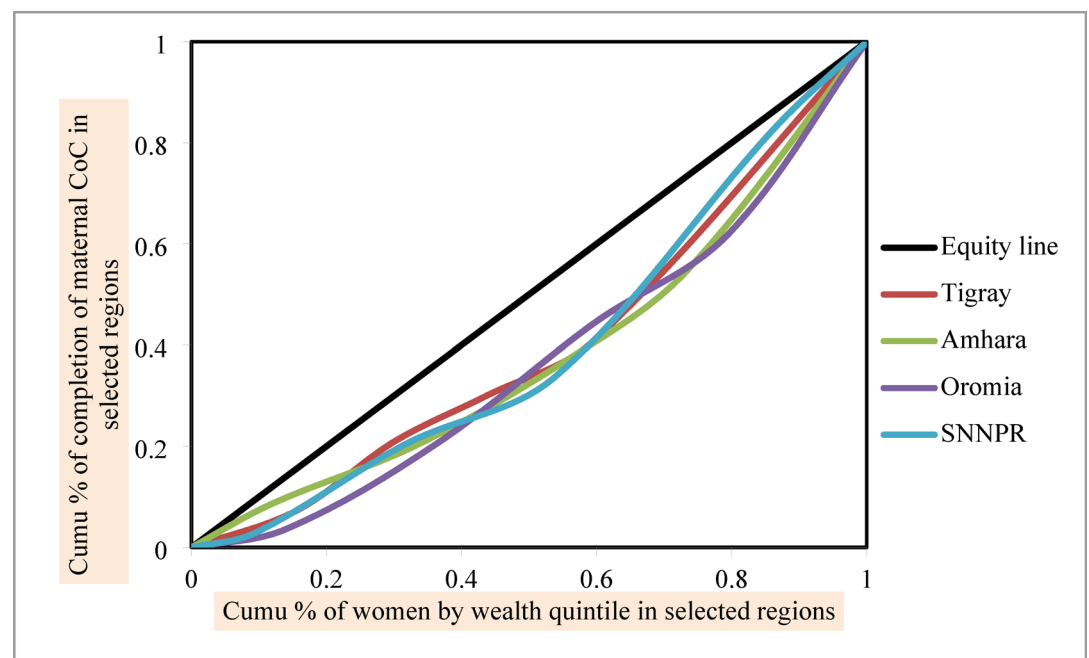


Fig. 7. Concentration curves for the completion of continuum of care for selected Ethiopian regions, mini-EDHS 2019. SNNPR, Southern Nations, Nationalities, and Peoples' Region.

Factors associated with the completion of continuum of maternal healthcare

In the multivariable analysis region, the log-likelihood ratio (LLR) and Akaike Information Criteria (AIC) measure were used to compare models. AIC was small for the fourth model (AIC=2912.07) as compared to the random intercept-only model or null model (AIC=3156.072), a model with only community-level factors (AIC=3062.942), and a model with only individual-level factors (AIC=2919.11). The log-likelihood (LL) was high for model fourth (LL=−1429.0395) as compared to the random intercept-only model or null model (LL=−1576.0359), a model with only community-level factors (LL=−1526.04709), and a model with only individual-level factors (LL=−1435.7633). Therefore, the fourth model was best fitted. The variance (SE), intra-

class correlation coefficient (ICC), and median odds ratio (MOR) of the random effect model for the null model were 1.15 (0.83, 1.60), 25.9%, and 2.77, respectively.

Factors such as region, types of society (agrarians, pastoralists, city dwellers), residence, educational status, wealth index, ANC initiation, informed about danger signs, and blood pressure measured had significant associations with the completion of the continuum of maternal health care. Accordingly, the odds of completing the continuum of maternal health care were 54% (AOR = 0.46, 95% CI 0.28, 0.77) less among women who belong to pastoralist compared to women who belong to agrarian. The odds of completing the continuum of maternal health care were 1.6 (AOR = 1.59, 95% CI 1.09, 2.33) times higher among urban resident women. The odds of completing the continuum of maternal health care were 1.7 (AOR = 1.67, 95% CI 1.19, 2.33) times, and 2.0 (AOR = 1.93, 95% CI 1.30, 2.87) times higher among women who attend secondary or higher education respectively compared to women who did not attend any formal education. The odds of completing the continuum of maternal health care were 42% (AOR = 0.58, 95% CI 0.37, 0.92) less among women who belonged to the poorest wealth quintile and 38% (AOR = 0.62, 95% CI 0.40, 0.96) less among women who belonged to the middle wealth quintile compared to women who belong to richest wealth quintile. The odds of completing the continuum of maternal health care were 2.0 (AOR = 1.97, 95% CI 1.61, 2.41) times higher among women who initiate ANC early. The odds of completing the continuum of maternal health care were 46% (AOR = 0.54, 95% CI 0.43, 0.66) less among women who were not informed about pregnancy danger signs, and 47% (AOR = 0.53, 95% CI 0.32, 0.85) less among women whose blood pressure was not measured (Table 4).

The value of median odd ratio (MOR) (2.77) in the null model depicts that there was a variation of completion of the continuum of care between clusters when we randomly select women from two clusters, women from clusters that have a high proportion of completion of the continuum of care were 2.77 times more to complete continuum of care as compared to women from low proportion of continuum of care cluster. The proportional change in variance (PCV) value in the fourth model (70.4%) depicted that 70.4% of the variability of completion of the continuum of care was explained by both the individual-level and community-level factors.

Discussion

This study examined proportion of, inequalities in, and factors associated with completion of maternal CoC among reproductive age group women who had at least one ANC in Ethiopia. The proportion of women who received a complete continuum of care was 23.97%. There were inequalities in the completion of maternal CoC across different socio-demographic and economic factors. Place of residence, region, wealth status, educational status, time to initiation ANC services, informed about obstetric danger signs, and blood pressure measured during pregnancy were significantly associated with the completion of maternal CoC.

The overall completion of continuum of maternal health care was low. This implies that large numbers of women failed to complete the maternal CoC, and healthcare facilities failed to keep women who booked for ANC services in the maternal CoC pathway. This might have contributed to consistently high maternal as well as neonatal mortality and morbidity¹⁸. Our finding showed that more dropouts were identified between the institutional birth and PNC services. This is similar to studies conducted in Ethiopia³¹. The possible reason could be postnatal care is the most neglected and the weakest of all reproductive and child health programs⁴¹.

Out of women who gave birth at health institutions, 36.6% of women did not receive PNC before discharge. A study done across sub-Saharan African countries revealed that 71.7% of women received PNC before discharge, with the rate ranging from 27% in Eswatini to 94% in Burkina Faso⁴². Despite guideline recommendations⁴³, it was observed that more educated, wealthier, and urban women received pre-discharge postnatal health checkups more than their less-educated, poor and rural counterparts⁴². Furthermore, a study utilizing Ugandan DHS data revealed that 35% of women did not receive immediate PNC service after they gave birth in health facilities⁴⁴. The odds of receiving immediate PNC were higher among women who gave birth in a private health facility⁴⁵. Conversely, a study conducted in Ethiopia revealed that giving birth at a health facility was negatively associated with immediate postnatal care utilization⁴⁶. This may be attributed to women discharging themselves early to avoid additional fees⁴⁷ or to factors such as poor quality of care, lack of support, verbal or physical abuse, and neglect by health care professionals during childbirth⁴⁸. Other potential factors include low implementation of immediate postnatal care guidelines by healthcare professionals⁴⁹ and insufficient healthcare professionals, leading to increased workload and job dissatisfaction⁵⁰.

We observed inequalities in the completion of maternal CoC, with urban residents more likely to complete it than rural residents. This finding aligns with findings from previous studies in Ethiopia^{29,51} and Ghana⁵². Our findings highlight regional inequalities in maternal CoC completion, with an absolute inequality of 22.28%. This finding is consistent with a study conducted in Ethiopia^{53,54} and Pakistan⁵⁵.

In the Tigray and SNNPR regions, disparities based on residence were more pronounced than those based on wealth in the completion of maternal CoC. On the contrary, in the Oromia and Amhara regions, wealth-based disparities were more pronounced than residence-based disparities. A study conducted in rural areas of Tigray further supports this finding, highlighting that the maldistribution of health facilities, long distances, lack of transportation, and inconvenient topography and weather conditions significantly hinder rural resident women from accessing recommended maternity services⁵⁶. Similarly, evidence from rural areas of SNNPR reinforces this finding. These studies indicate that women in these areas face multiple barriers, including limited awareness of maternal health services, cultural influences, and unsupportive social norms. In addition, unwelcoming attitudes from healthcare providers, geographic inaccessibility, and the widespread availability of TBAs who facilitate home deliveries further deter women from utilizing facility-based care^{57,58}. In the Oromia and Amhara regions, the active engagement of HEWs in rural areas may have contributed to narrowing residence-based disparities in maternal health service utilization. Consequently, wealth-related barriers appear to be a more prominent source of inequality in these regions^{59,60}. In contrast, a qualitative study conducted among HEWs and midwives in Tigray revealed that, despite the availability of HEWs, health posts, and partial ambulance services,

Variables		Crude OR (95% CI)	P-value	Model 1 ^a		Model 2 ^b		Model 3 ^c	
				AOR (95% CI)	P-value	AOR (95% CI)	P-value	AOR (95% CI)	P-value
Religion	Agrarian	Ref		Ref				Ref	
	Pastoralist	0.44 [0.26–0.74]	0.002	0.39 [0.23–0.63]	≤ 0.001			0.46 [0.28–0.77]	0.003
	City dweller	2.61 [1.86–3.67]	≤ 0.001	1.20 [0.83–1.74]	0.319			0.83 [0.58–1.19]	0.312
Residence	Urban	3.97 [2.95–5.34]	≤ 0.001	2.48 [2.48–4.95]	≤ 0.001			1.59 [1.09–2.33]	0.015
	Rural	Ref		Ref				Ref	
Marital status	Single	0.59 [0.16–2.11]	0.417			0.39 [0.11–1.41]	0.155	0.36 [0.10–1.29]	0.119
	Married	Ref				Ref		Ref	
	Widowed	1.32 [0.53–3.29]	0.547			0.35 [0.62–3.92]	0.347	1.56 [0.61–3.93]	0.345
	Divorced	1.19 [0.80–1.75]	0.382			0.43 [0.78–1.79]	0.434	1.12 [0.73–1.70]	0.593
Religion	Orthodox	1.57 [1.19–2.08]	0.001			1.30 [1.02–1.67]	0.034	1.14 [0.87–1.48]	0.343
	Muslim	Ref				Ref		Ref	
	Others*	0.91 [0.64–1.31]	0.638			0.85 [0.61–1.17]	0.328	0.71 [0.50–1.01]	0.060
Educational status	No education	Ref				Ref		Ref	
	Primary	1.55 [1.24–1.94]	0.000			1.24 [0.98–1.59]	0.073	1.22 [0.96–1.56]	0.103
	Secondary	2.71 [2.00–3.67]	0.000			1.70 [1.22–2.37]	0.002	1.67 [1.19–2.33]	0.003
	Higher	4.07 [2.84–5.85]	0.000			1.90 [1.33–2.93]	0.001	1.93 [1.30–2.87]	0.001
Wealth index	Poorest	0.18 [0.12–0.25]	≤ 0.001			0.39 [0.27–0.56]	≤ 0.001	0.58 [0.37–0.92]	0.022
	Poorer	0.28 [0.20–0.38]	≤ 0.001			0.56 [0.39–0.79]	0.001	0.72 [0.46–1.10]	0.132
	Middle	0.29 [0.21–0.40]	≤ 0.001			0.49 [0.35–0.69]	≤ 0.001	0.62 [0.40–0.96]	0.031
	Richer	0.38 [0.28–0.52]	≤ 0.001			0.58 [0.42–0.79]	0.001	0.71 [0.48–1.05]	0.086
	Richest	Ref				Ref		Ref	
Enrolled in CBHI	No	Ref				Ref		Ref	
	Yes	1.05 [0.85–1.28]	0.650			1.07 [0.87–1.31]	0.532	1.06 [0.86–1.30]	0.552
Parity	Primiparous	1.37 [1.09–1.71]	0.005			1.19 [0.95–1.51]	0.128	1.21 [0.95–1.53]	0.111
	Multiparous	Ref				Ref		Ref	
	Grand-multiparous	0.85 [0.67–1.08]	0.205			1.22 [0.94–1.58]	0.130	1.22 [0.94–1.58]	0.136
Age at first birth	< 18	0.76 [0.62–0.94]	0.011			0.96 [0.78–1.19]	0.752	0.97 [0.78–1.21]	0.803
	≥ 18	Ref				Ref		Ref	
ANC initiation	Early	2.59 [2.13–3.16]	≤ 0.001			1.95 [1.59–2.38]	≤ 0.001	1.97 [1.61–2.41]	≤ 0.001
	Late	Ref				Ref		Ref	
Informed on danger sign	No	0.41 [0.33–0.50]	≤ 0.001			0.53 [0.33–0.86]	0.010	0.54 [0.43–0.66]	≤ 0.001
	Yes	Ref				Ref		Ref	
BP measured	No	0.29 [0.18–0.46]	≤ 0.001			0.51 [0.32–0.83]	0.006	0.53 [0.32–0.85]	0.009
	Yes	Ref				Ref		Ref	
Blood sample taken	No	0.35 [0.25–0.49]	≤ 0.001			0.77 [0.52–1.14]	0.193	0.77 [0.52–1.14]	0.199
	Yes	Ref				Ref		Ref	
Urine sample taken	No	0.36 [0.27–0.49]	≤ 0.001			0.76 [0.50–0.91]	0.138	0.75 [0.52–1.07]	0.117
	Yes	Ref				Ref		Ref	

Table 4. Multilevel mixed-effect logistic regression analysis to determine factors associated with the completion of continuum of maternal health care among women in Ethiopia, 2019. Bold values indicate statistically significant results ($P < 0.05$); * Catholic and traditional religion followers.

the challenging geographical terrain continues to hinder access to maternal health services⁶¹. This implies a need for targeted interventions tailored to each region's specific challenges.

The positive concentration index for ANC 4+, institutional birth, and completion of maternal CoC confirm the existence of pro-rich distribution of these services. However, the negative concentration index for ANC < 4 and home birth indicate that incomplete ANC utilization and home births are disproportionately prevalent among poorer women. Moreover, we found that urban residents exhibited higher inequalities in home birth compared to rural residents, consistent with a study using Ghana DHS data that highlighted elevated odds of home births among urban residents in the poorest wealth quintile⁶². Interestingly, regardless of wealth status, rich women from rural areas opt for home birth, potentially blurring socioeconomic inequalities among rural residents. This assertion is supported by a case-control study in rural Ethiopia, where wealth status was not a determinant factor for home birth⁶³. The decision for home birth among rural women could be influenced by factors such as the opportunity for psychological support from family members, access to culturally acceptable food, the ability to adopt preferred birthing positions, and culturally accepted placenta disposal methods^{64–66}.

The regression analysis further revealed lower odds of completing maternal CoC among women from the poorest or middle-wealth quintile compared to the richest wealth quintile. This finding corroborated with studies in India⁶⁷, Cambodia⁶⁸, and Sierra Leone⁶⁹. This suggests that economically disadvantaged women face barriers such as direct⁷⁰, indirect⁷¹, or opportunistic⁷² costs associated with maternal healthcare services. A recent systematic review and meta-analysis conducted in Ethiopia supports this finding, showing that the poorest households bear the highest burden of out-of-pocket health expenditures⁷³.

These findings confirmed that the current maternal health services disproportionately benefit affluent women, highlighting the need to address socioeconomic disparities. Empowering women economically and giving them control over their income may enhance the completion rate of maternal CoC more than disadvantaged women, and implies that improving the economic status of women and enabling them to control over their income may increase the completion rate of maternal CoC, ensuring equitable access to essential services. However, a study conducted in Ethiopia using the 2016 DHS data found no significant association between wealth status and completion of Maternal CoC⁵⁴. This result may stem from the study's inclusion criteria, which focused on women who received at least four ANC visits. In contrast, evidence suggests that poorer women often do not attain this level of care⁷⁴.

The socioeconomic disparities in PNC utilization among urban residents were statistically insignificant, suggesting that women's knowledge about PNC services may be an important predictor of service utilization among urban residents⁷⁵. Additionally, sociocultural and religious beliefs may limit access to PNC services. In some communities, women and their newborns are expected to remain indoors for a specific period after birth, often until the baptism ceremony⁷⁶. Furthermore, some mothers are reluctant to allow HEWs to see their babies, particularly if the babies appear chubby, due to fear of the evil eye⁷⁷. Except for home birth and ANC 4+, there is a slight to huge inequity among rural residents for the components of the continuum of maternal services.

There is inequality in the completion of maternal CoC among women who attended formal education and had no formal education and among women with different levels of educational achievement. Furthermore, the regression analysis revealed completion of maternal CoC was positively influenced by attending secondary and higher education. This finding is consistent with studies conducted in India⁶⁷ and sub-Saharan Africa^{51,78}. The possible reason could be education increases women's cognitive skills, economic resources, and autonomy⁷⁹. Being educated provides the power to exercise autonomy in decision-making over their reproductive health rights⁸⁰. It also increases health literacy, the ability to appraise health information⁸¹, and health-seeking behaviors⁸². Women who attended no formal education had low access to health information⁸³. Moreover, less educated women had less geographical access to health services and needed to travel long distances to reach the nearest health facility⁸⁴. However, a study conducted in Ghana shows no significant association between the educational status of women and completion of maternal CoC⁵². This may be due to Ghana's strengthened community-based health services, enhancing maternal health service utilization regardless of educational background⁸⁵.

Belonging to pastoral region negatively influenced the completion of maternal continuum of care. Living in pastoral regions hinders maternal care completion due to factors like physical inaccessibility, lack of awareness about maternal healthcare services, economic constraints, insufficient infrastructure, socio-cultural norms, and women's restricted autonomy⁸⁶. In some areas, a nomadic lifestyle further disrupts continuity of maternal service by reducing access to fixed health facilities⁸⁷. This finding implies that policies should address sociocultural beliefs, improve accessibility and quality of maternal services in pastoral regions to retain women in the dimension of maternal CoC. Staffing more female health care providers⁸⁸, working with community elders and religious leaders⁸⁹, establishing well-integrated mobile health services⁹⁰, improving infrastructures, and empowering women⁸⁶ in these regions might be important.

Completion of maternal continuum of care was positively influenced by urban residence. The finding is consistent with studies conducted in Cambodia⁶⁸, and sub-Saharan Africa^{51,52}. The possible explanation for this could be health facilities in Ethiopia are concentrated in urban areas⁹¹. A study conducted in five regions (Amhara, Oromia, Tigray, SNNP, and Harari) and two administrative cities (Addis Ababa and Dire Dawa) of a total of 46 towns reported that the average time (SD) to reach the nearby health facility is 18 ($\pm$ 11) minutes⁹². However, studies done in rural areas revealed that women need to walk 60 to 70 km⁹³, and travel more than two hours to receive services⁹⁴. Furthermore, there is no transportation in some district areas^{71,93,94}. The urban-based health facilities had three times greater access to ambulances onsite than rural-based health facilities⁹⁵. This finding implies that actions to reduce barriers to accessing maternal health services in rural and marginalized areas could potentially improve the completion rate of maternal CoC. However, these findings contrast with studies that show the predominant role of Health Extension Workers (HEWs) in increasing access to and coverage of maternal health services for rural women^{96,97}. Additionally, a study done in Sierra Leone using DHS 2019 data shows no association between residence and completion of maternal CoC⁶⁹. The possible reason could be that evidence shows the Free Healthcare Initiative significantly enhanced maternal and child service coverage and equity in Sierra Leone⁹⁸.

Completion of maternal continuum of care was positively influenced by early ANC initiation time. The finding is consistent with a study conducted in sub-Saharan Africa^{51,69,78}. Early ANC bookings by women lead to longer interactions with healthcare providers to discuss the necessity of maternal and child healthcare services so that they could be informed about danger signs in pregnancy, have a well-defined birth plan, and better birth preparedness, including knowledge of delivery dates, signs of labor, and postpartum care⁹⁹. Our study also revealed that women who were not informed about obstetrics danger signs had lower odds of receiving complete care. The finding is in line with other studies conducted in the country^{29,54}. This could be due to being knowledgeable on the pregnancy danger signs associated with proper birth preparedness, and complication readiness¹⁰⁰. Moreover, birth preparedness, complication readiness and planned pregnancy are strong determinants of CoC^{27,101}. This finding suggests that enabling pregnant women to initiate ANC early and providing quality service along with proper counseling at each visit would promote timely use of complete

maternal and child health services. However, a study conducted in West Shoa zone Ethiopia found no significant association between being informed on danger and the completion of maternal CoC²⁸. A possible explanation for this discrepancy could be the quality of counseling on pregnancy danger signs influenced by the educational level of healthcare workers and the length of their pre-service training¹⁰².

Completion of maternal continuum of care was negatively influenced by blood pressure not being measured. This finding is in line with a study conducted in Egypt¹⁰³ and Ethiopia⁵⁴. This might be due to measuring blood pressure during pregnancy serves as a key component proxy indicator of the quality of ANC services^{104,105}. Good quality ANC service increases client satisfaction¹⁰⁶. Satisfaction with ANC services motivates pregnant women to seek and continue to use the services¹⁰⁷. This implies that providing appropriate and quality ANC services during pregnancy might be important to retain women in the successive maternal continuum of care.

In general, this study has important clinical and public health implications for reducing maternal and neonatal mortality and morbidity from preventable causes. By identifying significant gaps and inequalities in the completion of maternal CoC, the study underscores the need for targeted strategies that address socioeconomic, geographic, and educational barriers. Improving completion of maternal CoC enhances service utilization throughout pregnancy, childbirth, and the postpartum period, strengthens early detection and management of complications, and ultimately contributes to reducing maternal deaths. Addressing these disparities is essential to ensure equitable access to maternal health services for disadvantaged populations, thereby accelerating progress toward Sustainable Development Goal 3, specifically targets 3.1, 3.2, and 3.8.

Strengths and limitations of the study

The strengths of this study lie in its utilization of the most recent population-based data from the mini-Ethiopia Demographic Health Survey, featuring a relatively large sample size, a high response rate, and high-quality data. The study employed both simple and complex inequality analysis methods, providing a clear understanding of the levels of inequality in the completion of maternal CoC.

However, the study has several limitations. First, as a population-based cross-sectional survey, it was unable to establish causal relationships between the completion of the continuum of care and its predictors. Second, reliance on self-reported data may introduce recall and socially desirable biases. This could lead to inaccuracies in the reported completion rates. Third, due to small cell sizes in some regions, we conducted simple inequality analyses and concentration curves for only four regions. As a result, our findings related to inequalities may not accurately represent conditions across all regions, which could affect the study's external validity. Finally, due to missing data on postnatal care frequency and timing after birth, the study relied on just one pre- and post-discharge postnatal care visit to construct the continuum of care variable, despite WHO recommendations for a minimum of four postnatal visits. This limitation may compromise the assessment of care quality and continuity.

Conclusion

Completion of the maternal continuum of care was low in Ethiopia. There was a significant inequality in the completion of maternal CoC across wealth status, place of residence, and educational status. Region, residence, educational status, wealth index, ANC initiation, informed on danger signs, and blood pressure measured have statistically significant associations with the completion of the continuum of maternal health care. We recommend policymakers and program planners prioritize effective, inclusive policies and programs tailored to rural women, those with lower education, and economically disadvantaged groups. Healthcare professionals should provide counseling on pregnancy danger signs and ensure high-quality ANC services, including regular blood pressure monitoring. Moreover, culturally sensitive care within health facilities is essential to increase rural births, beyond addressing financial barriers.

Data availability

This study used the 2019 mini-EDHS data, which used a population-based cross-sectional design. This study used the 2019 mini-EDHS dataset, collected through a population-based cross-sectional design. Data access is open for research, with permissions waived for approved studies, obtainable through DHS Program registration (<https://dhsprogram.com/Data/>). We accessed the official DHS Program permission letter, confirming authorized data use and adherence to ethical guidelines. We accessed the data on 11/10/2022.

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References

- Long, D. *SDG 3: Ensure Healthy Lives and Promote Well-Being for All At All Ages*. (2022).
- WHO. *Health Inequality Monitor*, <https://www.who.int/data/inequality-monitor/about>.
- WHO. *Handbook on Health Inequality Monitoring: With a Special Focus on Low-and Middle-Income Countries* (World Health Organization, 2013).
- FMOH. (Federal Ministry of Health (FMOH) Addis Ababa, Ethiopia, 2016).
- Bayked, E. M., Toleha, H. N., Kebede, S. Z., Workneh, B. D. & Kahissay, M. H. The impact of community-based health insurance on universal health coverage in Ethiopia: A systematic review and meta-analysis. *Glob. Health Action*. **16**, 2189764 (2023).
- Assefa, Y. et al. Primary health care contributions to universal health coverage, Ethiopia. *Bull. World Health Organ.* **98**, 894 (2020).
- Bobo, F. T., Yesuf, E. A. & Woldie, M. Inequities in utilization of reproductive and maternal health services in Ethiopia. *Int. J. Equity Health*. **16**, 1–8 (2017).
- Mezmur, M., Navaneetham, K., Letamo, G. & Bariagaber, H. Socioeconomic inequalities in the uptake of maternal healthcare services in Ethiopia. *BMC Health Serv. Res.* **17**, 1–11 (2017).
- Gebre, E., Worku, A. & Bukola, F. Inequities in maternal health services utilization in Ethiopia 2000–2016: Magnitude, trends, and determinants. *Reprod. Health*. **15**, 119. <https://doi.org/10.1186/s12978-018-0556-x> (2018).

10. Pate, E., Collado, C. & Solis, J. A. Health equity and maternal mortality. In *Pan American Health Organization. Equity and Health: Views from the Pan American Sanitary Bureau*, 85–98 (2001).
11. WHO & UNICEF. *Reduction of Maternal Mortality: A Joint WHO/UNFPA/UNICEF/World Bank Statement* (1999).
12. WHO. *Trends in Maternal Mortality 2000 to 2017: Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division*. (2019).
13. Roos, N. & von Xylander, S. R. Why do maternal and newborn deaths continue to occur?. *Best Pract. Res. Clin. Obstet. Gynaecol.* **36**, 30–44 (2016).
14. WHO. *Trends in Maternal Mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division: Executive Summary*. (2023).
15. Tesfay, N., Tariku, R., Zenebe, A., Habtetsion, M. & Woldeyohannes, F. Place of death and associated factors among reviewed maternal deaths in Ethiopia: A generalised structural equation modelling. *BMJ Open* **13**, e060933. <https://doi.org/10.1136/bmjopen-2022-060933> (2023).
16. WHO. *Strategies Towards Ending Preventable Maternal Mortality (EPMM)*. (2015).
17. Camara, B. S. et al. Women's progression through the maternal continuum of care in Guinea: Evidence from the 2018 Guinean Demographic and Health Survey. *Tropical Med. Int. Health* **26**, 1446–1461 (2021).
18. Kerber, K. J. et al. Continuum of care for maternal, newborn, and child health: From slogan to service delivery. *The Lancet* **370**, 1358–1369 (2007).
19. WHO. *WHO Recommendations on Maternal Health: Guidelines Approved by the WHO Guidelines Review Committee*. (World Health Organization, 2017).
20. Asefa, A. et al. Wealth-based inequality in the continuum of maternal health service utilisation in 16 sub-Saharan African countries. *Int. J. Equity Health* **22**, 203 (2023).
21. Rahman, M. H. et al. *Level and Wealth Inequity in Continuum of Maternal Healthcare Services Among Bangladeshi Women of Reproductive Age: Evidence From Bangladesh Multiple Indicator Cluster Survey 2012–13 and 2019*. (2022).
22. Parvin, N. et al. Socioeconomic inequalities in the continuum of care across women's reproductive life cycle in Bangladesh. *Sci. Rep.* **12**, 1–11 (2022).
23. Abagero, B., Teshome, M. S. & Abate, K. H. Magnitude and predictors of antenatal care (ANC) completion among mothers attending delivery and post-natal service in Jimma town, Oromia Region, South West Ethiopia. *J. Public Health Epidemiol.* **9**, 251–259 (2017).
24. Habte, F. & Demissie, M. Magnitude and factors associated with institutional delivery service utilization among childbearing mothers in Cheha district, Gurage zone, SNNPR, Ethiopia: A community based cross sectional study. *BMC Pregnancy Childbirth* **15**, 1–12 (2015).
25. Wudineh, K. G., Nigusie, A. A., Gesese, S. S., Tesu, A. A. & Beyene, F. Y. Postnatal care service utilization and associated factors among women who gave birth in Debretabour town, North West Ethiopia: A community-based cross-sectional study. *BMC Pregnancy Childbirth* **18**, 1–9 (2018).
26. Shitie, A., Assefa, N., Dhressa, M. & Dilnessa, T. Completion and factors associated with maternity continuum of care among mothers who gave birth in the last one year in Enemay District, Northwest Ethiopia. *J. Pregnancy* **2020**, 7019676. <https://doi.org/10.1155/2020/7019676> (2020).
27. Tizazu, M. A. et al. Completing the continuum of maternity care and associated factors in Debre Berhan town, Amhara, Ethiopia, 2020. *J. Multidiscip. Healthc.* <https://doi.org/10.2147/JMDH.S293323> (2021).
28. Buli, T. D. et al. Completion of the continuum of maternity care and associated factors among women who gave birth in the last 6 months in Chelia district, West Shoa zone, Ethiopia: A community-based cross-sectional study. *Front Public Health* **10**, 1026236. <https://doi.org/10.3389/fpubh.2022.1026236> (2022).
29. Abebe, G. F., Belachew, D. Z., Girma, D., Aydiko, A. & Negesse, Y. Multilevel analysis of the predictors of completion of the continuum of maternity care in Ethiopia; using the recent 2019 Ethiopia mini demographic and health survey. *BMC Pregnancy Childbirth* **22**, 1–13 (2022).
30. Boltana, M. T. et al. *Predictors of Dropout From Maternal Continuum of Care in Ethiopia: Evidence From the 2016 Population-Based Health Survey*. (2020).
31. Muluneh, A. G., Kassa, G. M., Alemayehu, G. A. & Merid, M. W. High dropout rate from maternity continuum of care after antenatal care booking and its associated factors among reproductive age women in Ethiopia, evidence from Demographic and Health Survey 2016. *PLoS ONE* **15**, e0234741 (2020).
32. Daka, D. W. et al. Inequities in the uptake of reproductive and maternal health services in the biggest regional state of Ethiopia: Too far from “Leaving no one behind”. *ClinicoEconomics Outcomes Res. CEOR* **12**, 595 (2020).
33. Geda, N. R. et al. Inequalities in adherence to the continuum of maternal and child health service utilization in Ethiopia: Multilevel analysis. *J. Health Popul. Nutr.* **40**, 45. <https://doi.org/10.1186/s41043-021-00271-w> (2021).
34. EPHI, I. *Ethiopia Mini Demographic and Health Survey 2019: Key Indicators* (EPHI and ICF, 2019).
35. Tekelab, T., Chojenta, C., Smith, R. & Loxton, D. Factors affecting utilization of antenatal care in Ethiopia: A systematic review and meta-analysis. *PLoS ONE* **14**, e0214848 (2019).
36. Belachew, A. B., Kahsay, A. B. & Abebe, Y. G. Individual and community-level factors associated with introduction of prelacteal feeding in Ethiopia. *Arch. Public Health* **74**, 1–11 (2016).
37. Sahiledengle, B. et al. A multilevel analysis of factors associated with childhood diarrhea in Ethiopia. *Environ. Health Insights* **15**, 11786302211009894 (2021).
38. Sisay, B. G. et al. Dietary diversity and its determinants among children aged 6–23 months in Ethiopia: Evidence from the 2016 Demographic and Health Survey. *J. Nutr. Sci.* **11**, e88 (2022).
39. Alem, A. Z. et al. Timely initiation of antenatal care and its associated factors among pregnant women in sub-Saharan Africa: A multicountry analysis of Demographic and Health Surveys. *PLoS ONE* **17**, e0262411 (2022).
40. Wagstaff, A., O'Donnell, O., Van Doorslaer, E. & Lindelow, M. *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation*. (World Bank Publications, 2007).
41. WHO. *WHO Recommendations on Postnatal Care of the Mother and Newborn*. (World Health Organization, 2014).
42. Benova, L. et al. Provision of postpartum care to women giving birth in health facilities in sub-Saharan Africa: A cross-sectional study using Demographic and Health Survey data from 33 countries. *PLoS Med.* **16**, e1002943 (2019).
43. United States Agency for International Development (USAID), M., MCHIP. *A Pre-Discharge Checklist for Improving Facility-Based Postnatal Care for Mothers and Newborns*, <https://www.mhft.org/2017/06/15/a-pre-discharge-checklist-for-improving-facility-based-postnatal-care-for-mothers-and-newborns/> (June 15, 2017).
44. Dey, T., Ononge, S., Weeks, A. & Benova, L. Immediate postnatal care following childbirth in Ugandan health facilities: An analysis of Demographic and Health Surveys between 2001 and 2016. *BMJ Glob. Health* **6**, e004230 (2021).
45. Quayle, T. *Factors Associated with Immediate Postnatal Care in Lao People's Democratic Republic: An Analysis of the 2017 Lao People's Democratic Republic Multiple Indicator Cluster Survey* (University of Nevada, 2022).
46. Hussien, A. M. et al. Trends and factors associated with immediate postnatal care utilisation in Ethiopia: Analysis of the demographic and health surveys, 2011–2019. *J. Glob. Health Rep.* **7**, e2023022 (2023).
47. Ntambue, A. M. et al. Commercialization of obstetric and neonatal care in the Democratic Republic of the Congo: A study of the variability in user fees in Lubumbashi, 2014. *PLoS ONE* **13**, e0205082 (2018).

48. Sheferaw, E. D., Kim, Y.-M., Van Den Akker, T. & Stekelenburg, J. Mistreatment of women in public health facilities of Ethiopia. *Reprod. Health* **16**, 1–10 (2019).
49. Bune, A. G., Girmaye, E., Lemma, D. & Bekele, G. G. Immediate postnatal care guidelines implementation and associated factors among healthcare providers in East Shewa Zone public health facilities, Oromia, Ethiopia, 2022: A multicentre cross-sectional study. *BMJ Open* **13**, e077434 (2023).
50. Gerein, N., Green, A. & Pearson, S. The implications of shortages of health professionals for maternal health in Sub-Saharan Africa. *Reprod. Health Matters* **14**, 40–50 (2006).
51. Alem, A. Z., Shitu, K. & Alamneh, T. S. Coverage and factors associated with completion of continuum of care for maternal health in Sub-Saharan Africa: A multicountry analysis. *BMC Pregnancy Childbirth* **22**, 422. <https://doi.org/10.1186/s12884-022-04757-1> (2022).
52. Enos, J. Y., Amoako, R. D. & Doku, I. K. Utilization, predictors and gaps in the continuum of care for maternal and newborn health in Ghana. *Int. J. MCH AIDS* **10**, 98–108. <https://doi.org/10.21106/ijma.425> (2021).
53. Melaku, M. S. et al. Geographical variation and predictors of zero utilization for a standard maternal continuum of care among women in Ethiopia: A spatial and geographically weighted regression analysis. *BMC Pregnancy Childbirth* **22**, 1–18 (2022).
54. Chaka, E. E., Parsaeian, M. & Majdzadeh, R. Factors associated with the completion of the continuum of care for maternal, Newborn, and child health services in Ethiopia. Multilevel model analysis. *Int. J. Prevent. Med.* **10**, 136 (2019).
55. Iqbal, S., Maqsood, S., Zakar, R., Zakar, M. Z. & Fischer, F. Continuum of care in maternal, newborn and child health in Pakistan: Analysis of trends and determinants from 2006 to 2012. *BMC Health Serv. Res.* **17**, 1–15 (2017).
56. Mesele, H. Perceived physical barriers to maternal health seeking behavior among rural women: The case of Raya-Alamata district. *Southern Tigray Ethiop.* **3**, 47–52 (2018).
57. Yesera, G., Mekuria, M. & Degaga, N. Barriers to use maternity care service in rural areas among mothers who give birth. In *Arba Minch Surrounding District, Gamo Gofa Zone, South Eastern Ethiopia*, vol. 2 (2017).
58. Yoseph, A., Teklesilasie, W., Guillen-Grima, F. & Astatkie, A. Perceptions, barriers, and facilitators of maternal health service utilization in southern Ethiopia: A qualitative exploration of community members' and health care providers' views. *PLoS ONE* **19**, e0312484 (2024).
59. UNICEF. *Health Expenditure Analysis for Oromia Regional State*, https://www.unicef.org/ethiopia/media/10561/file/2_Oromia_Regional%20health%20expenditure%20analysis.pdf.pdf (2012/13–2020/21).
60. UNICEF. *Health Expenditure Analysis for Amhara National Regional State* https://www.unicef.org/ethiopia/media/10546/file/10_Amhara_Regional%20health%20expenditure%20analysis.pdf.pdf (2012/13–2020/21).
61. Gebrehiwot, T., San Sebastian, M., Edin, K. & Goicolea, I. Health workers' perceptions of facilitators of and barriers to institutional delivery in Tigray, Northern Ethiopia. *BMC Pregnancy Childbirth* **14**, 1–10 (2014).
62. Ahinkorah, B. O. et al. What influences home delivery among women who live in urban areas? Analysis of 2014 Ghana Demographic and Health Survey data. *PLoS ONE* **16**, e0244811 (2021).
63. Wondimu, M. S. & Woldeamayrat, E. M. Determinants of home delivery among women in rural pastoralist community of Hamar District, Southern Ethiopia: A case-control study. *Risk Management and Healthcare Policy*, 2159–2167 (2020).
64. Adatara, P., Strumpher, J., Ricks, E. & Mwini-Nyaledzigbor, P. P. Cultural beliefs and practices of women influencing home births in rural Northern Ghana. *Int. J. Womens Health*. <https://doi.org/10.2147/ijwh.s190402> (2019).
65. Roro, M. A., Hassen, E. M., Lemma, A. M., Gebreyesus, S. H. & Afework, M. F. Why do women not deliver in health facilities: A qualitative study of the community perspectives in south central Ethiopia? *BMC Res. Notes* **7**, 1–7 (2014).
66. Ababor, S. et al. Socio-cultural beliefs and practices influencing institutional delivery service utilization in three communities of Ethiopia: A qualitative study. *Ethiop. J. Health Sci.* **29**, 343 (2019).
67. Kothavale, A. & Meher, T. Level of completion along continuum of care for maternal, newborn and child health services and factors associated with it among women in India: A population-based cross-sectional study. *BMC Pregnancy Childbirth* **21**, 1–12 (2021).
68. Chham, S., Radovich, E., Buffel, V., Ir, P. & Wouters, E. Determinants of the continuum of maternal health care in Cambodia: An analysis of the Cambodia demographic health survey 2014. *BMC Pregnancy Childbirth* **21**, 410. <https://doi.org/10.1186/s12884-021-03890-7> (2021).
69. Sserwanja, Q. et al. Continuum of maternal and newborn health in Sierra Leone: A 2019 national survey. *Arch. Public Health* **80**, 186. <https://doi.org/10.1186/s13690-022-00946-8> (2022).
70. Wilunda, C. et al. Barriers to institutional childbirth in Rumbek North County, South Sudan: A qualitative study. *PLoS ONE* **11**, e0168083 (2016).
71. Kitila, S. B., Feyissa, G. T. & Wordofa, M. A. Why do women walk away from maternal health services in Southwest Ethiopia? A qualitative study of caregivers' and clients' perspectives. *BMC Women's Health* **23**(1), 83 (2022).
72. Chimatiro, C. S., Hajison, P., Chipeta, E. & Muula, A. S. Understanding barriers preventing pregnant women from starting antenatal clinic in the first trimester of pregnancy in Ntcheu District-Malawi. *Reprod. Health* **15**, 1–7 (2018).
73. Borde, M. T., Kabthymmer, R. H., Shaka, M. F. & Abate, S. M. The burden of household out-of-pocket healthcare expenditures in Ethiopia: A systematic review and meta-analysis. *Int. J. Equity Health* **21**, 14. <https://doi.org/10.1186/s12939-021-01610-3> (2022).
74. Arefaynie, M. et al. Number of antenatal care utilization and associated factors among pregnant women in Ethiopia: Zero-inflated Poisson regression of 2019 intermediate Ethiopian Demography Health Survey. *Reprod. Health* **19**, 36 (2022).
75. Angore, B. N., Tufa, E. G. & Bisetegen, F. S. Determinants of postnatal care utilization in urban community among women in Debre Birhan Town, Northern Shewa, Ethiopia. *J. Health Popul. Nutr.* **37**, 1–9 (2018).
76. Girma Tareke, K., Feyissa, G. T. & Kebede, Y. Exploration of barriers to postnatal care service utilization in Debre Libanos District, Ethiopia: A descriptive qualitative study. *Front. Glob. Womens. Health* **3**, 986662. <https://doi.org/10.3389/fgwh.2022.986662> (2022).
77. Amsalu, G., Talie, A., Gezimu, W. & Duguma, A. Non-utilization of postnatal care and its associated factors among women who gave birth in rural districts of Northern Ethiopia: A community-based mixed-method study. *Womens Health (Lond)* **18**, 17455057221125092. <https://doi.org/10.1177/17455057221125091> (2022).
78. Sserwanja, Q., Musaba, M. W., Mutisya, L. M., Olal, E. & Mukunya, D. Continuum of maternity care in Zambia: A national representative survey. *BMC Pregnancy Childbirth* **21**, 1–10 (2021).
79. Weitzman, A. The effects of women's education on maternal health: Evidence from Peru. *Soc. Sci. Med.* **180**, 1–9. <https://doi.org/10.1016/j.socscimed.2017.03.004> (2017).
80. Olani, A., Yadessa, T. & Yadessa, F. Woman's autonomy on maternal health service utilization and associated factors in Ambo town, West Showa zone, Ethiopia. *Mortality* **4**, 77–81 (2019).
81. Jansen, T. et al. The role of health literacy in explaining the association between educational attainment and the use of out-of-hours primary care services in chronically ill people: A survey study. *BMC. Health Serv. Res.* **18**, 394. <https://doi.org/10.1186/s12913-018-3197-4> (2018).
82. Latunji, O. & Akinyemi, O. Factors influencing health-seeking behaviour among civil servants in Ibadan, Nigeria. *Ann. Ibadan Postgrad. Med.* **16**, 52–60 (2018).
83. Matovelo, D. et al. Why don't illiterate women in rural, Northern Tanzania, access maternal healthcare?. *BMC. Pregnancy Childbirth* **21**, 1–11 (2021).
84. Dotse-Gborgbortsi, W. et al. Distance is “a big problem”: A geographic analysis of reported and modelled proximity to maternal health services in Ghana. *BMC. Pregnancy Childbirth* **22**, 1–12 (2022).

85. Sakeah, E. et al. Impact of community health interventions on maternal and child health indicators in the Upper East region of Ghana. *BMC. Pregnancy Childbirth* **23**, 298. <https://doi.org/10.1186/s12884-023-05577-7> (2023).
86. Jebena, M. G. et al. Barriers and facilitators of maternal health care services use among pastoralist women in Ethiopia: Systems thinking perspective. *Pastoralism* **12**, 1–17 (2022).
87. Ibrahim, M. A., Demissie, M., Medhanyie, A. A., Worku, A. & Berhane, Y. Reasons for low level of skilled birth attendance in Afar pastoralist community, North East Ethiopia: A qualitative exploration. *Pan Afr. Med. J.* **30**, 51 (2018).
88. Ahmed, M., Demissie, M., Worku, A., Abirha, A. & Berhane, Y. Socio-cultural factors favoring home delivery in Afar pastoralist community, northeast Ethiopia: A qualitative study. *Reprod. Health* **16**, 1–9 (2019).
89. El Shiekh, B. & van der Kwaak, A. Factors influencing the utilization of maternal health care services by nomads in Sudan. *Pastoralism* **5**, 23 (2015).
90. Eba, K. et al. Mobile health service as an alternative modality for hard-to-reach pastoralist communities of Afar and Somali regions in Ethiopia. *Pastoralism* **13**, 17 (2023).
91. Hendrix, N. et al. Estimated travel time and staffing constraints to accessing the Ethiopian health care system: A two-step floating catchment area analysis. *J. Glob. Health.* <https://doi.org/10.7189/jogh.13.04008> (2023).
92. Getachew, S., Kaba, M., Gizaw, M. & Taye, G. Health service access, utilization and prevailing health problems in the urban vulnerable sections of Ethiopia. *Ethiop. J. Health Dev.* **34**, 12–23 (2020).
93. Medhanyie, A. A. et al. Barriers to the uptake of reproductive, maternal and neonatal health services among women from the pastoralist communities of Afar, Ethiopia: A qualitative exploration. *Ethiop. J. Health Dev.* **32** (2018).
94. Shallo, S. A., Daba, D. B. & Abubekkar, A. Demand–supply-side barriers affecting maternal health service utilization among rural women of West Shoa Zone, Oromia, Ethiopia: A qualitative study. *PLoS ONE* **17**, e0274018 (2022).
95. Defar, A. et al. Low ambulance availability at health facilities and disparity across regions in Ethiopia: A cross-sectional health facility level assessment. (2019).
96. Medhanyie, A. et al. The role of health extension workers in improving utilization of maternal health services in rural areas in Ethiopia: A cross sectional study. *BMC Health Serv. Res.* **12**, 1–9 (2012).
97. Karim, A. M. et al. Effect of Ethiopia's health extension program on maternal and newborn health care practices in 101 rural districts: A dose-response study. *PLoS ONE* **8**, e65160 (2013).
98. Witter, S. et al. The free healthcare initiative in Sierra Leone: Evaluating a health system reform, 2010–2015. *Int. J. Health Plann. Manage.* **33**, 434–448 (2018).
99. Atisa, F. O. *Influence of Early Booking for Antenatal Care on Antenatal and Early Pregnancy Outcomes at Kenyatta National Hospital.* (University of Nairobi, 2015).
100. Andarge, E., Nigussie, A. & Wondafrash, M. Factors associated with birth preparedness and complication readiness in Southern Ethiopia: A community based cross-sectional study. *BMC Pregnancy Childbirth* **17**, 1–13 (2017).
101. Haile, D. et al. Level of completion along continuum of care for maternal and newborn health services and factors associated with it among women in Arba Minch Zuria woreda, Gamo zone, Southern Ethiopia: A community based cross-sectional study. *PLoS ONE* **15**, e0221670 (2020).
102. Duysburgh, E. et al. Counselling on and women's awareness of pregnancy danger signs in selected rural health facilities in Burkina Faso, Ghana and Tanzania. *Trop. Med. Int. Health* **18**, 1498–1509 (2013).
103. Hamed, A., Mohamed, E. & Sabry, M. Egyptian status of continuum of care for maternal, newborn, and child health: Sohag Governorate as an example. *Int. J. Med. Sci. Public Health* **7**, 1 (2018).
104. Raru, T. B. et al. Quality of antenatal care and associated factors among pregnant women in East Africa using Demographic and Health Surveys: A multilevel analysis. *Womens Health* **18**, 17455065221076732 (2022).
105. Arsenault, C. et al. Equity in antenatal care quality: An analysis of 91 national household surveys. *Lancet Glob. Health* **6**, e1186–e1195 (2018).
106. Onyeajam, D. J., Xirasagar, S., Khan, M. M., Hardin, J. W. & Odutolu, O. Antenatal care satisfaction in a developing country: A cross-sectional study from Nigeria. *BMC Public Health* **18**, 1–9 (2018).
107. Falah, M. A. Females' satisfaction and perception about prenatal care services at primary health care centres. *Int. J. Sci. Res.* **5**, 620–627 (2015). The figure caption is currently above the figure. Please move the caption below the figure

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Declarations

Competing interests

The authors declare no competing interests.

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