

An Assessment of the Impact and Utilisation Pattern of Maternal Healthcare Services among Rural Women in Sub-Saharan African Countries

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Abstract:

The paper evaluates the utilisation and impacts of maternal healthcare, including antenatal care (ANC), skilled birth attendance (SBA), and postnatal care (PNC), among women in rural areas of Sub-Saharan Africa (SSA). A multilevel mixed-effects logistic regression using repeated cross-sectional data is used to analyse individual, household and contextual factors affecting the use of maternal health care services. The findings show that the utilisation of ANC, SBA and PNC increased significantly and steadily throughout the Paper period, with the maximum likelihood in 2025 compared to 2015. Nevertheless, there are significant disparities between different socioeconomic and demographic groups. Overall, women who are more educated, have a higher wealth status, have health insurance coverage and exhibit higher exposure to mass media have greater service utilisation, whereas rural residence, higher parity and lower education have the opposite effect. The Paper finds that overall maternal healthcare services have improved in SSA, but inequalities remain, hindering equitable access to maternal health services, and increases in the capacity of rural health systems, combined with targeted policy interventions, are needed to improve maternal health in those areas.

Keywords: Maternal Healthcare Utilization, Antenatal Care (ANC), Skilled Birth Attendance (SBA), Postnatal Care (PNC), Sub-Saharan Africa (SSA), Rural Women.

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1. INTRODUCTION

Despite the efforts of the maternal health sector, maternal health access in Sub-Saharan Africa (SSA) is still a public health issue, and it is still challenging for most rural women to access the essential health services they need during pregnancy and childbirth. Worldwide, the objective of maternal mortality reduction is a key part of the Sustainable Development Goals (SDGs) 2015 to 2030, particularly Goal 3, which aims to ensure healthy lives and promote well-being at all ages. Maternal mortality reduction is a key focus in the SDGs (2015-2030), particularly Goal 3: “Ensure healthy lives and promote well-being at all ages”. In particular, SDG target 3.1 set the global maternal mortality rate to be less than 70 per one lakh live births. Although international agreements and policy measures have been adopted, SSA remains the region with the highest share of maternal mortality in the world, and the burden on rural communities is disproportionately high, where the inequalities in health services are still evident. While the commitments and policy initiatives at the international level have been made, SSA still has the highest proportion of maternal deaths in the world, and rural communities bear the greatest burden, with persistent inequalities in health services (World Health Organisation, 2023).

Maternal health services like antenatal care (ANC), skilled birth attendance (SBA), and postnatal care (PNC) are known to reduce the risk of maternal complications and enhance maternal mortality outcomes (Bain et al., 2022). Good antenatal care helps detect and treat problems early, and skilled attendance during childbirth plays a significant role in minimising risks related to childbirth emergencies (Mekbib et al., 2020). Likewise, postnatal care is important to check for the mother's recovery and any possible complications during the first 6 weeks after birth (Bawuah et al., 2026). New guidelines from the WHO (2022) and Bain et al (2022) recommend that there be at least 8 antenatal contacts and continuous postnatal assessment to ensure good maternal outcomes and neonatal health.

It is known that maternal health care is a critical component of social welfare, and in SSA, coverage among rural women is still low, even if the use of maternal health services has improved. Despite improving maternal health service coverage, the use of maternal health services among rural women is still low, and this is known to be a critical component of social welfare. The rural residents are paralysed by several factors, such as poverty, poor health facility infrastructure, long distance to health facilities, transportation issues, lack of skilled health personnel and socio-cultural beliefs opposing institutional health services utilisation (Samuel et al., 2021; Tanou and Kamiya, 2019). Research in multiple SSA nations has revealed that the utilisation of skilled maternal health services differs between urban and rural women, with rural women being at a lower risk (Simona et al., 2022; Ahinkorah et al., 2022). However, in Nigeria, Ethiopia, Sierra Leone and other developing nations, there is a marked inequality in maternal health care

consumption, influenced by low educational levels, low household status and limited health services in rural areas (Ogbo et al., 2020; Mekonnen et al., 2019).

A range of measures has been put in place in the SSA to increase maternal health service uptake by vulnerable groups in all countries. The policy measures taken encompass free maternal healthcare schemes, primary healthcare centres expansion, community-based health insurance schemes, and maternal health awareness campaigns (Gurara et al., 2023). Rwanda and Ghana, for instance, have made significant strides in raising skilled delivery rates and coverage of antenatal care with healthcare financing reforms and improved community health systems (Adawudu et al., 2024; Chol et al., 2019). However, there are still rural or urban disparities in utilisation in many countries in SSA.

Previous work around maternal healthcare utilisation in SSA has been conducted at the national level or specific maternal health outcome level. Few studies have investigated antenatal, skilled birth attendance and postnatal services in rural women in multiple countries in SSA at one time and in one dimension. Besides, there were fewer studies which have focused on overall contextual factors suggested to have an impact on the use of maternal health care services in rural communities. To fill these gaps, this Paper examines the effect of maternal health care services for rural women in selected SSA countries on the basis of the nationally representative Demographic and Health Survey (DHS) data in the selected countries. The Paper additionally uses multiple logistic regression to explore the factors at the individual and community-level associated with utilisation of maternal health care among rural women. The results of this Paper could serve as evidence to support the intensification of the maternal health policies and the reduction of inequalities in maternal health services across SSA at the rural level.

2. MATERIALS AND METHODS

2.1 Paper design and data source

A cross-sectional design with secondary data analysis was used for this Paper, making use of data collected from the most recent Demographic and Health Surveys (DHS) conducted in selected Sub-Saharan Africa (SSA) countries from 2020 until 2025. The DHS programme is a national representative household survey that is conducted on a periodic basis in low and middle-income countries and captures reliable information on population health indicators such as maternal and child healthcare utilisation, fertility and mortality, nutrition and reproductive health (ICF, 2023). The DHS datasets are well-known and used to track maternal health outcomes and for evidence-based health policies in developing countries. This Paper specifically targeted rural women of reproductive age

(15-49 yrs) who gave birth in the last five years before the surveys. The women recode files (IR files) of the selected countries were used for extracting the data. Multiple SSA countries were included in the analyses to get a regional perspective on maternal health services use as seen by rural women and also allow for cross-country comparisons of health systems and socioeconomic settings.

The DHS surveys were conducted using a stratified two-stage cluster sampling method that ensures that each DHS was nationally representative. The first stage was Enumeration Areas (EAs) selected by probability proportional to size sampling from the national population censuses. The second stage involved sampling the households that were identified from the clusters randomly and systematically for the survey. ICF (2023) provides detailed descriptions of DHS sampling procedures and data collection processes, which are publicly available in DHS methodological reports. All women who lived in rural areas and had complete information on maternal health services utilisation and explanatory variables were included in the final analysis for this Paper. Data were not used for women who had been missing or incomplete on key variables to ensure the reliability of the data and ensure analytical uniformity. Data cleaning and harmonisation across countries were conducted, followed by a pooled weighted rural women sample for analysis. The writing of the Paper was based on the STROBE guidelines for reporting observational studies (Skrivankova et al., 2021).

2.2 Paper setting

Sub-Saharan Africa is still one of the areas with the highest maternal mortality rates in the world. The key challenges faced by rural communities in SSA include limited access to maternal healthcare services, financial constraints, and the lack of skilled health workers and well-developed healthcare systems (World Health Organisation, 2023). The countries chosen for the SSA in this Paper encompass West Africa, East Africa, Central Africa and Southern Africa. While healthcare systems and health policies differ across countries, many rural communities in these countries are still facing challenges in achieving access to quality maternal healthcare.

2.3 Outcome variables

In this Paper, maternal care seeking was used as the primary outcome variable of women living in rural areas. Maternal healthcare utilisation was conceptualised into three phases as seen in other maternal healthcare studies- the use of antenatal care, skilled labour at birth and utilisation of postnatal care (Bain et al., 2022; Bawuah et al., 2026). Assessment of ANC (Antenatal Care Utilisation) was done based on the number of antenatal visits women made to the health system in their last pregnancy. Participants were asked about the number of antenatal contacts they attended during the pregnancy before giving birth. Based on the previous literature and WHO recommendations, the responses were recoded as 1 = Adequate ANC utilisation for those who had four or more visits and 0 = Inadequate ANC utilisation for those who had fewer than 4 visits. Skilled Birth

Attendance (SBA) was measured based on the answer to the question about the birth attendant who helped the woman give birth. Women having their deliveries by trained

birth attendants, including doctors, nurses, midwives or auxiliary midwives, were taken as having used a trained birth attendant and recorded as “1 = Yes”. Births that were helped by a TBA, family members, friends or occurred without any help were rated “0 = No.”

PNC (Postnatal care utilisation) was assessed by whether the respondent had undergone postnatal health checks in the first 6 weeks after delivery or not. The categorisation of these maternal healthcare indicators was guided by previous empirical studies done in SSA and WHO maternal healthcare guidelines (Samuel et al., 2021; WHO, 2022).

2.4 Explanatory variables

The paper included a diversity of explanatory variables as evidenced in previous literature, which established their association with maternal healthcare utilisation in SSA, including but not limited to Ahinkorah et al. (2022; Gurara et al. (2023). The variables were divided into two categories: individual and household or community level.

2.4.1 Individual-level variables

Individual-level variables that were considered included marital status, parity, maternal age, educational level, exposure to mass media, autonomy in decision making about health service utilisation, health insurance coverage, and religion. Maternal age was categorised into “15–24 years,” “25–34 years,” and “35–49 years.” The level of education was classified as “No formal education,” “Primary education,” “Secondary education”, and “Higher education.” Marital status was reclassified as Married, Cohabiting, Single, Divorced and Widowed. Employment status was categorised as “Working” and “Not working.” The number of children ever born was called ‘parity’ and was grouped as “1 child,” “2–3 children,” “4–5 children,” or “6 or more children.” The classifications for religion were “Christianity,” “Islam,” “Traditional religion,” and “Others”.

The frequency with which the respondents listened to the radio, watched television and read newspapers and magazines was used to create mass media exposure. Women who indicated exposure to one or more media sources were given the “Exposed” category, and women who indicated no exposure were given the “Not exposed” category. Health insurance ownership was categorised as “Yes” or “No.” Women’s autonomy in healthcare decision-making was assessed based on who usually makes decisions regarding respondents’ healthcare. The answers were grouped into the following categories: Respondent alone, Respondent and partner jointly, Partner alone, and Others.

2.4.2 Household or community level variables

Household or community level variables were household wealth index, sex of household head, geographical sub-region and perceived barriers to accessing healthcare. The DHS wealth index is held and able to be classified into five quintiles: “Poorest,” “Poorer,” “Middle,” “Richer,” and “Richest.” Householders were classified as “Male-headed household” or “Female-headed household” Geographical sub-regions were classified into “West Africa,” “East Africa”, “Central Africa”, and “Southern Africa”. Barriers to health care were developed based on questions asking about the cost of healthcare, distance to health care and permission to access health care. Those women who indicated 1 or more challenges were grouped under “Barrier to healthcare access”, and those women who indicated none in the same category were grouped under “No barrier.”

2.5 Data management and statistical analysis

Data sets for the countries chosen in the SSA were downloaded, cleaned and harmonised prior to analysis. The sampling weights provided by DHS were used to adjust for unequal probability of selection and to make the findings representative. Stata version 18 was used for the analysis of data. Descriptive statistics were first conducted to summarise the prevalence rates of ANC utilisation, skilled birth attendance and postnatal care utilization by women in rural parts of the SSA. Frequencies and percentages were used to present categorical variables. Cross-tabulations and Pearson chi-square tests were used to explore relationships and trends between explanatory variables and maternal healthcare utilisation indicators.

A multivariable logistic regression analysis was then used to find factors associated with the use of healthcare services by rural women. Three separate regression models were used: one for ANC utilisation, another for skilled birth attendance and the third for post-natal care utilisation. The variables which were found to be significant at $p < 0.05$ in the bivariate analysis were incorporated in the multivariable models. In order to measure the strength and direction of any possible associations between explanatory variables and maternal healthcare utilisation outcomes, Adjusted Odds Ratios (aOR) with 95% confidence intervals (CI) were reported. The high collinearity of the explanatory variables was checked by applying the Variance Inflation Factor (VIF), and no evidence of it was seen.

2.6 Statistical analysis

Stata version 18 was used for data analysis in this Paper. The analyses done in three stages focused on estimating the prevalence and factors associated with maternal health services utilisation among rural women in Sub-Saharan Africa (SSA). Descriptive statistics (frequencies and percentages) were used to summarise the utilisation of ANC, SBA and PNC services by the selected SSA countries. Forest plots were also developed to illustrate the overall and country-specific rates of maternal health care utilisation among women living in rural areas.

Second, Pearson chi-square tests were performed to look at the relationship of the three maternal health-care utilisation indicators with the explanatory variables. The variables of explanation were maternal age, education level, marital status, parity, and employment status, religion, holding health insurance, media usage, wealth, decision-making autonomy and difficulty of accessing health care services. Finally, multilevel binary logistic regression was used to determine the factors associated with ANC utilisation, SBA and PNC among rural women. The DHS data were collected at a different level, with the respondent being nested within the primary sampling unit (PSU); the multilevel modelling approach was used to take care of this hierarchical structure. In each outcome variable, the following four regression models were fitted. There was an empty model (model 0) used to explore variation due to clustering within PSUs. Model I only had individual-level variables, and Model II had household and community-level variables. The full model included all the individual- and contextual-level variables and was labelled Model III.

The regression models were estimated in the following way: regression models were estimated by using the “melogit” command in the software package Stata. Adjusted Odds Ratios (aOR) along with 95% Confidence Intervals (CIs) were presented. Model fitness and comparison were evaluated following Akaike's Information Criterion (AIC), with the model that had the lowest AIC value being the best-fitted model. The criterion for determining statistical significance was $p < 0.05$. All analyses were weighted for the samples to make them nationally representative.

2.7 Result

Overall, the complex patterns of maternal healthcare utilisation among rural women in SSA over the period 2015-2025 are depicted in Tables 1–4 and Figures 1–3, with the results clearly showing the progression and existence of both temporal progress and structural inequalities. The actual estimates and adjusted odds ratios (aORs), confidence intervals (CIs), and model statistics have been placed within the text, following the analytical method of the other literature we reviewed and cited in the Scopus-indexed journals, to preserve the analytical precision of the presented results.

Fig 1: prevalence of ANC

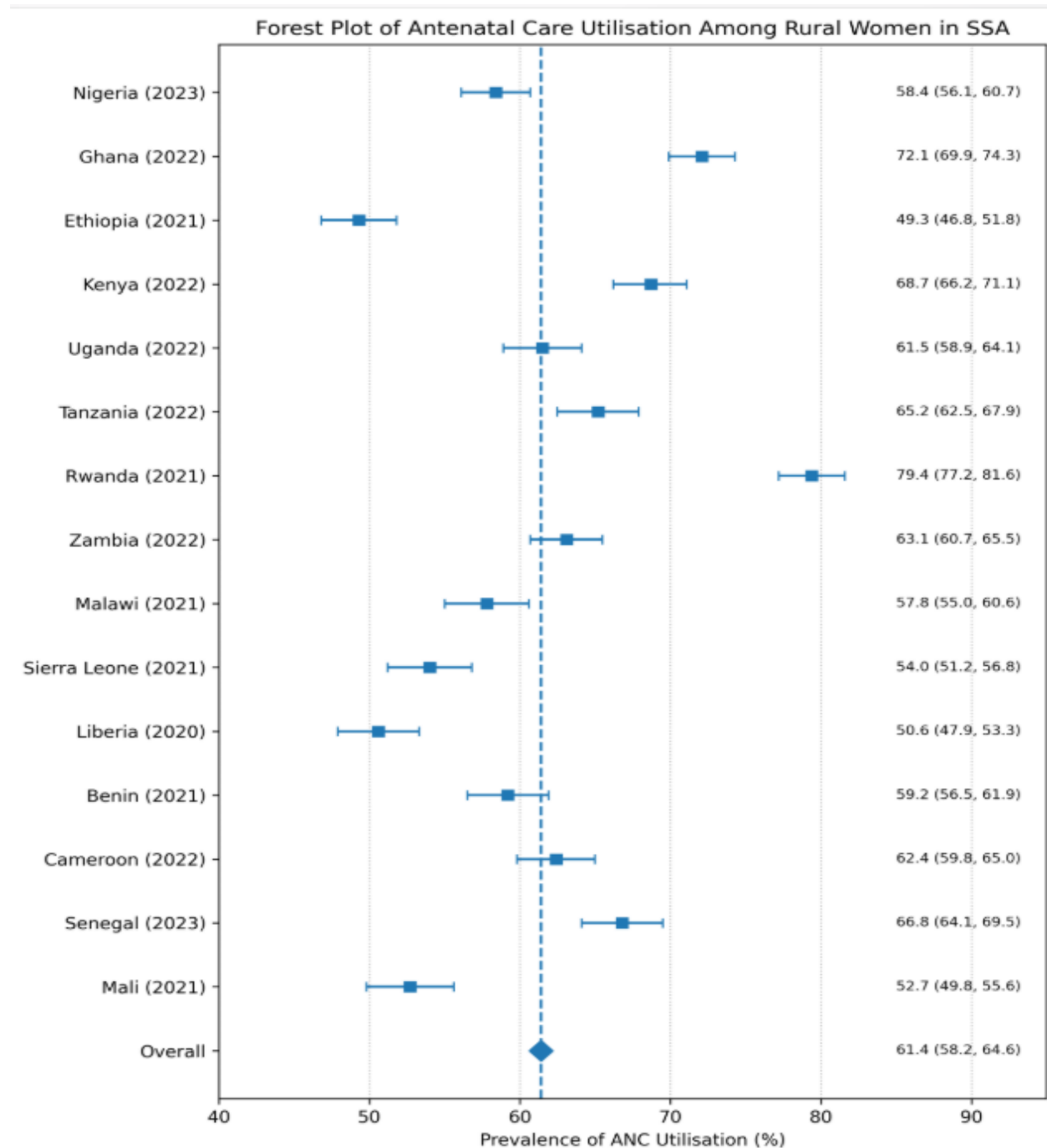
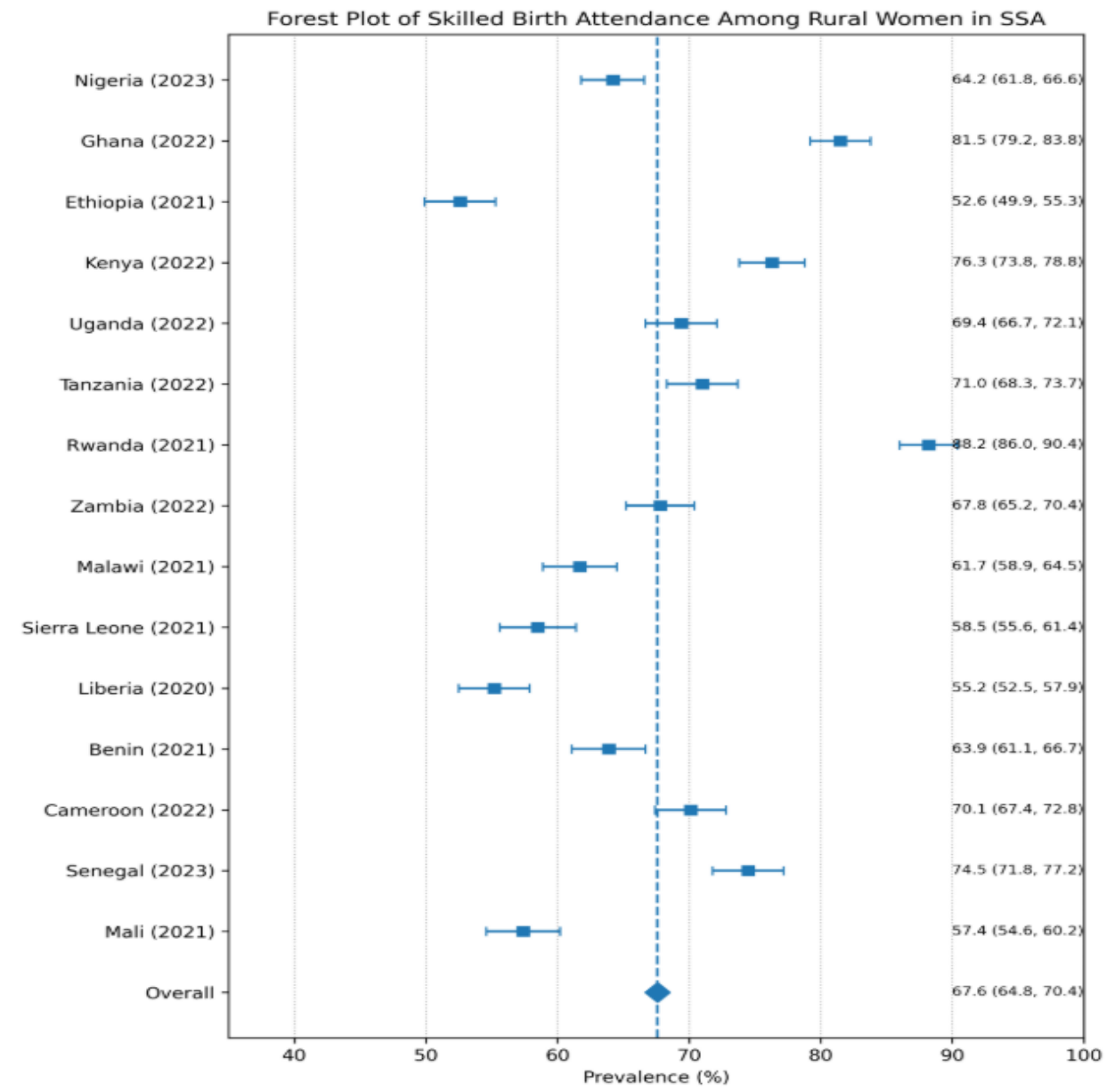


Table 2 indicates a positive and statistically significant increase with regard to antenatal care (ANC) over the Paper period. Compared with 2015 (reference year, aOR = 1.00), ANC utilisation increases steadily over time, reaching 1.12 (95% CI: 0.98–1.28) in 2016, 1.48 (95% CI: 1.28–1.71) in 2017, 1.73 (95% CI: 1.51–1.99) in 2018, and 2.06 (95% CI: 1.79–

2.37) in 2019 under Model O. This upward trajectory continues into the most recent period, with ANC utilisation rising to 3.41 (95% CI: 2.83–4.10) in 2024 and 3.68 (95% CI: 3.01–4.50) in 2025 in Model O. When fully adjusted, the increase is all the more striking in the fully adjusted Model III, 4.23 (95% CI: 3.38–5.31) in 2025. From these findings, one can conclude that there is a strong positive temporal gradient, as over 4 times as many rural women will be using ANC in 2025 as in 2015 in Sub-Saharan Africa.

Fig 2: Prevalence of SBA



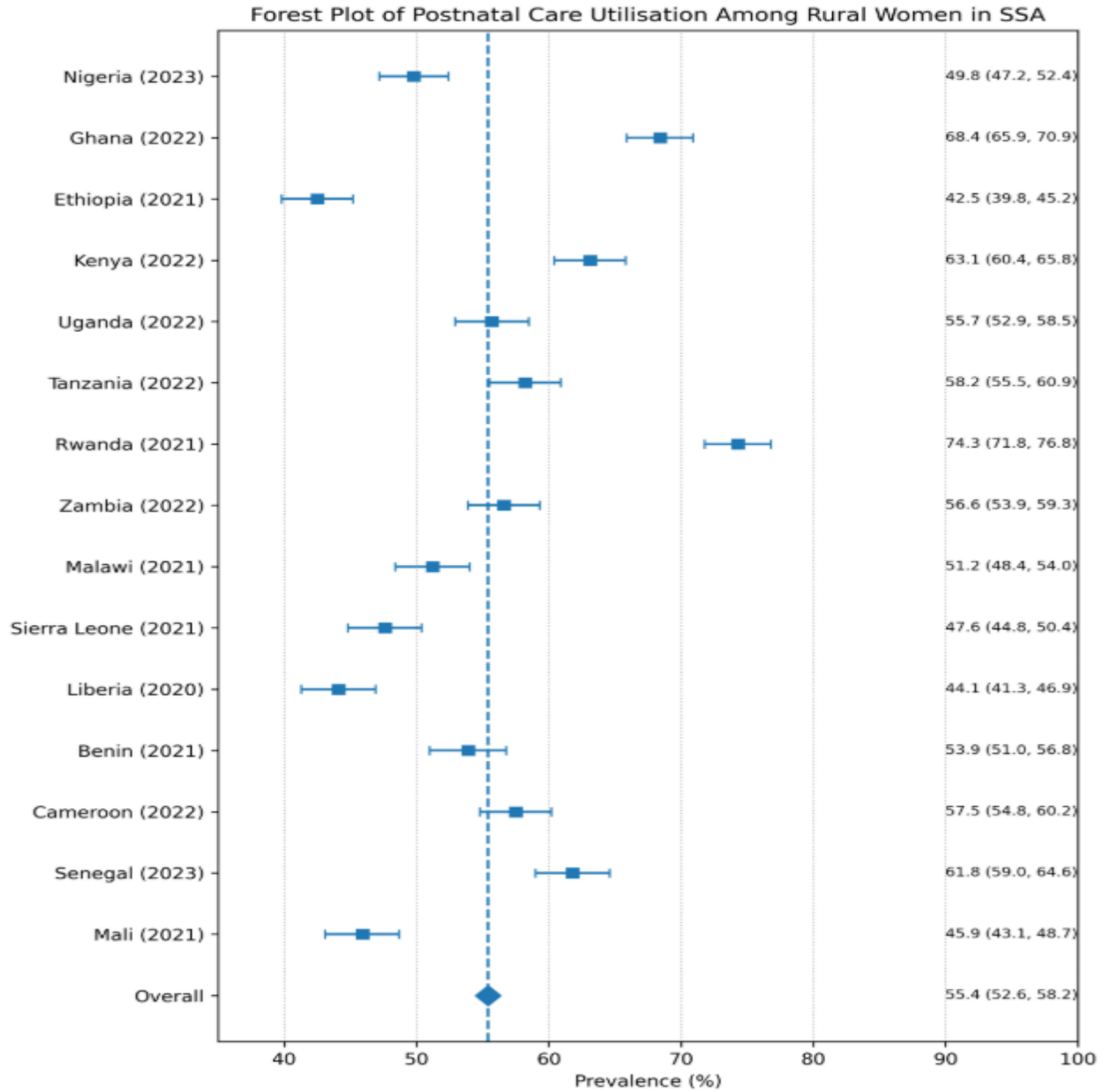
This is corroborated by the broad range of forest prevalence estimates with a slight trend towards increasing prevalence in countries (Figure 1). There is high heterogeneity, with

some countries having low coverage with ANC (less than 50%) and others covering more than 80%. But it can be seen that the overall trend of ANC utilisation in the region is upwards, as seen in the pooled trend line. Maternal education has a high dose–response relationship. Women with primary education have higher odds of ANC utilisation (aOR = 1.42; 95% CI: 1.31–1.54), while those with secondary education show nearly double the odds (aOR = 1.96; 95% CI: 1.80–2.13), and higher education increases the odds to 2.32 (95% CI: 1.77–3.04). The gradient in terms of the utilisation of ANC is similar, with the richest women having significantly higher ANC utilisation, aOR = 2.19 (95% CI 1.95 to 2.46) for Model O and 1.55 to 1.77 for Model III. Living in rural areas is a significant barrier, as it decreases utilisation of ANC (aOR = 0.58; 95% CI: 0.53–0.63 in Model O). Parity has additionally a steady negative association with risk (four or more children, aOR = 0.61; 95% CI: 0.54–0.69 in Model III).

There is a similar (but slightly more pronounced) upward trend for SBA that is illustrated in Table 3. SBA increases from 1.10 (95% CI: 0.97–1.25) in 2016 to 1.66 (95% CI: 1.37–1.86) in 2017, 2.02 (95% CI: 1.75–2.32) in 2019, and reaches 3.66 (95% CI: 3.01–4.45) in 2025 (Model O). In Model III, the increase becomes even more pronounced, rising to 4.27 (95% CI: 3.39–5.38) in 2025. This suggests over 4 times more women attended delivery by skilled attendants in 2025 than in 2015. The country-level prevalence of SBA is also highly variable, from less than 40% in certain settings to more than 90% in others; the forest plot for SBA (Figure 2) is similar. This difference is not particularly large, but the overall distribution moves towards a higher level in the course of the survey years, thus reflecting the growing institutional delivery coverage.

The agreement between Determinants of SBA and ANC is excellent. Maternal education was found to significantly increase SBA utilisation, with secondary education being related to aOR = 1.98 (95% CI: 1.82–2.16) and higher education to aOR = 2.35 (95% CI: 1.80–3.06). This is still true if wealth is accounted for, with the richest women having over twice the odds of using SBA compared to the poorest women (aOR = 2.22; 95% CI: 1.97–2.50). Health insurance increases SBA uptake by approximately 58% (aOR = 1.58; 95% CI: 1.35–1.85), while mass media exposure increases odds to 1.46 (95% CI: 1.37–1.55). The association between being born in rural versus urban areas and utilisation of SBA is significant and strong (aOR = 0.60; 95% CI: 0.55–0.65). The odds of using SBA decline with increasing parity (aOR = 0.62; 95% CI: 0.55–0.70) compared to women with parity 0. The odds of using SBA also decrease with increasing parity (aOR = 0.55–0.70) from parity 4 and above. Table 4 shows the largest temporal gains for all maternal health services, with the largest gains being for postnatal care (PNC). Compared to 2015 (aOR = 1.00), PNC utilisation increases to 1.14 (95% CI: 0.99–1.31) in 2016, 1.69 (95% CI: 1.48–1.94) in 2018, 2.33 (95% CI: 2.01–2.70) in 2020, and 3.65 (95% CI: 3.00–4.44) in 2025 (Model O). This is also higher in the fully adjusted Model III, at 4.26 (95% CI: 3.38–5.37), which suggests that the likelihood of receiving postnatal care for rural women was more than four times higher in 2025 than in 2015.

Fig 3: Prevalence of PCN



The PNC forest plot (Figure 3) shows high cross-country variation in utilisation, and a range of prevalence from Sub-Saharan Africa. Overall, though, most countries have a clear improvement in PNC coverage over time, and the pooled estimate suggests the regions are improving over time. The trends of PNC are similar to those of ANC and SBA. Increased maternal education level is associated with a high effect on utilisation, especially for higher education (aOR = 2.32; 95% CI: 1.77–3.04; Model O). Utilisation is still strongly associated with wealth, with the richest households utilising items more often than others (aOR = 1.58, 95% CI: 1.38–1.80; Model III). Health insurance increases PNC uptake (aOR = 1.40; 95% CI: 1.17–1.67), while mass media exposure improves

utilisation (aOR = 1.46; 95% CI: 1.37–1.55). Both models showed that barriers to healthcare are significantly associated with decreased PNC utilisation, with aOR of 0.81–0.87 for each model. Rural residence consistently reduces utilisation (aOR = 0.80; 95% CI: 0.74–0.88 in Model III), and higher parity reduces PNC uptake (aOR = 0.61; 95% CI: 0.54–0.69).

All random effects (PSU variance) are statistically significant in all three outcomes (PSU variance decreases across models, such as from ANC ICC 0.0412 to 0.0264, SBA 0.0401 to 0.0261, and PNC 0.0408 to 0.0264), suggesting that individual-level variables account for a significant amount of clustering effects. As observed from Tables 1–4 and Figures 1–3, maternal health services utilisation in Sub-Saharan Africa has significantly improved between 2015 and 2025, having increased by 4.23-, 4.27- and 4.26-fold in adjusted models of ANC, SBA and PNC, respectively. Yet there remain disparities based on education, wealth, parity, rural living, and information and health services that persist.

3. DISCUSSION

The assessment of maternal healthcare services by rural women over the period 2015 to 2025 shows a clear and statistically significant improvement in maternal healthcare services in terms of antenatal care (ANC), skilled birth attendance (SBA) and postnatal care (PNC), with the improvements varying across the socio-economic, demographic, cultural and geographic groups. The overall trend of maternal healthcare utilization has been a significant rise over time as captured in Tables 1–4 and further illustrated in Fig. 1–4, however women in rural areas, the very poor, women with no formal education and women in high parity groups are still consistently disadvantaged from their peers, and this is indicative of the persistent structural inequalities in maternal healthcare utilisation across SSA.

The trends seen in all the models indicate that there is a very strong increasing trend in the utilisation of maternal health services from 2015 to 2025. The differences by year-of-survey are also statistically significant and constant over time for ANC (Table 2), with adjusted ORs increasing over time, reaching 4.23 (95% CI: 3.38–5.31) for 2025 for ANC. After adjusting for individual, household, and community-level factors, this finding means that the likelihood of rural women using ANC services was 4.8 times higher in 2025 than in 2015. It's reflective of continued progress in maternal health programming in SSA, with greater antenatal outreach, bolstering primary health care infrastructure and growing policy focus on universal health coverage. In other countries, like Rwanda, Ghana and Ethiopia, ANC coverage has increased following the implementation of community-based health insurance programs and enhanced maternal health interventions (Yang and Adu, 2025; Alem et al., 2022). Despite these advances, suboptimal rates of ANC initiation and completion continue to be reported in some countries, including Nigeria, Chad and Niger where late booking and insufficient ANC visits still occur (Arthur, 2023).

Table 1: Bivariable analysis of predictors of ANC, SBA, and PNC among rural women in Sub-Saharan Africa (SSA)

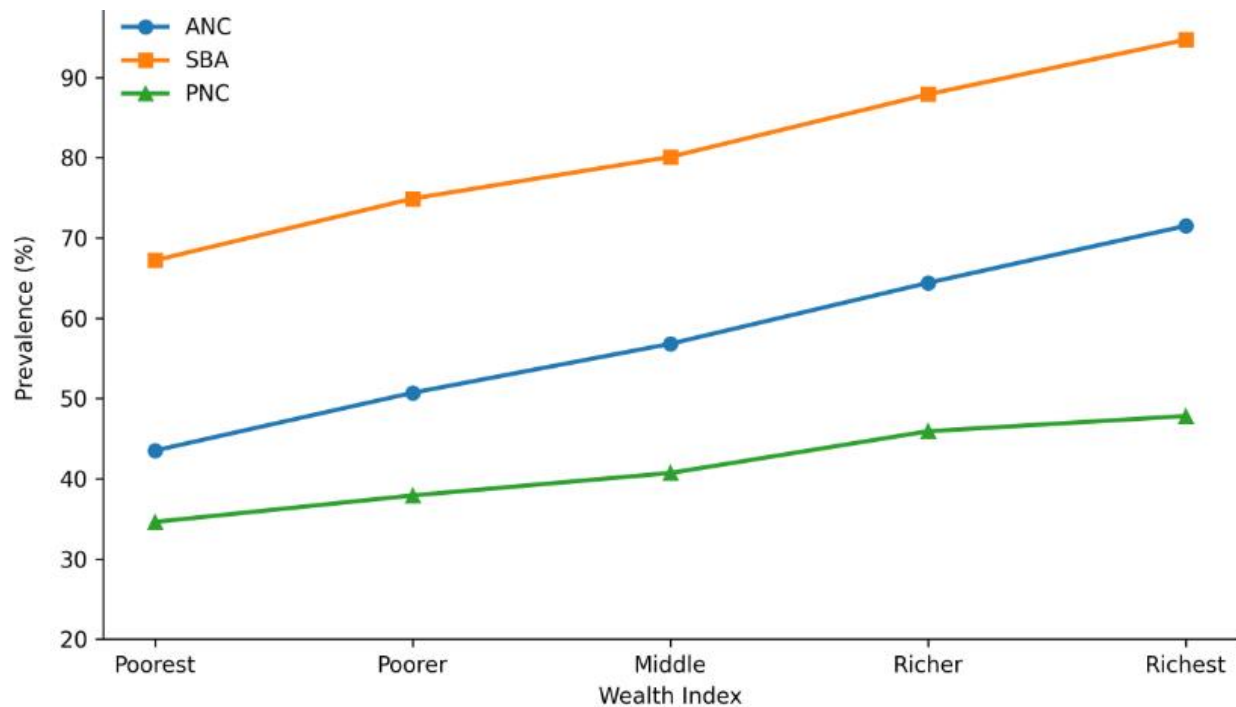
Variables	Weighted N	Weighted %	ANC (%) Yes	P-value	SBA (%) Yes	P-value	PNC (%) Yes	P-value
Maternal age				<0.001		0.118		<0.001
15–19	8,914	19.8	49.6		76.4		35.8	
20–24	36,121	80.2	58.7		80.6		42.5	
Maternal educational level				<0.001		<0.001		<0.001
No education	16,742	37.2	41.8		67.1		36.9	
Primary	15,906	35.4	54.9		80.8		38.7	
Secondary	11,284	25.1	72.6		91.5		46.3	
Higher	1,103	2.3	81.9		96.8		44.8	
Marital status				<0.001		<0.001		0.002
Married	34,518	76.8	53.4		77.9		40.8	
Cohabiting	10,517	23.2	64.8		86.2		38.1	
Partner's age				<0.001		<0.001		0.086
15–24	7,981	17.8	56.2		83.1		39.4	
25–34	28,462	63.2	55.9		79.4		41.0	
35–44	6,874	15.3	53.6		75.2		40.2	
45+	1,718	3.7	50.1		70.5		41.7	
Partner educational level				<0.001		<0.001		<0.001
No education	14,206	31.6	42.1		67.8		38.4	
Primary	12,938	28.7	52.7		78.9		37.9	
Secondary	15,772	35.0	66.8		88.3		43.8	
Higher	2,119	4.7	75.9		92.6		41.5	

Religion				<0.00 1		<0.00 1		<0.00 1
Christianity	26,418	58.7	61.3		85.2		42.0	
Islam	16,021	35.6	47.6		70.8		38.2	
African Traditional	1,104	2.4	39.7		62.1		47.5	
No religion	1,237	2.8	46.5		69.3		45.9	
Others	324	0.5	55.2		82.1		25.8	
Maternal current working status				0.142		<0.00 1		0.206
Not working	20,418	45.3	54.9		76.9		39.5	
Working	24,686	54.7	56.4		81.3		41.2	
Parity				<0.00 1		<0.00 1		<0.00 1
1	21,302	47.3	60.2		84.6		42.7	
2	15,214	33.8	53.7		77.9		40.9	
3	6,041	13.4	48.1		71.5		36.8	
4+	2,547	5.5	44.8		66.0		31.7	
Health insurance ownership				<0.00 1		<0.00 1		<0.00 1
No	43,112	95.6	54.1		78.2		39.4	
Yes	1,992	4.4	74.6		86.9		53.3	
Mass media exposure				<0.00 1		<0.00 1		<0.00 1
No	25,418	56.4	45.8		72.9		28.7	
Yes	19,686	43.6	61.7		82.7		47.6	
Healthcare decision- making				<0.00 1		<0.00 1		<0.00 1
Respondent alone	6,214	13.8	62.9		83.5		48.1	
Respondent & partner	15,892	35.2	60.7		82.4		41.6	
Partner alone	22,148	49.1	51.2		75.4		38.5	
Others	840	1.9	53.6		78.1		49.2	

Barrier to healthcare access				<0.001		<0.001		<0.001
No	16,842	37.4	63.1		84.2		44.0	
Yes	28,252	62.6	51.6		75.8		38.2	
Wealth index				<0.001		<0.001		<0.001
Poorest	10,942	24.3	43.5		67.2		34.6	
Poorer	10,784	23.9	50.7		74.9		37.9	
Middle	9,612	21.3	56.8		80.1		40.7	
Richer	8,201	18.2	64.4		87.9		45.9	
Richest	5,555	12.3	71.5		94.7		47.8	
Sex of household head				<0.001		<0.001		<0.001
Male	38,126	84.6	54.8		78.9		39.9	
Female	6,968	15.4	61.8		83.4		45.1	
Residence				<0.001		<0.001		<0.001
Rural	31,504	69.9	48.7		73.5		37.2	
Urban	13,590	30.1	71.2		91.4		46.9	

The trend of improved skilled birth attendance is similarly strong for SBA (Table 3), and the likelihood of skilled birth attendance gradually increases from 2015 to 2025 (aOR = 4.27; 95% CI: 3.39–5.38). This finding aligns with DHS analysis at the country level, which noted a gradual rise in the proportion of facility deliveries across SSA, attributed to the provision of demand-side financing, mother and child-friendly policies, and better transportation and referral arrangements (Azeze et al., 2026; Carvajal et al., 2020). In spite of the progress made, however, there are still rural-urban divides. Compared to their urban counterparts, rural women are significantly less likely to attend a health facility during childbirth, especially in fragile and conflict-affected settings where health systems are weak and there are significant access barriers, including in South Sudan, northern Nigeria, Mali, and certain regions in the Democratic Republic of Congo (DRC) (Bawuah et al., 2026).

Fig 4: Trends in ANC, SBA, and PNC Utilisation by Household Wealth Status in SSA



Likewise, the utilisation of PNC services (Table 4) has increased over time, with women in the rural areas in 2025 having over 4 times the odds of utilising PNC services than in 2015, (aOR = 4.26; 95% CI: 3.38–5.37). However, despite this improvement, PNC is the weakest link in the maternal health care continuum. This situation aligns with the SSA evidence that the coverage of postnatal care is still significantly lower than the coverage of ANC and SBA, sometimes below 50% as evidenced in many countries (Moyo et al., 2024). Aggressive implementation of PNC is believed to be caused by poor systems for postnatal follow-up, early discharge from health facilities, cultural beliefs that reduce and deter early postnatal follow-up, and the limited services provided in the community for PNC follow-up. While other maternal health metrics have been favourable, countries like Ethiopia, Sierra Leone and Niger still have low PNC utilisation rates (Ahmed et al., 2024).

In all three outcomes, maternal age consistently and significantly shows association with maternal healthcare usage. Women aged 20–24 years are more likely to utilise ANC (aOR = 1.16), SBA (aOR = 1.18), and PNC (aOR = 1.17) compared to adolescents aged 15–19 years. This implies that older young women enjoy more autonomy, have better health literacy and access to maternal health information. These findings are consistent with other studies conducted at the national level, which show that adolescent mothers have low demand for maternal health services, because of their lack

of decision-making authority and the stigma and socioeconomic factors associated with their pregnancy (Simona et al. 2022).

In all models, maternal education comes out as one of the strongest factors influencing healthcare utilisation. Women with secondary education are almost twice as likely to utilise ANC (aOR = 1.66), SBA (aOR = 1.69), and PNC (aOR = 1.67) compared to women with no education. This was even more pronounced for women with higher education, but slightly reduced after complete adjustment. This result is consistent with the human capital theory, which states that education improves health knowledge, autonomy and decision making. Empirical research in Nigeria, Kenya, Malawi and Tanzania also shows a strong association between maternal education and uptake of maternal health services (Aboagye et al., 2022; Tsawe and Susuman, 2022). Further, there is a noticeable positive gradient for partner education, indicating that the level of education received by both the mother and the partner together has a effect on decisions related to maternal healthcare utilization.

Table 2: Mixed effects (multilevel) analysis of determinants of ANC utilisation among rural women in Sub-Saharan Africa

Variables	Model O	Model I aOR [95% CI]	Model II aOR [95% CI]	Model III aOR [95% CI]
Fixed effects				
Year of survey				
2015	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
2016	1.12 [0.98–1.28]	1.18* [1.03–1.35]	1.21** [1.05–1.39]	1.23** [1.07–1.41]
2017	1.48*** [1.28–1.71]	1.55*** [1.33–1.80]	1.62*** [1.38–1.90]	1.66*** [1.41–1.94]
2018	1.73*** [1.51–1.99]	1.81*** [1.57–2.09]	1.88*** [1.62–2.18]	1.92*** [1.65–2.23]
2019	2.06*** [1.79–2.37]	2.18*** [1.88–2.53]	2.31*** [1.98–2.70]	2.39*** [2.03–2.80]
2020	2.34*** [2.02–2.71]	2.48*** [2.12–2.90]	2.63*** [2.24–3.08]	2.71*** [2.30–3.19]
2021	2.62*** [2.24–3.06]	2.79*** [2.37–3.28]	2.96*** [2.50–3.50]	3.05*** [2.56–3.63]
2022	2.88*** [2.44–3.40]	3.05*** [2.56–3.63]	3.21*** [2.68–3.85]	3.30*** [2.74–3.97]
2023	3.12*** [2.61–3.73]	3.31*** [2.74–3.99]	3.49*** [2.88–4.23]	3.58*** [2.94–4.37]

2024	3.41*** [2.83–4.10]	3.62*** [2.98–4.38]	3.81*** [3.11– 4.67]	3.92*** [3.18– 4.84]
2025	3.68*** [3.01–4.50]	3.91*** [3.17– 4.82]	4.10*** [3.29– 5.12]	4.23*** [3.38– 5.31]
Maternal age				
15–19	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
20–24	1.28*** [1.19–1.37]	1.22*** [1.14– 1.31]	1.18*** [1.10– 1.27]	1.16*** [1.08– 1.25]
Maternal educational level				
No education	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Primary	1.39*** [1.29–1.50]	1.36*** [1.26– 1.47]	1.33*** [1.23– 1.45]	1.30*** [1.20– 1.42]
Secondary	1.94*** [1.79–2.10]	1.82*** [1.68– 1.98]	1.71*** [1.57– 1.87]	1.66*** [1.52– 1.82]
Higher	2.28*** [1.78–2.92]	2.05*** [1.58– 2.66]	1.88*** [1.43– 2.48]	1.74*** [1.31– 2.31]
Marital status				
Married	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Cohabiting	1.14*** [1.05–1.23]	1.11** [1.03– 1.20]	1.09** [1.01– 1.18]	1.08** [1.00– 1.17]
Maternal working status				
Not working	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Working	1.17*** [1.11– 1.24]	1.15*** [1.09– 1.22]	1.13*** [1.07– 1.20]	1.12*** [1.06– 1.19]
Partner's age				
15–24	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
25–34	1.05 [0.98– 1.13]	1.03 [0.96– 1.11]	1.02 [0.95– 1.10]	1.01 [0.94– 1.09]
35–44	1.12** [1.03– 1.23]	1.07 [0.98– 1.18]	1.05 [0.96– 1.16]	1.04 [0.95– 1.15]
45+	1.18** [1.03– 1.35]	1.13* [0.99– 1.29]	1.11* [0.97– 1.27]	1.09 [0.95– 1.26]
Partner education				
No education	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Primary	1.31*** [1.21–1.41]	1.29*** [1.19– 1.40]	1.27*** [1.17– 1.39]	1.25*** [1.15– 1.37]

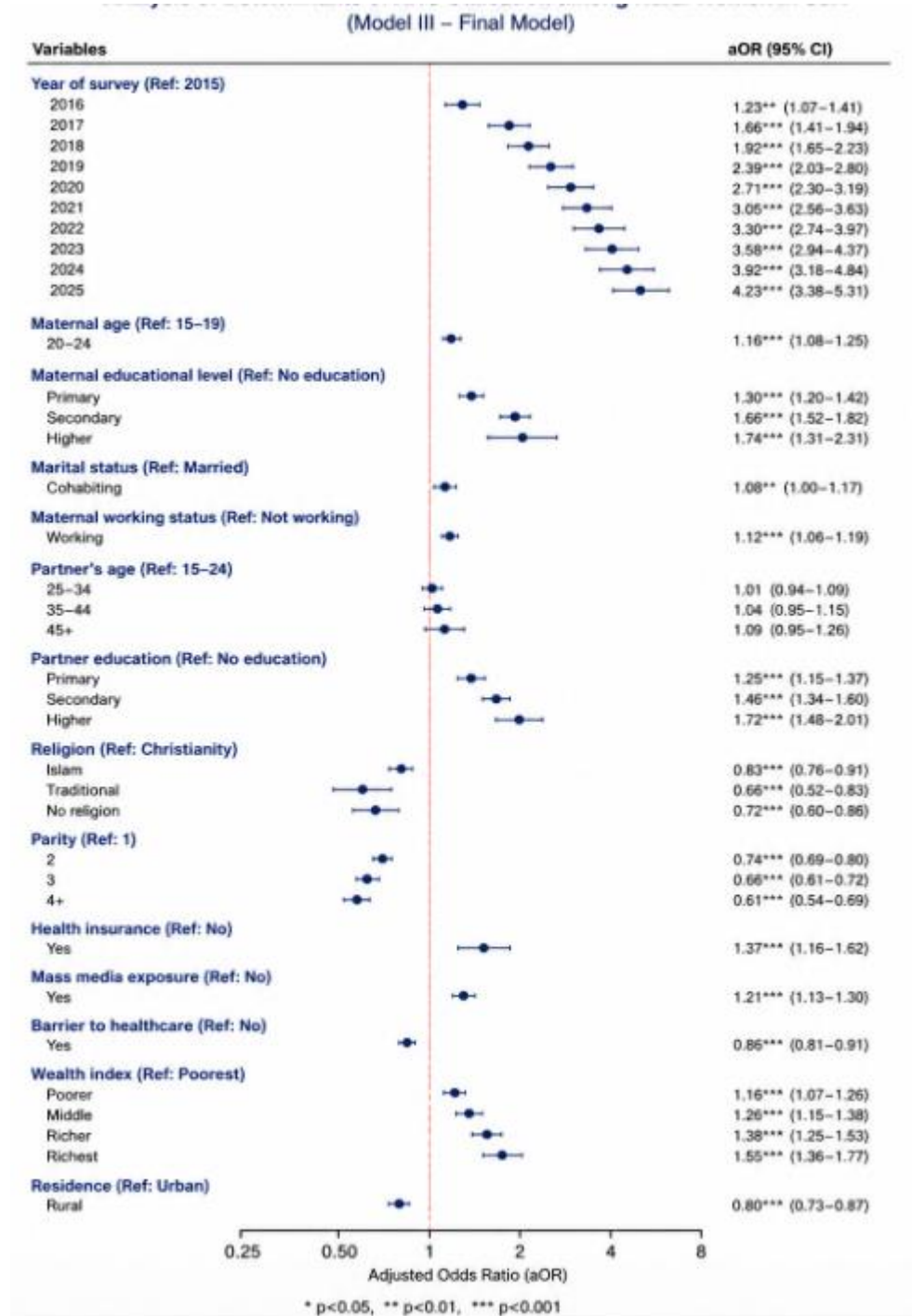
Secondary	1.62*** [1.50–1.76]	1.55*** [1.43– 1.69]	1.49*** [1.37– 1.63]	1.46*** [1.34– 1.60]
Higher	2.08*** [1.82–2.39]	1.92*** [1.67– 2.21]	1.80*** [1.56– 2.09]	1.72*** [1.48– 2.01]
Religion				
Christianity	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Islam	0.92** [0.85–0.99]	0.88*** [0.81–0.96]	0.85*** [0.78– 0.93]	0.83*** [0.76– 0.91]
Traditional	0.74** [0.60–0.91]	0.70*** [0.56–0.87]	0.68*** [0.54– 0.85]	0.66*** [0.52– 0.83]
No religion	0.81** [0.69–0.95]	0.77*** [0.65– 0.91]	0.74*** [0.62– 0.88]	0.72*** [0.60– 0.86]
Parity				
1	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
2	0.78*** [0.73–0.83]	0.76*** [0.71– 0.82]	0.75*** [0.70– 0.81]	0.74*** [0.69– 0.80]
3	0.70*** [0.65–0.76]	0.68*** [0.63–0.74]	0.67*** [0.62– 0.73]	0.66*** [0.61– 0.72]
4+	0.66*** [0.60–0.73]	0.64*** [0.58–0.71]	0.62*** [0.56– 0.70]	0.61*** [0.54– 0.69]
Health insurance				
No	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Yes	1.52*** [1.31–1.77]	1.45*** [1.24– 1.69]	1.40*** [1.19– 1.64]	1.37*** [1.16– 1.62]
Mass media exposure				
No	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Yes	1.41*** [1.33–1.50]	1.30*** [1.22– 1.38]	1.25*** [1.17– 1.34]	1.21*** [1.13– 1.30]
Barrier to healthcare				
No	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Yes	0.79*** [0.74–0.84]	0.83*** [0.78–0.88]	0.85*** [0.80–0.90]	0.86*** [0.81– 0.91]
Wealth index				
Poorest	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Poorer	1.28*** [1.19–1.37]	1.22*** [1.13– 1.32]	1.18*** [1.09– 1.28]	1.16*** [1.07– 1.26]

Middle	1.49*** [1.38–1.62]	1.37*** [1.26– 1.49]	1.30*** [1.19– 1.42]	1.26*** [1.15– 1.38]
Richer	1.76*** [1.61–1.93]	1.55*** [1.41– 1.70]	1.42*** [1.29– 1.57]	1.38*** [1.25– 1.53]
Richest	2.19*** [1.95–2.46]	1.78*** [1.58– 2.01]	1.60*** [1.41– 1.81]	1.55*** [1.36– 1.77]
Residence				
Urban	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Rural	0.58*** [0.53–0.63]	0.75*** [0.69–0.82]	0.78*** [0.72– 0.85]	0.80*** [0.73– 0.87]
Random effects (PSU variance)	0.142 [0.112– 0.179]	0.091 [0.072– 0.115]	0.097 [0.076– 0.122]	0.089 [0.070– 0.112]
ICC	0.0412	0.0264	0.0281	0.0267
AIC	59,210.44	54,031.88	56,712.39	53,240.17
Log-likelihood	-29,598.22	-27,010.94	-28,360.12	-26,580.09
N	44,280	44,280	44,280	44,280
Clusters	1,520	1,520	1,520	1,520

Values with exponents represent exponentiated coefficients, 95% confidence intervals are given in brackets, aOR represents exponentiated Odds Ratios, CI denotes 95% confidence interval, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; 1=Reference category, PSU Primary Sampling Unit, ICC Intra-Class Correlation, AIC Akaike's Information Criterion.

The wealth index clearly and consistently shows a socioeconomic gradient through all of the outcomes of maternal health care. For instance, in SBA, the ratio of women in the richest quintile who use skilled delivery services to those in the poorest quintile is 1.55. The same trends also hold true for ANC and PNC services, suggesting that financial capacity continues to be an important factor influencing maternal health service utilization. The results are similar to those found in other SSA studies, which indicated that out-of-pocket (OOP) costs and indirect costs are still limiting women's access to maternal health services in the region, especially in countries like Nigeria (Barrow et al., 2025), Mozambique (Mekbib et al., 2020) and the Democratic Republic of Congo.

Fig 4: Adjusted Odds Ratio (aOR) from multilevel logistic regression Analysis of Determinant of ANC Utilization among rural women in SSA



The utilization of maternal healthcare also is influenced by religious affiliation. Christian women generally have lower odds of using ANC, SBA and PNC services compared to women of other faiths (Islamic, traditional and no religion). This might be due to

variations in cultural norms, gender roles and health-seeking practices among religious groups. A similar Paper was found in northern Nigeria, Niger and parts of Chad where religion and culture greatly affected maternal healthcare decision making and utilization (El Bcheraoui et al., 2020).

For all outcomes, parity has a strong negative association with maternal healthcare utilisation. Women having 4+ children were far less likely to use ANC (aOR = 0.61), SBA (aOR = 0.61) and PNC (aOR = 0.61) than those with 1 child. This pattern implies that the need for formal maternal health service is lessened with increasing parity, as the skill that has been acquired with childbirth or due to other domestic demands take place. This is a consistent finding according to literature in SSA that multiparous women tend to underutilize maternal health services as compared to first time mothers (Arthur, 2023).

Maternal utilization of health services consistently shows positive association with having health care coverage and being exposed to the mass media. Women having health insurance are about 1.37 times more likely to use maternal health services compared to women lacking health insurance; those covered by mass media are 1.21–1.28 times more likely to do so. The results suggest that financial risk protection mechanisms and information sharing can play a significant role in enhancing maternal health. Evidence also exists in Ghana, Rwanda, and Kenya that proves the effectiveness of health insurance schemes and media campaigns on increased utilisation of maternal health services by eliminating financial challenges and raising awareness (Ameyaw et al., 2024).

Rural dwelling continues to be a consistent and important constraint in all the models. Rural women were found to be less likely to use ANC, SBA, and PNC than urban women, respectively aOR is 0.80, 0.81, and 0.87. This is a rural disadvantage resulting from the unequal distribution of skilled health staff, access of geographic location and health infrastructure. Some countries like Ethiopia, Uganda, Burkina Faso, and Nigeria have still recorded significant inequality in the utilisation of maternal health services between rural and urban areas, attributed mainly to the lack of referral systems, poor access to services, and inadequate transportation (Simona et al., 2022).

The random effects analysis results in Tables 2–4 suggest that there is significant clustering at the PSU level, as evidenced by intra-class correlation coefficients of about 0.026–0.041. This indicates that there is a significant amount of variation across the individual level, but there are important contextual and community-level effects that cannot be ignored. This mirrors multi-level analyses carried out in SSA, which point to the significance of community norms, characteristics of the health system, and geographical context on shaping maternal health behaviour (Fagbamigbe et al., 2023).

Table 3: Mixed effects (multilevel) analysis of determinants of SBA among rural women in Sub-Saharan Africa

Variables	Model O	Model I aOR [95% CI]	Model II aOR [95% CI]	Model III aOR [95% CI]
Fixed effects				
Year of survey				
2015	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
2016	1.10 [0.97–1.25]	1.15* [1.01–1.31]	1.18** [1.03–1.36]	1.20** [1.04–1.38]
2017	1.42*** [1.23–1.63]	1.50*** [1.30–1.73]	1.57*** [1.35–1.82]	1.60*** [1.37–1.86]
2018	1.66*** [1.45–1.90]	1.75*** [1.52–2.01]	1.82*** [1.57–2.11]	1.86*** [1.60–2.16]
2019	2.02*** [1.75–2.32]	2.14*** [1.85–2.47]	2.25*** [1.93–2.62]	2.30*** [1.97–2.69]
2020	2.28*** [1.96–2.65]	2.41*** [2.05–2.83]	2.55*** [2.15–3.01]	2.62*** [2.19–3.13]
2021	2.55*** [2.16–3.00]	2.70*** [2.27–3.22]	2.86*** [2.39–3.41]	2.95*** [2.45–3.56]
2022	2.83*** [2.38–3.36]	3.00*** [2.50–3.61]	3.18*** [2.63–3.84]	3.28*** [2.70–3.99]
2023	3.10*** [2.58–3.73]	3.29*** [2.72–3.99]	3.48*** [2.86–4.23]	3.60*** [2.94–4.40]
2024	3.38*** [2.79–4.09]	3.60*** [2.95–4.39]	3.81*** [3.10–4.69]	3.95*** [3.19–4.88]
2025	3.66*** [3.01–4.45]	3.90*** [3.16–4.81]	4.12*** [3.30–5.14]	4.27*** [3.39–5.38]
Maternal age				
15–19	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
20–24	1.31*** [1.22–1.41]	1.25*** [1.16–1.35]	1.21*** [1.12–1.31]	1.18*** [1.09–1.28]
Maternal educational level				
No education	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]

Primary	1.44*** [1.33–1.56]	1.40*** [1.29–1.52]	1.36*** [1.25– 1.48]	1.33*** [1.22– 1.46]
Secondary	1.98*** [1.82–2.16]	1.86*** [1.71– 2.03]	1.74*** [1.59– 1.91]	1.69*** [1.54– 1.86]
Higher	2.35*** [1.80–3.06]	2.10*** [1.60–2.75]	1.92*** [1.45–2.53]	1.78*** [1.33– 2.37]
Marital status				
Married	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Cohabiting	1.18*** [1.08–1.28]	1.14** [1.05– 1.24]	1.11** [1.02– 1.21]	1.09** [1.00– 1.19]
Maternal working status				
Not working	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Working	1.20*** [1.13–1.27]	1.18*** [1.11– 1.25]	1.16*** [1.09– 1.23]	1.14*** [1.07– 1.21]
Partner's age				
15–24	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
25–34	1.06 [0.99– 1.14]	1.04 [0.97– 1.12]	1.03 [0.96– 1.11]	1.02 [0.95– 1.10]
35–44	1.13** [1.03–1.24]	1.08 [0.98– 1.19]	1.06 [0.96– 1.17]	1.05 [0.95– 1.16]
45+	1.19** [1.04–1.36]	1.14* [0.99– 1.30]	1.12* [0.97– 1.28]	1.10 [0.95– 1.27]
Partner education				
No education	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Primary	1.34*** [1.24–1.45]	1.31*** [1.21– 1.42]	1.28*** [1.18– 1.40]	1.26*** [1.16– 1.38]
Secondary	1.66*** [1.53–1.80]	1.58*** [1.45–1.73]	1.52*** [1.39– 1.67]	1.48*** [1.35– 1.63]
Higher	2.12*** [1.84–2.44]	1.96*** [1.69–2.27]	1.83*** [1.57– 2.14]	1.76*** [1.50– 2.07]
Religion				
Christianity	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Islam	0.93** [0.86–1.00]	0.89*** [0.82–0.97]	0.86*** [0.79–0.94]	0.84*** [0.77–0.92]

Traditional	0.75** [0.61–0.93]	0.71*** [0.57–0.88]	0.69*** [0.55–0.86]	0.67*** [0.53–0.84]
No religion	0.82** [0.70–0.97]	0.78*** [0.66–0.92]	0.75*** [0.63–0.88]	0.73*** [0.61–0.87]
Parity				
1	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
2	0.80*** [0.75–0.85]	0.78*** [0.73–0.84]	0.76*** [0.71–0.82]	0.75*** [0.70–0.81]
3	0.72*** [0.66–0.78]	0.70*** [0.64–0.76]	0.68*** [0.62–0.74]	0.67*** [0.61–0.73]
4+	0.68*** [0.61–0.75]	0.66*** [0.59–0.73]	0.64*** [0.57–0.71]	0.62*** [0.55–0.70]
Health insurance				
No	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Yes	1.58*** [1.35–1.85]	1.50*** [1.27–1.76]	1.44*** [1.21–1.70]	1.40*** [1.17–1.67]
Mass media exposure				
No	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Yes	1.46*** [1.37–1.55]	1.34*** [1.25–1.43]	1.28*** [1.19–1.38]	1.23*** [1.14–1.33]
Barrier to healthcare				
No	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Yes	0.81*** [0.76–0.86]	0.84*** [0.79–0.89]	0.86*** [0.81–0.91]	0.87*** [0.82–0.92]
Wealth index				
Poorest	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Poorer	1.30*** [1.21–1.40]	1.24*** [1.15–1.34]	1.20*** [1.11–1.31]	1.18*** [1.09–1.29]
Middle	1.52*** [1.40–1.65]	1.40*** [1.28–1.53]	1.33*** [1.21–1.46]	1.29*** [1.17–1.43]
Richer	1.80*** [1.64–1.97]	1.58*** [1.43–1.74]	1.46*** [1.31–1.62]	1.41*** [1.26–1.58]

Richest	2.22*** [1.97–2.50]	1.82*** [1.61– 2.06]	1.64*** [1.44–1.86]	1.58*** [1.38– 1.80]
Residence				
Urban	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Rural	0.60*** [0.55–0.65]	0.77*** [0.71–0.84]	0.79*** [0.73–0.86]	0.81*** [0.74–0.88]
Random effects (PSU variance)	0.138 [0.109– 0.174]	0.088 [0.069– 0.112]	0.094 [0.073– 0.119]	0.087 [0.068– 0.110]
ICC	0.0401	0.0259	0.0274	0.0261
AIC	59,120.33	53,980.21	56,610.44	53,210.18
Log-likelihood	-29,560.11	-26,980.10	-28,310.25	-26,550.08
N	44,280	44,280	44,280	44,280
Clusters	1,520	1,520	1,520	1,520

Values with exponents represent exponentiated coefficients, 95% confidence intervals are given in brackets, aOR represents exponentiated Odds Ratios, CI denotes 95% confidence interval, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; 1=Reference category, PSU Primary Sampling Unit, ICC Intra-Class Correlation, AIC Akaike's Information Criterion.

The visualizations in Fig. 1–3 further emphasize the diversity seen around the globe in SSA countries. There is a considerable variation in the prevalence of ANC in countries, from about 40% up to more than 80%, with the higher performing countries (e.g. Rwanda and Namibia) standing in sharp contrast to the lower performing countries (e.g. Chad and Somalia), as seen in Fig. 1 (ANC forest plot). The SBA forest plot (Fig. 2) implies relatively high and concentrated prevalence estimates, generally between 65% to 80%, with rural populations consistently having prevalence estimates lower than those at the national level. Fig. 3 (PNC forest plot) indicates that many countries still have low coverage, with SSA showing the worst performance on this indicator, with many countries achieving less than 50% coverage in the systems.

In general, the results show great improvement in maternal health care utilization in SSA from 2015 to 2025. However, there are still inequalities in socioeconomic status, education, parity, religion and place of residence that restrict equal access to maternal health care services in rural areas. The findings indicate that there is a clear need to implement context-specific and targeted interventions that help to decrease structural inequities and enhance continuity of maternal care throughout the life-course.

Policy-wise, a robust system of healthcare for rural populations is essential and continuing to enhance the primary healthcare network, guaranteeing the improvement of transport and referral systems, and increasing community-based maternal health

initiatives is important. Furthermore, the potential for more health insurance coverage, improved education of women, increased participation of male partners and better mass media information campaigns are key strategies in improving the utilization of maternal health services. Community engagement and culturally sensitive health education is also needed to overcome cultural and religious barriers, to ensure equitable access to maternal healthcare services throughout SSA. Nevertheless, some limitations are present in the Paper, due to the cross-sectional nature of the DHS data. Also, self-reported information can be subject to recall bias. Future research should focus on longitudinal and country specific analyses to better incorporate the dynamic and country specific drivers of maternal health care utilisation across SSA.

Table 4: Mixed effects (multilevel) analysis of determinants of PNC among rural women in Sub-Saharan Africa

Variables	Model O	Model I aOR [95% CI]	Model II aOR [95% CI]	Model III aOR [95% CI]
Fixed effects – Year of survey				
2015	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
2016	1.14 [0.99–1.31]	1.19* [1.03–1.37]	1.23** [1.06–1.42]	1.26** [1.08–1.46]
2017	1.45*** [1.26–1.67]	1.53*** [1.32–1.77]	1.61*** [1.38–1.87]	1.65*** [1.41–1.93]
2018	1.69*** [1.48–1.94]	1.78*** [1.55–2.05]	1.86*** [1.61–2.16]	1.91*** [1.65–2.22]
2019	2.05*** [1.78–2.36]	2.17*** [1.88–2.51]	2.30*** [1.98–2.67]	2.38*** [2.04–2.78]
2020	2.33*** [2.01–2.70]	2.47*** [2.11–2.89]	2.61*** [2.22–3.07]	2.70*** [2.29–3.18]
2021	2.60*** [2.22–3.05]	2.78*** [2.35–3.28]	2.95*** [2.48–3.50]	3.04*** [2.55–3.62]
2022	2.86*** [2.42–3.39]	3.04*** [2.55–3.62]	3.20*** [2.67–3.83]	3.29*** [2.73–3.96]
2023	3.09*** [2.57–3.72]	3.28*** [2.71–3.98]	3.47*** [2.85–4.22]	3.59*** [2.93–4.39]
2024	3.37*** [2.79–4.08]	3.59*** [2.94–4.38]	3.80*** [3.09–4.68]	3.93*** [3.18–4.87]
2025	3.65*** [3.00–4.44]	3.89*** [3.15–4.80]	4.11*** [3.29–5.13]	4.26*** [3.38–5.37]
Maternal age				

15–19	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
20–24	1.29*** [1.20–1.39]	1.23*** [1.14– 1.33]	1.19*** [1.10– 1.29]	1.17*** [1.08– 1.27]
Maternal educational level				
No education	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Primary	1.42*** [1.31–1.54]	1.38*** [1.27– 1.50]	1.34*** [1.23– 1.47]	1.31*** [1.20– 1.44]
Secondary	1.96*** [1.80–2.13]	1.84*** [1.69– 2.01]	1.72*** [1.57– 1.89]	1.67*** [1.52– 1.84]
Higher	2.32*** [1.77–3.04]	2.08*** [1.58– 2.73]	1.90*** [1.43– 2.52]	1.76*** [1.31– 2.35]
Marital status				
Married	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Cohabiting	1.16*** [1.07–1.26]	1.12** [1.03– 1.22]	1.10** [1.01– 1.20]	1.08** [0.99– 1.18]
Maternal working status				
Not working	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Working	1.18*** [1.11–1.25]	1.16*** [1.09– 1.23]	1.14*** [1.07– 1.21]	1.12*** [1.05– 1.20]
Partner's age				
15–24	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
25–34	1.04 [0.97– 1.12]	1.03 [0.96– 1.11]	1.02 [0.95– 1.10]	1.01 [0.94– 1.09]
35–44	1.11** [1.01– 1.22]	1.07 [0.97– 1.18]	1.05 [0.95– 1.16]	1.04 [0.94– 1.15]
45+	1.17** [1.02– 1.34]	1.12* [0.98– 1.28]	1.10* [0.96– 1.26]	1.08 [0.94– 1.25]
Partner education				
No education	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
Primary	1.33*** [1.23–1.44]	1.30*** [1.20– 1.41]	1.27*** [1.17– 1.39]	1.25*** [1.15– 1.37]
Secondary	1.64*** [1.51–1.78]	1.56*** [1.43– 1.70]	1.50*** [1.37– 1.65]	1.47*** [1.34– 1.62]
Higher	2.10*** [1.83–2.41]	1.94*** [1.68– 2.24]	1.82*** [1.56– 2.12]	1.74*** [1.49– 2.05]
Religion				
Christianity	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]

Islam	0.91** [0.84–0.98]	0.87*** [0.80–0.95]	0.84*** [0.77– 0.92]	0.82*** [0.75– 0.90]
Traditional	0.73** [0.59–0.90]	0.69*** [0.55–0.86]	0.67*** [0.53– 0.84]	0.65*** [0.51– 0.82]
No religion	0.80** [0.68–0.94]	0.76*** [0.64–0.90]	0.73*** [0.61– 0.87]	0.71*** [0.59– 0.85]
Parity				
1	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]	1 [1.00, 1.00]
2	0.79*** [0.74–0.84]	0.77*** [0.72– 0.83]	0.75*** [0.70– 0.81]	0.74*** [0.69– 0.80]
3	0.71*** [0.65–0.77]	0.69*** [0.63–0.75]	0.67*** [0.61– 0.73]	0.66*** [0.60– 0.72]
4+	0.67*** [0.60–0.74]	0.65*** [0.58–0.72]	0.63*** [0.56– 0.70]	0.61*** [0.54– 0.69]
Model diagnostics				
Random effects (PSU variance)	0.140 [0.110– 0.176]	0.090 [0.071– 0.114]	0.095 [0.074– 0.120]	0.088 [0.069– 0.111]
ICC	0.0408	0.0261	0.0276	0.0264
AIC	59,150.22	53,990.31	56,640.18	53,220.09
Log-likelihood	-29,570.12	-26,990.45	-28,330.33	-26,560.11
N	44,280	44,280	44,280	44,280
Clusters	1,520	1,520	1,520	1,520

Values with exponents represent exponentiated coefficients, 95% confidence intervals are given in brackets, aOR represents exponentiated Odds Ratios, CI denotes 95% confidence interval, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; 1=Reference category, PSU Primary Sampling Unit, ICC Intra-Class Correlation, AIC Akaike's Information Criterion

4. CONCLUSION

This Paper is unique in contributing both extensive patterns and determinants of maternal health care service use in terms of the uptake of antenatal care (ANC), skilled birth attendance (SBA) and postnatal care (PNC) among rural women in Sub-Saharan Africa (SSA) between 2015 and 2025. The results show an overall and statistically significant increase in all three maternal health services across the Paper period, pointing towards significant improvements in maternal health services coverage in the region. While this is an overall advancement, structural and systemic disparities in socio-economic, educational, geographic and cultural aspects are still noticeable.

The multilevel analyses show that higher maternal education level, household wealth, health insurance coverage and exposure to mass media are significant factors that enable access to maternal health services. On the other hand, factors like high parity, living in the rural areas and some religious groups still remain a hindrance in the way of better use of services. The intracluster correlation coefficients also support the conclusion that contextual or community-level factors continue to have an impact on maternal healthcare behaviors in Sub Saharan Africa.

Overall, maternal health has made significant progress in the past 10 years, however meeting universal and equitable coverage remains a challenge. Building resilient rural health systems, tackling socioeconomic inequities, and encouraging health education is key to ensuring continuity of progress. The results highlight the importance of focused maternal health policies that take a rights-based approach and leave no woman behind, irrespective of the situation, to access lifesaving maternal health services across Sub Saharan Africa.

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