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Rural-urban correlates of skilled birth attendance utilisation in Sierra Leone: a national cross-sectional survey

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Abstract

Introduction: Understanding the context specific correlates of skilled birth attendance (SBA) in urban and rural areas is key to designing relevant strategies and programs. This analysis aimed to assess for the rural-urban correlates of SBA in Sierra Leone.

Methods: Using data from the 2019 Sierra Leone Demographic and Health Survey (SLDHS) that applied multistage stratified sampling, a total of 7,326 women aged 15–49 who had a live birth within five years preceding the survey were eligible for the analysis. Multivariable logistic regression was done.

Results: SBA was higher in urban areas at 94.9% (95% CI: 94.1-95.7) compared to 84.2% (95% CI: 83.8-85.9) in rural areas. Rural women resident in the Southern, Northern and Eastern regions, with post-primary education (aOR = 1.80; 95% CI 1.30 to 2.48), exposure to mass media (aOR = 1.48; 95% CI 1.13 to 1.94), not having difficulties with distance to the nearest health facility (aOR = 2.25; 95% CI 1.68 to 3.02) were associated with higher odds of SBA. Urban women resident in the Southern, Eastern region, with households having less than seven members (aOR = 1.53; 95% CI 1.01 to 2.34), exposure to mass media (aOR = 1.76; 95% CI 1.08 to 2.86) and not having difficulties with distance to the nearest health facility (aOR = 1.61; 95% CI 1.04 to 2.48) were associated with higher odds of SBA.

Conclusion: Region, mass media exposure and distance to the nearest health facility were significantly associated with SBA among both rural and urban women. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of ANC initiation were only significant in rural areas. Given the observed differences, improving SBA requires context-specific tailored approaches and strategies including targeting mechanisms that have to be designed differently.

Keywords: Skilled birth attendance, Sierra Leone, Rural-Urban, Women, DHS

Strengths and limitations of the study

- This is the foremost nationwide analysis that explores the rural-urban correlates of skilled birth attendance in Sierra Leone
- The study used a nationally representative sample using the most recent Sierra Leone Demographic and Health Survey (SLDHS) 2019 data, making the findings of the present study generalisable for women in Sierra Leone.
- The temporal relationship between the outcome variable and the independent variables could not be established due to the cross-sectional nature of the survey.
- Since the data was collected from women who had childbirths within five years preceding the survey, we anticipate recall bias in the process of collecting this data among the respondents.

Introduction

Globally, over 34% of deliveries are not supervised by a skilled birth attendant, which is over 45 million births each year [1]. Sub-Saharan Africa has registered significant progress with skilled birth attendance, but over 50% of births are still supervised by unskilled health personnel [1]. About 303,000 maternal deaths are registered annually with ninety-nine percent of these occurring in low- and middle-income countries [2]. Skilled birth attendance (SBA) is a proven evidence based intervention for reducing maternal and neonatal morbidity and mortality [3]. Skilled birth attendance can reduce the possibility of death owing to intrapartum-related complications or stillbirth by up to 20% [4]. Therefore, ensuring increased utilisation of SBA can substantially contribute towards achievement of the Sustainable Development Goal (SDG) 3 that aims at reducing MMR to 70 per 100, 000 and neonatal mortality ratio (NMR) of ≤12 per 1,000 live births by 2030 [4, 5]. A skilled birth attendant is "an accredited health professional such as a midwife, doctor, or nurse who have been trained with adequate skills needed to handle uncomplicated pregnancies, childbirth, and the immediate postnatal period, and in the identification, management, and referral of complications in women and newborns" [4].

Besides the women losing their lives, effects of maternal mortality and morbidity are also experienced by their families and communities [6]. Children who lose their mothers have an increased risk of death or other health challenges such as malnutrition and the society loses resources when women die in their most productive years [6]. In Sierra Leone, pregnancy carries an approximate lifetime risk of maternal mortality of 1 in 17 making it among the highest globally [4]. Despite the government's efforts to improve maternal health with approaches such as Free Health Care Initiative (FHCI) in 2010 that exempted user fees for maternal healthcare services [7], much has not been achieved, as Sierra Leone is among the top three countries with the highest maternal mortality ratio (MMR), globally [4, 8].

Although disparities in the levels of utilisation of SBA between urban and rural women in Sierra Leone have been documented [4, 9], information on factors responsible for these differences has not been adequately explored. Therefore, it is important to further understand these factors when stratifying by rural-urban place of residence among women because this may be key to designing effective context-specific interventions tailored to the needs of each setting. We aimed to

determine the correlates of skilled birth attendance in Sierra Leone, stratified by rural-urban place of residence.

Methods

Data source

The study used secondary data from the 2019 Sierra Leone Demographic and Health Survey (SLDHS) accessed from MEASURE DHS database at http://dhsprogram.com/data/available-datasets.cfm. SLDHS was a nationally representative cross-sectional survey implemented between May and August 2019 by Statistics Sierra Leone (Stats SL) with technical assistance from ICF intern through the DHS Program and funded by the United States Agency for International Development (USAID). The Demographic and Health Survey datasets are freely available to the public though researchers must register with MEASURE DHS and submit a request before accessing them.

Study sampling and participants

The 2019 SLDHS samples were selected using a stratified, two-stage cluster sampling design that resulted in the random selection of 13,872 households [9]. Detailed sampling procedures were published in the final report [9]. DHS uses different questionnaires. Household questionnaire collects data on household environment, assets and basic demographic information of household members while women's questionnaire collects data about women's reproductive health, domestic violence and nutrition indicators. This secondary analysis included women aged 15 to 49 years who had a live birth within five years preceding the survey and were either permanent residents or slept in the selected household the night preceding the survey. Out of the total weighted sample of 15,574 women in the individual women's data set, only 7,326 had given birth within five years preceding the survey with 4,531 women in rural areas and 2,795 women in urban areas**.** Of the 7,326 women, 113 women (32 in rural areas and 81 in urban areas) had missing data on the timing of ANC first contact leading to a total of 4,499 rural women and 2,714 urban women in the logistic regression analysis as shown in **the supplementary file 1.**

Variables

Dependent variables

Skilled birth attendance was defined as delivery conducted by a doctor, nurse or midwife [9] and was coded as one (1) while un skilled birth attendance was coded as zero (0).

Independent variables

This study included determinants of skilled birth attendance based on evidence from available literature and data [1, 4, 6]. Sixteen explanatory variables were included and categorized as shown in **Table1**:

Statistical analysis

In order to account for the multi-stage cluster study design, complex sample package of SPSS (version 25.0) statistical software was used and the data was adjusted using sampling weight, primary sampling unit, and strata. Before logistic regression, each exposure/predictor (independent variable) was assessed separately for its association with the outcome variable using bivariable logistic regression and we presented the crude odds ratio (COR), 95% confidence interval (CI) and p-values. Independent variables with a p-value ≤ 0.25 at the bivariable level, and not strongly collinear with other independent variables were included in the final multivariable logistic regression model to assess the independent effect of each variable on skilled birth attendance. Adjusted odds ratios (AOR), 95% confidence intervals (CI) and p-values were calculated with statistical significance level set at p-value < 0.05. A STROBE checklist has been attached as **supplementary file 2.**

Patient and public involvement

Patients were not involved. However, local authorities in the different regions were contacted before data collection. A comprehensive report on the survey results was released and openly available on the DHS website.

Ethics approval

High international ethical standards are ensured during MEASURE DHS surveys and the 2019 SLDHS protocol was reviewed and approved by the Sierra Leone Ethics and Scientific Review Committee and the ICF Institutional Review Board. Besides, the local authorities before implementing the survey and well-informed verbal consent are sought from the respondents prior

to data collection. However, ethical approval ID was not provided in the SLDHS survey report. This data set was obtained from the MEASURE DHS website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) after getting their permission, and no formal ethical clearance was obtained since we conducted a secondary analysis of publicly available data.

Results

Table 2 shows a comparison of background characteristics of study participants. Rural areas had more participants (4,531) compared to urban areas (2,795). Remarkable differences were observed in region with 1.1% of rural women residing in Western region compared to 51.1% in urban areas. Furthermore, 63.2% of rural women had no education compared to 35.5% in urban areas, 34.8% in rural areas belonged to the poorest quintile compared to 0.4% in urban areas and 36.2% had exposure to mass media in rural areas compared to 69.7% in urban areas. Over 60.3% of rural women had big problems with distance to the nearest health facility compared to 25.8% in urban areas. Overall, 88.3% (6468/7,326, 95% CI: 87.9-89.4) of the women had skilled birth attendance. Skilled birth attendance was higher in urban areas at 94.9% (2,653/2,795, 95% CI: 94.1-95.7) compared to 84.2% (3,816/4,531, 95% CI: 83.8-85.9) in rural areas.

Factors associated with skilled birth attendance

Table 3 presents the predictors of rural and urban skilled birth attendance in Sierra Leone. Our analysis revealed that region of residence, exposure to mass media and distance to the nearest health facility have significant positive association with skilled birth attendance among women from both regions of residence. In the rural areas, belonging to the Southern (aOR = 3.13; 95% CI 2.10 to 4.68), Northern (aOR = 2.90; 95% CI 1.91 to 4.42) and Eastern regions (aOR = 5.71; 95% CI 3.07 to 10.65), being visited a field worker (aOR = 1.37; 95% CI 1.05 to 1.79), post-primary education (aOR = 1.80; 95% CI 1.30 to 2.48), exposure to mass media (aOR = 1.48; 95% CI 1.13 to 1.94), not having big problems with distance to the nearest health facility (aOR = 2.25; 95% CI 1.68 to 3.02) were positively associated with skilled birth attendance while initiating ANC after the first trimester (aOR = 0.76; 95% CI 0.60 to 0.95) was negatively associated with skilled birth attendance.

In the urban areas, belonging to Southern (aOR = 5.09; 95% CI 1.96 to 13.25), Eastern region (aOR =11.7; 95% CI 4.56 to 30.21), households with less than seven members (aOR = 1.53; 95% CI 1.01 to 2.34), had exposure to mass media (aOR = 1.76; 95% CI 1.08 to 2.86) and had no big

problems with distance to the nearest health facility (aOR = 1.61; 95% CI 1.04 to 2.48) were positively associated with skilled birth attendance. **Wealth index was imprecisely significant with urban women belonging to the richest quintile (aOR = 2.53; 95% CI 0.99 to 6.48) being more likely to have skilled birth attendance compared to those in the poor quintile.**

Discussion

In this study, we looked at factors associated with SBA utilisation in Sierra Leone stratified by rural-urban place of residence. Overall, 88.3% (95% CI: 87.9-89.4) of the women had skilled birth attendance. The overall, urban, rural and SBA prevalence in our study shows 28, 15 and 31 percentage point increases respectively compared to that of 2013 [4, 10]. This shows a tremendous improvement in the uptake of the SBA between 2013 and 2019 in Sierra Leone which could be attributed to the changes in health-seeking behaviour and transformation of the health systems witnessed after the Ebola epidemic [11, 12]. The introduction of free maternal health care services with the Free Health Care Initiative (FHCI) that exempted pregnant women, breastfeeding mothers and children under 5 years of age from paying fees for services in 2010 could also partly have contributed to the observed increase in SBA utilisation [13, 14]. SBA was higher in urban areas at 94.9% (95% CI: 94.1-95.7) compared to 84.2% (95% CI: 83.8-85.9) in rural areas. Higher SBA utilization among urban women has also been shown by Ameyaw et al [4] and this could be partly explained by factors such as the post-conflict fragility of the rural healthcare system, high concentration of health care facilities and healthcare workers in urban areas enabling easier access to maternal healthcare services [4, 15, 16]. Higher SBA utilization among urban women compared to rural women has been shown in several other studies [17-19].

Region of residence, exposure to mass media, and distance to the nearest health facility had significant association with SBA uptake in both rural and urban areas. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of initiation ANC were only significant in rural areas. Being a resident of the South, the Eastern and Northern regions was associated with more odds of SBA utilisation among rural areas compared to those in the Western and North-western regions which was a similar finding for urban women in the Eastern and Southern regions. This is an unexpected finding since the Western region has the largest concentration of health workers and health facilities, the most developed and houses the capital and economic city of the country and hence

has higher quality social amenities compared to other regions [13, 15]. However, the Western areas have witnessed increasing numbers of urban poor coupled with high standards of living and inequitable distribution of social amenities including public and private health facilities, which negatively affects access to healthcare [20, 21]. Furthermore, the documented staff challenges in urban areas such as poor delegation, favoritism and a lack of autonomy could partly affect quality of services in public health facilities which further limits utilisation of healthcare [13, 15]. The government's efforts to ensure better service delivery in the less developed regions that are far away from the developed Western region could also have contributed to this observation [22]. Region has been shown to be associated with SBA in studies done in similar contexts [23].

Exposure to mass media was associated with more odds of SBA utilisation in both rural and urban areas. Mass media help in reducing knowledge gaps by sensitizing the public on the benefits of healthcare seeking and utilisation which leads to positive attitudes, challenges negative social norms and improves health seeking behavior [24, 25]. Furthermore, women who are exposed to mass media are more likely to be educated, have discussions with their peers which interpersonal interactions contribute greatly in challenging negative norms that might affect health seeking and hence lead to positive health seeking behavioral change [26, 27]. Hence, enhancing mass media exposure can be used to provide quality healthcare communication that can lead to an improvement in the utilization of SBA [28]. Exposure to media has been shown in previous studies done in similar contexts to have a positive association with SBA [4, 29, 30].

Rural and urban women who reported that distance to health facilities was not a major challenge had higher odds of SBA utilization. Our study observed that the mothers in rural areas and urban areas who had no big problem with distance to a health facility had 2.25 and 1.62 higher odds respectively of being attended to by a skilled birth attendant compared to their counterparts who had challenges of distance to the nearest health facility. The strong association between distance to health facility and SBA utilization among the rural mothers compared to urban can be partly explained by the fact that rural areas of Sierra Leone have poor road networks compared to urban areas with most roads being only accessible by off-road vehicles or motorbikes. This is further compounded by the lack of access to affordable transport and health facilities that far apart from each other, which contributes to delays faced by women in rural areas [31, 32]. Distance to

health facilities has been shown to impede access to maternal child health services including SBA in several other studies [6, 33, 34].

Unlike in urban areas, being visited by a field health worker, such as a community health worker (CHW) among rural women was significantly associated with SBA utilization. The high demand of CHWs in rural areas due to limited accessibility of healthcare because of shortage of health facilities and large distances needed to be covered by rural women [15, 31] compared to easier access of health facilities in urban areas could partly explain the observed difference in association. The increased SBA utilization among rural women who were visited by field health workers could be partly explained by the fact these field health workers equip mothers with knowledge on the dangers of using unskilled birth attendants and complications of pregnancies in addition to encouraging them to seek care within health facilities [35]. Being visited by field health workers has been shown to be associated with SBA in several other studies [36, 37].

Level of education was significantly associated with SBA in rural areas but not urban areas. Women with post-primary education had more odds of SBA utilisation compared to women with no education. Educated women are believed to easily understand counseling given from healthcare workers, more health literate hence informed on obstetric danger signs, which enables them to seek early maternal healthcare [28]. Educated women have also been shown to develop greater confidence, be more conscious of their health and better capabilities to make wise decisions about their own health, have more antenatal care visits, and eventually leading to better SBA utilisation [4, 6]. Furthermore, higher levels of education have an influence on women's positive interpretation of mass media messages leading to positive healthcare seeking behavior change [28]. In predominantly patriarchal African societies and mainly in rural areas [38], men are the main sources of household income and have the highest household decision making [39]. Women in rural areas tend to be less empowered than their urban counterparts due to the more conservative societies in rural areas hence factors such as education that might increase women's status and decision making are more likely to have an impact on healthcare seeking [40-43]. This might partly explain the significance of education in rural areas and the non-significance in urban areas. Our findings indicate the need for government to strengthen access to quality girl child education among rural areas to atleast secondary school level. Level of education has been shown to be associated with SBA utilisation among several other studies [28, 44, 45]. Delayed

initiation of ANC among rural women was associated with less odds of SBA utilization. ANC utilization has been shown to be associated with several other studies [28, 33, 46]. Delayed initiation could partly reflect poor health seeking behaviour which is further observed by reduced odds of SBA utilization. However, there is need for further studies to explore the association of ANC utilization and SBA given the fact that ANC frequency was not significantly associated with SBA but timing of ANC initiation was.

Besides the three factors that were significant in both rural and urban areas, household size was the only factor that showed significance in urban areas. Women who belonged to households with less than seven members had more odds of SBA utilization compared to their counterparts. This is in agreement with a study done in Nigeria and India [47, 48]. Although wealth index was marginally significant in urban areas, women belonging to the richest wealth quintile had 2.5 odds of SBA utilisation compared to their counterparts in the poorest households. We hypothesize that families with smaller sizes tend to have less expenditure which enables savings that can be used for the direct and indirect costs involved in accessing healthcare [48]. Furthermore, smaller sizes could be attributed to better maternal healthcare seeking such as modern contraceptives utilization which is further translated into SBA utilisation [48]. Lastly, having smaller family size might lead to less time spent by women while doing household chores and providing care to other family members and increase their time to seek healthcare [49]. However, given the dearth of information regarding household size and SBA utilisation, we recommend further studies to explore this.

Strengths and limitations

The strength of this study was that we used a nationally representative sample for the analysis and thus the results can be generalised to all Sierra Leone women. Since the data was extracted from DHS surveys, we are confident that standardized procedures such as validated questionnaires were used in data collection to ensure the validity of the results. This being a cross-sectional study, this creates a limitation in establishing casual relationships from the established associations. In addition, since most of the data was for women who had childbirths within five years preceding the survey, we anticipate recall bias in the process of collecting this data among the respondents.

Conclusion and public health implications

In Sierra Leon, SBA utilisation has greatly improved in the last decade. Utilisation is higher in the urban compared to the rural areas. Region of residence, exposure to mass media, and distance to the nearest health facility had a significant association with SBA uptake in both rural and urban areas. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of initiation ANC were only significant in rural areas. Hence ensuring context specific policies and strategies is crucial to ensure effective SBA utilisation. Generally, maternal stakeholders need to focus on Western region, use of mass media for awareness and sensitization and ensuring increased availability of affordable and accessible health facilities in both rural and urban areas. In addition, urban specific programs need to focus on women residing in larger households and rural specific programs need to focus on use of field health workers, women educated to primary level and below and ensuring timely initiation of ANC services.

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Author contributions

QS Conceived the idea, drafted the manuscript, performed analysis and interpreted the results. IM, KK and MWM reviewed and interpreted the results, reviewed the first draft and drafted the subsequent versions of the manuscript. All authors read and approved the final manuscript.

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Competing interests

None declared

Patient consent for publication Not required.

Data availability statement All data are available from the Demographic and Health Surveys website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) upon registration.

Ethics statement

High international ethical standards are ensured during MEASURE DHS surveys and the 2019 SLDHS protocol was reviewed and approved by the Sierra Leone Ethics and Scientific Review Committee and the ICF Institutional Review Board. Besides, the local authorities before implementing the survey and well-informed verbal consent are sought from the respondents prior to data collection. This data set was obtained from the MEASURE DHS website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) after getting their permission, and no formal ethical clearance was obtained since we conducted a secondary analysis of publicly available data.

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Table 1: Categorisation of independent variables

Variable	Categorization	Explanation
Maternal age	15-19 years, 20–34 years and 35–49 years	-
Wealth index	poorest, poorer, middle, richer and richest quintiles	Wealth index is a measure of relative household economic status and was calculated by SLDHS from information on household asset ownership using Principal Component Analysis [50] . Among rural women, only 0.9% and 5.7% belonged to the richest and richer quintiles, hence these were combined into one to have rich, middle, poorer and poorest quintiles in logistic regression. Among urban women, only 0.3% and 3.0% belonged to the poorest and poorer quintiles, hence these were combined

		into one to have poor, middle, richer and richest quintiles in logistic regression.
Region	Northern, Eastern, Southern, Western and Northwestern	Among rural women, only 1.1% belonged to the Western region hence in logistic regression, Western and Northwestern regions were combined.
Education	No education, primary education, secondary and tertiary education	Among rural women, only 0.5% of the women had tertiary education and only 7.1% in urban hence secondary and tertiary were combined to have post-primary in the logistic regression analysis.
Household size	Less than seven members and seven and above members	Based on the dataset average of seven members per household
Sex of household head	Male or female	
Marital status	Married and Not Married	Marriage included those in formal and informal unions while not married included the never married, divorced, separated and widowed.
Religion	Muslims and Christians and others	
Problem seeking permission to access healthcare	Big problem and no big problem	In the questionnaire, seeking permission to access healthcare had three original responses: no problem, no big problem and big problem. However, none of the study participants reported no problem hence we only had two responses.
Difficulties accessing nearest health facility	big problem and no big problem	In the questionnaire, problems with distance to the nearest health facility had three original responses: no problem, no

		big problem and big problem. However, none of the study participants reported no problem hence we only had two responses.
Exposure to media	Yes and No	Yes included women who had exposure to any of the four mass media (radio, television (TV) and newspapers and internet)
Working	Yes and No	-
Visited by fieldworker	Yes and No	-
Parity	5 and above, 2-4 and 1	-
ANC frequency	8 and above ANC contacts and less than 8 ANC contacts	-
ANC timing	Within the first trimester and after first trimester	-

Table 2: Socio-demographic characteristics of women in Sierra Leone as per the 2019 SLDHS

	Rural		**Urban**	
Characteristics	**N=4531**	**%**	**N=2795**	**%**
Age				
15 to 19	375	8.3	223	8.0
20 to 34	2835	62.6	1995	71.4
35 to 49	1322	29.2	577	20.6
Visited by field worker				
No	3126	69.0	1933	69.2
Yes	1405	31.0	862	30.8
Region				
Western	51	1.1	1428	51.1
Eastern	1059	23.4	483	17.3
Northwestern	1096	24.2	285	10.2
Northern	1082	23.9	351	12.6
Southern	1244	27.5	248	8.9
Religion				
Islam	3729	82.3	2036	72.9

Christianity and others	802	17.7	758	27.1
Sex household head				
Male	3663	80.8	1857	66.4
Female	868	19.2	938	33.6
Household Size				
7 and above	2083	46.0	1236	44.2
Less than 7	2448	54.0	1559	55.8
Working status				
Not working	684	15.1	998	35.7
Working	3847	84.9	1796	64.3
Marital status				
Not married	606	13.4	723	25.9
Married	3925	86.6	2072	74.1
Education Level				
No Education	2866	63.2	992	35.5
Primary Education	729	16.1	304	10.9
Secondary Education	913	20.1	1302	46.6
Tertiary	24	0.5	197	7.1
Wealth Index				
Poorest	1576	34.8	11	0.4
Poorer	1466	32.4	85	3.0
Middle	1192	26.3	296	10.6
Richer	258	5.7	1184	42.4
Richest	40	0.9	1219	43.6
Parity				
1	1011	22.3	977	35.0
2-4	2522	55.7	1493	53.4
5 and above	998	22.0	324	11.6
Exposure to mass media				
No	2890	63.8	846	30.3
Yes	1641	36.2	1948	69.7
Permission to access healthcare				
Big problem	1427	31.5	399	14.3
Not big problem	3104	68.5	2396	85.7
Distance to health facility				
Big problem	2732	60.3	722	25.8
Not big problem	1799	39.7	2073	74.2
ANC timing [a]				
First trimester	2048	45.5	1165	42.9
After first trimester	2451	54.5	1549	57.1
ANC attendance				
8 contacts and above	988	21.8	622	22.3
Less than 8 contacts	3543	78.2	2173	77.7

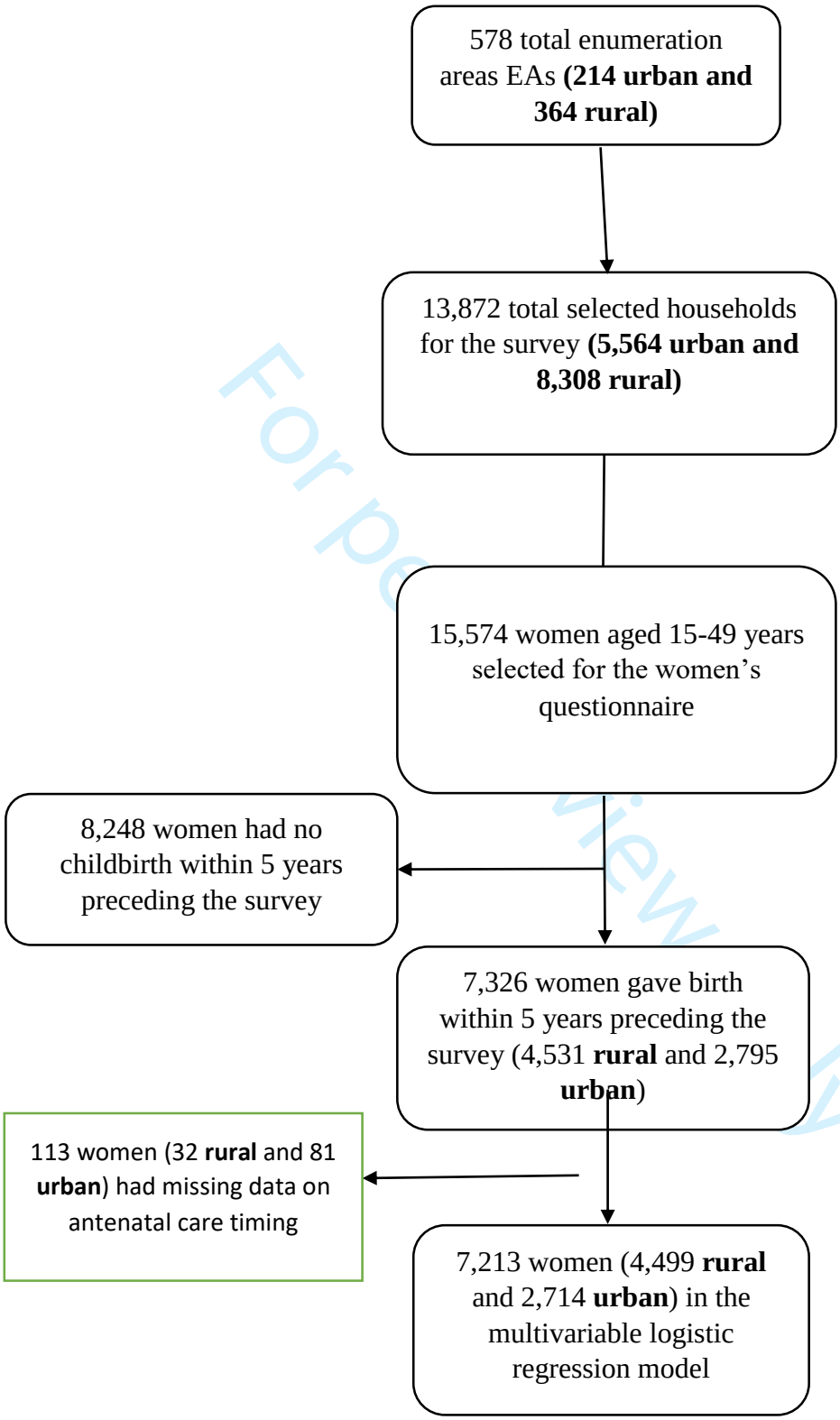
[a]= missing 32 (0.7%) respondents in rural and 81 (2.9%) in urban areas

Table 3: Factors associated with skilled birth attendance in Sierra Leone as per the 2019 SLDHS

	Rural N=4499			Urban N=2714		
Characteristics	**Crude model cOR (95% CI)**	**P-value**	**Adjusted model aOR (95% CI)**	**Crude model cOR (95% CI)**	**P-value**	**Adjusted model aOR (95% CI)**
Age		0.002			0.825	
35 to 49	1		1	1		
20 to 34	**1.32 (1.08-1.60)**		1.18 (0.95-1.46)	0.94 (0.56-1.60)		
15 to 19	**1.86 (1.26-2.75)**		1.45 (0.94-2.25)	0.78 (0.35-1.73)		
Visited by fieldworker		0.004			0.625	
No	1		1	1		
Yes	**1.47 (1.13-1.92)**		**1.37 (1.05-1.79)**	1.14 (0.68-1.89)		
Region		<0.001			<0.001	
West and Northwestern	1		1	1		1
Southern	**2.74 (1.82-4.13)**		**3.13 (2.10-4.68)**	**4.32 (1.64-11.40)**		**5.09 (1.96-13.25)**
Northern	**2.96 (1.92-4.57)**		**2.90 (1.91-4.42)**	1.56 (0.74-3.33)		2.03 (0.92-4.49)
Eastern	**5.38 (2.95-9.81)**		**5.71 (3.07-10.65)**	**6.07 (2.71-13.61)**		**11.7 (4.56-30.22)**
Religion		0.199			0.094	
Christianity and others	1		1	1		1
Islam	0.81 (0.59-1.12)		1.37 (0.98-1.93)	0.61 (0.34-1.09)		0.93 (0.51-1.70)
Sex household head		0.269			0.522	
Male	1			1		
Female	1.15 (0.90-1.47)			0.87 (0.58-1.32)		
Household Size		0.065			0.036	
7 and above	1		1	1		1
Less than 7	1.22 (0.99-1.50)		1.13 (0.91-1.40)	**1.63 (1.03-2.58)**		**1.53 (1.01-2.34)**
Working status		0.745			0.080	
Not working	1			1		1
Working	0.95 (0.67-1.33)			0.70 (0.47-1.04)		0.79 (0.49-1.26)
Marital status		<0.001			0.885	
Not married	1		1	1		
Married	**0.59 (0.44-0.79)**		0.78 (0.57-1.07)	1.03 (0.66-1.62)		
Education Level		<0.001			0.020	
No Education	1		1	1		1
Primary	1.29 (0.96-1.72)		1.06 (0.79-1.42)	1.89 (0.95-3.76)		1.71 (0.81-3.60)
Post-primary	**2.34 (1.74-3.15)**		**1.80 (1.30-2.48)**	**1.94 (1.18-3.19)**		1.38 (0.76-2.51)
Wealth Index					0.200	
Poor				1		1
Middle				1.04 (0.33-3.32)		1.20 (0.41-3.49)
Richer				1.11 (0.40-3.03)		1.46 (0.63-3.36)
Richest				1.96 (0.67-5.72)		;,
Wealth Index		0.282				

Poorest	1					
Poorer	1.01 (0.81-1.26)					
Middle	1.19 (0.88-1.61)					
Rich	1.61 (0.97-2.67)					
Parity		0.018			0.106	
5 and above	1		1	1		1
2-4	1.09 (0.89-1.34)		0.85 (0.68-1.06)	1.53 (0.80-2.93)		1.04 (0.54-1.20)
1	**1.43 (1.09-1.88)**		0.96 (0.69-1.32)	**2.13 (1.05-4.31)**		1.27 (0.61-2.68)
Exposure to media		0.001			<0.001	
No	1		1	1		1
Yes	**1.56 (1.20-2.03)**		**1.48 (1.13-1.94)**	**2.20 (1.43-3.36)**		**1.76 (1.08-2.86)**
Permission to access		0.916			0.398	
Big problem	1			1		
Not big problem	0.99 (0.75-1.29)			0.77 (0.41-1.43)		
Distance to health		<0.001			0.104	
Big problem	1		1	1		1
Not big problem	**2.27 (1.67-3.08)**		**2.25 (1.68-3.02)**	1.43 (0.93-2.19)		**1.61 (1.04-2.48)**
ANC timing [a]		0.001			0.041	
First trimester	1		1	1		1
After first trimester	0.67 (0.53-0.85)		**0.76 (0.60-0.95)**	**0.65 (0.43-0.98)**		0.77 (0.49-1.20)
ANC attendance		0.615			0.060	
8 contacts and above	1			1		**1**
Less than 8	1.07 (0.82-1.39)			0.60 (0.35-1.02)		0.64 (0.38-1.08)

[a]= missing 32 in rural and 81 in urban. **bold**= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio



Additional file Figure 1: flow chat of sampling process

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4,5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	5
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7

		(*b*) Report category boundaries when continuous variables were categorized	6-7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Rural-urban correlates of skilled birth attendance utilisation in Sierra Leone: evidence from the 2019 Sierra Leone demographic health survey

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Abstract

Objectives Understanding the context specific correlates of skilled birth attendance (SBA) in urban and rural areas is key to designing relevant strategies and programs. This analysis aimed to assess for the rural-urban correlates of SBA in Sierra Leone.

Setting Data from the nationally representative 2019 Sierra Leone Demographic and Health Survey (SLDHS) were used.

Participants The study included a weighted sample of 7,326 women aged 15–49 years who had a live birth within five years preceding the survey (4,531 in rural areas and 2,795 women in urban areas)**.**

Primary and secondary outcome measure Skilled birth attendance (primary) and predictors of skilled birth attendance (secondary).

Results SBA was higher in urban areas at 94.9% (95% CI: 94.1-95.7) compared to 84.2% (95% CI: 83.8-85.9) in rural areas. Rural women resident in the Southern, Northern and Eastern regions, with post-primary education (aOR = 1.8; 95% CI 1.3 to 2.5), exposure to mass media (aOR = 1.5; 95% CI 1.1 to 1.9), not having difficulties with distance to the nearest health facility (aOR = 2.3; 95% CI 1.7 to 3.0) were associated with higher odds of SBA. Urban women resident in the Southern, Eastern region, with households having less than seven members (aOR = 1.5; 95% CI 1.1 to 2.3), exposure to mass media (aOR = 1.8; 95% CI 1.1 to 2.9) and not having difficulties with distance to the nearest health facility (aOR = 1.6; 95% CI 1.1 to 2.5) were associated with higher odds of SBA.

Conclusion Given the observed differences, improving SBA requires context-specific tailored approaches and strategies including targeting mechanisms that have to be designed differently.

Keywords: Skilled birth attendance, Sierra Leone, Rural-Urban, Women, DHS

Strengths and limitations of the study

- This is the foremost nationwide analysis that explores the rural-urban correlates of skilled birth attendance in Sierra Leone
- The study used a nationally representative sample using the most recent Sierra Leone Demographic and Health Survey (SLDHS) 2019 data, making the findings of the present study generalisable for women in Sierra Leone.
- The temporal relationship between the outcome variable and the independent variables could not be established due to the cross-sectional nature of the survey.
- Since the data was collected from women who had childbirths within five years preceding the survey, we anticipate recall bias in the process of collecting this data among the respondents.

Introduction

Globally, over 34% of deliveries are not supervised by a skilled birth attendant, which is over 45 million births each year [1, 2]. Sub-Saharan Africa has registered significant progress with

skilled birth attendance, but over 50% of births are still supervised by unskilled health personnel [3]. About 303,000 maternal deaths are registered annually with ninety-nine percent of these occurring in low- and middle-income countries [4]. Skilled birth attendance (SBA) is a proven evidence based intervention for reducing maternal and neonatal morbidity and mortality [5, 6]. Skilled birth attendance can reduce the possibility of death owing to intrapartum-related complications or stillbirth by up to 20% [7]. Therefore, ensuring increased utilisation of SBA can substantially contribute towards achievement of the Sustainable Development Goal (SDG) 3 that aims at reducing the global maternal mortality ratio (MMR) to less than 70 per 100, 000 and neonatal mortality ratio (NMR) of ≤12 per 1,000 live births by 2030 [7-9]. A skilled birth attendant is "an accredited health professional such as a midwife, doctor, or nurse who have been trained with adequate skills needed to handle uncomplicated pregnancies, childbirth, and the immediate postnatal period, and in the identification, management, and referral of complications in women and newborns" [7].

Besides the women losing their lives, effects of maternal mortality and morbidity are also experienced by their families and communities [10]. Children who lose their mothers have an increased risk of death or other health challenges such as malnutrition and the society loses resources when women die in their most productive years [10]. In Sierra Leone, pregnancy carries an approximate lifetime risk of maternal mortality of 1 in 17 making it among the highest globally [7]. Despite the efforts by the health stakeholders, utilisation of maternal health services such as coverage of four or more antenatal (ANC) contacts marginally increased from 76% in 2013 to 79% in 2019 while early initiation in the first trimester declined from 45% in 2013 to 44% in 2019 [11], although the Ministry of Health adopted the new WHO ANC model in 2017 that aims for at least eight ANC contacts[12]. Although this is indicated in the Sierra Leone

National Reproductive, Maternal, Neonatal, Child and Adolescent Health (RMNCAH) strategy (2017-2021), no data is available about the progress of utilisation of eight or more ANC contacts with the latest SLDHS giving statistics on utilisation of at least four ANC contacts [11].

Sierra Leone's long civil war and Ebola epidemic left the health system fragile and overwhelmed with inadequate skilled health personnel having low and irregular remuneration [13]. Despite the government's efforts to improve maternal health with approaches such as Free Health Care Initiative (FHCI) in 2010 that exempted user fees for maternal healthcare services [14], much has not been achieved, as Sierra Leone is among the top three countries with the highest maternal mortality ratio (MMR), globally [7, 15]. Furthermore, the effectiveness of the FHCI is challenged by inadequate skilled health personnel, increasing demand and stock-outs of crucial medical supplies and equipment leading to patients having to pay for services that are meant to be free [16, 17]. Secondary and tertiary care in Sierra Leone is provided by 14 district and regional governmental hospitals and four tertiary referral hospitals which are all located in the Western Area Urban District [18]. The country's nurse density is one of the world's lowest having approximately 0.2 nurses and midwives per 1000 people [13].

Although disparities in the levels of utilisation of SBA between urban and rural women in Sierra Leone have been documented [7, 11], information on factors responsible for these differences has not been adequately explored. Therefore, it is important to further understand these factors when stratifying by rural-urban place of residence among women because this may be key to designing effective context-specific interventions tailored to the needs of each setting. We aimed to determine the correlates of skilled birth attendance in Sierra Leone, stratified by rural-urban place of residence.

Methods

Data source

The study used secondary data from the 2019 Sierra Leone Demographic and Health Survey (SLDHS) accessed from MEASURE DHS database at http://dhsprogram.com/data/available-datasets.cfm. SLDHS was a nationally representative cross-sectional survey implemented between May and August 2019 by Statistics Sierra Leone (Stats SL) with technical assistance from ICF intern through the DHS Program and funded by the United States Agency for International Development (USAID). The Demographic and Health Survey datasets are freely available to the public though researchers must register with MEASURE DHS and submit a request before accessing them.

Study sampling and participants

The 2019 SLDHS samples were selected using a stratified, two-stage cluster sampling design that resulted in the random selection of 13,872 households [11]. Detailed sampling procedures were published in the final report [11]. DHS uses different questionnaires. Household questionnaire collects data on household environment, assets and basic demographic information of household members while women's questionnaire collects data about women's reproductive health, domestic violence and nutrition indicators. This secondary analysis included women aged 15 to 49 years who had a live birth within five years preceding the survey and were either permanent residents or slept in the selected household the night preceding the survey. Out of the total weighted sample of 15,574 women in the individual women's data set, only 7,326 had given birth within five years preceding the survey with 4,531 women in rural areas and 2,795 women

in urban areas**.** Of the 7,326 women, 113 women (32 in rural areas and 81 in urban areas) had missing data on the timing of ANC first contact leading to a total of 4,499 rural women and 2,714 urban women in the logistic regression analysis as shown in **the supplementary file 1.**

Variables

Dependent variables

Skilled birth attendance was defined as delivery conducted by a doctor, nurse or midwife [11] and was coded as one (1) while un skilled birth attendance was coded as zero (0).

Independent variables

This study included determinants of skilled birth attendance based on evidence from available literature and data [3, 7, 10]. Sixteen explanatory variables were included and categorized as shown in **Table1**:

Statistical analysis

In order to account for the multi-stage cluster study design, complex sample package of SPSS (version 25.0) statistical software was used incorporating the following variables in the analysis plan to account for the multistage sample design inherent in the DHS dataset: individual sample weight, sample strata for sampling errors/design, and cluster number [19, 20]. Cross tabulation was conducted and associations between background characteristics and skilled birth attendance their p-values were presented in **Tables 3 and 4.** Before multivariable logistic regression, each exposure/predictor (independent variable) was assessed separately for its association with the outcome variable using bivariable logistic regression and we presented the crude odds ratio

(COR), 95% confidence interval (CI) and p-values. Independent variables with a p-value ≤ 0.25 at the bivariable level, and not strongly collinear with other independent variables were included in the final multivariable logistic regression model to assess the independent effect of each variable on skilled birth attendance [21]. Adjusted odds ratios (AOR), 95% confidence intervals (CI) and p-values were calculated with adjusted model statistical significance level set at p-value < 0.05. A STROBE checklist has been attached as **supplementary file 2.** Sensitivity analysis was done with unskilled birth attendance as the outcome and the results are shown in **supplementary file 3.**

Patient and public involvement

Patients were not involved. However, local authorities in the different regions were contacted before data collection. A comprehensive report on the survey results was released and openly available on the DHS website.

Ethics approval

High international ethical standards are ensured during MEASURE DHS surveys and the 2019 SLDHS protocol was reviewed and approved by the Sierra Leone Ethics and Scientific Review Committee and the ICF Institutional Review Board. Besides, the local authorities before implementing the survey and well-informed verbal consent are sought from the respondents prior to data collection. However, ethical approval ID was not provided in the SLDHS survey report. This data set was obtained from the MEASURE DHS website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) after getting their permission, and no formal ethical clearance was obtained since we conducted a secondary analysis of publicly available data.

Results

Table 2 shows a comparison of background characteristics of study participants. Rural areas had more participants (4,531) compared to urban areas (2,795). Remarkable differences were observed in region with 1.1% of rural women residing in Western region compared to 51.1% in urban areas. Furthermore, 63.2% of rural women had no education compared to 35.5% in urban areas, 34.8% in rural areas belonged to the poorest quintile compared to 0.4% in urban areas and 36.2% had exposure to mass media in rural areas compared to 69.7% in urban areas. Over 60.3% of rural women had big problems with distance to the nearest health facility compared to 25.8% in urban areas. Overall, 88.3% (6468/7,326, 95% CI: 87.9-89.4) of the women had skilled birth attendance. Skilled birth attendance was higher in urban areas at 94.9% (2,653/2,795, 95% CI: 94.1-95.7) compared to 84.2% (3,816/4,531, 95% CI: 83.8-85.9) in rural areas.

Factors associated with skilled birth attendance

Tables 3 and 4 presents the predictors of rural and urban skilled birth attendance in Sierra Leone. Our analysis revealed that region of residence, exposure to mass media and distance to the nearest health facility have significant positive association with skilled birth attendance among women from both regions of residence. In the rural areas, belonging to the Southern (aOR = 3.1; 95% CI 2.1 to 4.7), Northern (aOR = 2.9; 95% CI 1.9 to 4.4) and Eastern regions (aOR = 5.7; 95% CI 3.1 to 10.7), being visited a field worker (aOR = 1.4; 95% CI 1.1 to 1.8), post-primary education (aOR = 1.8; 95% CI 1.3 to 2.5), exposure to mass media (aOR = 1.5; 95% CI 1.1 to 1.9), not having big problems with distance to the nearest health facility (aOR = 2.3; 95% CI 1.7 to 3.0) were positively associated with skilled birth attendance while initiating ANC after the first trimester (aOR = 0.8; 95% CI 0.6 to 0.9) was negatively associated with skilled birth attendance.

In the urban areas, belonging to Southern (aOR = 5.1; 95% CI 2.0 to 13.3), Eastern region (aOR =11.7; 95% CI 4.6 to 30.2), households with less than seven members (aOR = 1.5; 95% CI 1.1 to 2.3), had exposure to mass media (aOR = 1.8; 95% CI 1.1 to 2.9) and had no big problems with distance to the nearest health facility (aOR = 1.6; 95% CI 1.1 to 2.5) were positively associated with skilled birth attendance. Wealth index was imprecisely significant with urban women belonging to the richest quintile (aOR = 2.5; 95% CI 1.0 to 6.5) being more likely to have skilled birth attendance compared to those in the poor quintile.

Discussion

In this study, we looked at factors associated with SBA utilisation in Sierra Leone stratified by rural-urban place of residence. Overall, 88.3% (95% CI: 87.9-89.4) of the women had skilled birth attendance. The overall, urban, rural and SBA prevalence in our study shows 28, 15 and 31 percentage point increases respectively compared to that of 2013 [7, 22]. This shows a tremendous improvement in the uptake of the SBA between 2013 and 2019 in Sierra Leone which could be attributed to the changes in health-seeking behaviour and transformation of the health systems witnessed after the Ebola epidemic [23, 24]. The introduction of free maternal health care services with the Free Health Care Initiative (FHCI) that exempted pregnant women, breastfeeding mothers and children under 5 years of age from paying fees for services in 2010 could also partly have contributed to the observed increase in SBA utilisation [25, 26]. SBA was higher in urban areas at 94.9% (95% CI: 94.1-95.7) compared to 84.2% (95% CI: 83.8-85.9) in rural areas. Higher SBA utilization among urban women has also been shown by Ameyaw et al [7] and this could be partly explained by factors such as the post-conflict fragility of the rural healthcare system, high concentration of health care facilities and healthcare workers in urban areas enabling easier access to maternal healthcare services [7, 27, 28]. Higher SBA utilization

among urban women compared to rural women has been shown in several other studies [29-31]. The mismatch between high coverage of SBA and the persistently high rates of maternal and perinatal mortality is not only unique to Sierra Leon. Available evidence from similar low resource settings in Sub-Saharan points towards poor quality of services offered [26, 32].

Region of residence, exposure to mass media, and distance to the nearest health facility had significant association with SBA uptake in both rural and urban areas. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of initiation ANC were only significant in rural areas. Being a resident of the South, the Eastern and Northern regions was associated with more odds of SBA utilisation among rural areas compared to those in the Western and North-western regions which was a similar finding for urban women in the Eastern and Southern regions. This is an unexpected finding since the Western region has the largest concentration of health workers and health facilities, the most developed and houses the capital and economic city of the country and hence has higher quality social amenities compared to other regions [25, 27]. However, the Western areas have witnessed increasing numbers of urban poor coupled with high standards of living and inequitable distribution of social amenities including public and private health facilities, which negatively affects access to healthcare [33, 34]. Furthermore, the documented staff challenges in urban areas such as poor delegation, favoritism and a lack of autonomy could partly affect quality of services in public health facilities which further limits utilisation of healthcare [25, 27]. The government's efforts to ensure better service delivery in the less developed regions that are far away from the developed Western region could also have contributed to this observation [12]. Region has been shown to be associated with SBA in studies done in similar contexts [35].

Exposure to mass media was associated with more odds of SBA utilisation in both rural and urban areas. Mass media help in reducing knowledge gaps by sensitizing the public on the benefits of healthcare seeking and utilisation which leads to positive attitudes, challenges negative social norms and improves health seeking behavior [36, 37]. Furthermore, women who are exposed to mass media are more likely to be educated, have discussions with their peers which interpersonal interactions contribute greatly in challenging negative norms that might affect health seeking and hence lead to positive health seeking behavioral change [38, 39]. Hence, enhancing mass media exposure can be used to provide quality healthcare communication that can lead to an improvement in the utilization of SBA [40]. Exposure to media has been shown in previous studies done in similar contexts to have a positive association with SBA [7, 41, 42].

Rural and urban women who reported that distance to health facilities was not a major challenge had higher odds of SBA utilization. Our study observed that the mothers in rural areas and urban areas who had no big problem with distance to a health facility had 2.25 and 1.62 higher odds respectively of being attended to by a skilled birth attendant compared to their counterparts who had challenges of distance to the nearest health facility. The strong association between distance to health facility and SBA utilization among the rural mothers compared to urban can be partly explained by the fact that rural areas of Sierra Leone have poor road networks compared to urban areas with most roads being only accessible by off-road vehicles or motorbikes. This is further compounded by the lack of access to affordable transport and health facilities that far apart from each other, which contributes to delays faced by women in rural areas [43, 44]. Distance to health facilities has been shown to impede access to maternal child health services including SBA in several other studies [10, 45, 46].

Unlike in urban areas, being visited by a field health worker, such as a community health worker (CHW) among rural women was significantly associated with SBA utilization. The high demand of CHWs in rural areas due to limited accessibility of healthcare because of shortage of health facilities and large distances needed to be covered by rural women [27, 43] compared to easier access of health facilities in urban areas could partly explain the observed difference in association. The increased SBA utilization among rural women who were visited by field health workers could be partly explained by the fact these field health workers equip mothers with knowledge on the dangers of using unskilled birth attendants and complications of pregnancies in addition to encouraging them to seek care within health facilities [47]. Being visited by field health workers has been shown to be associated with SBA in several other studies [48, 49].

Level of education was significantly associated with SBA in rural areas but not urban areas. Women with post-primary education had more odds of SBA utilisation compared to women with no education. Educated women are believed to easily understand counseling given from healthcare workers, more health literate hence informed on obstetric danger signs, which enables them to seek early maternal healthcare [40]. Educated women have also been shown to develop greater confidence, be more conscious of their health and better capabilities to make wise decisions about their own health, have more antenatal care visits, and eventually leading to better SBA utilisation [7, 10]. Furthermore, higher levels of education have an influence on women's positive interpretation of mass media messages leading to positive healthcare seeking behavior change [40]. In predominantly patriarchal African societies and mainly in rural areas [50], men are the main sources of household income and have the highest household decision making [51]. Women in rural areas tend to be less empowered than their urban counterparts due to the more conservative societies in rural areas hence factors such as education that might increase women's

status and decision making are more likely to have an impact on healthcare seeking [52-55]. This might partly explain the significance of education in rural areas and the non-significance in urban areas. Our findings indicate the need for government to strengthen access to quality girl child education among rural areas to at least secondary school level. Level of education has been shown to be associated with SBA utilisation among several other studies [40, 56, 57]. Delayed initiation of ANC among rural women was associated with less odds of SBA utilization. ANC utilization has been shown to be associated with several other studies [40, 45, 58]. Delayed initiation could partly reflect poor health seeking behaviour which is further observed by reduced odds of SBA utilization. However, there is need for further studies to explore the association of ANC utilization and SBA given the fact that ANC frequency was not significantly associated with SBA but timing of ANC initiation was.

Besides the three factors that were significant in both rural and urban areas, household size was the only factor that showed significance in urban areas. Women who belonged to households with less than seven members had more odds of SBA utilization compared to their counterparts. This is in agreement with a study done in Nigeria and India [59, 60]. Although wealth index was marginally significant in urban areas, women belonging to the richest wealth quintile had 2.5 odds of SBA utilisation compared to their counterparts in the poorest households. We hypothesize that families with smaller sizes tend to have less expenditure which enables savings that can be used for the direct and indirect costs involved in accessing healthcare [60]. Furthermore, smaller sizes could be attributed to better maternal healthcare seeking such as modern contraceptives utilization which is further translated into SBA utilisation [60]. Lastly, having smaller family size might lead to less time spent by women while doing household chores and providing care to other family members and increase their time to seek healthcare [61].

However, given the dearth of information regarding household size and SBA utilisation, we recommend further studies to explore this.

Strengths and limitations

The strength of this study was that we used a nationally representative sample for the analysis and thus the results can be generalised to all Sierra Leone women. Since the data was extracted from DHS surveys, we are confident that standardized procedures such as validated questionnaires were used in data collection to ensure the validity of the results. This being a cross-sectional study, this creates a limitation in establishing casual relationships from the established associations. In addition, since most of the data was for women who had childbirths within five years preceding the survey, we anticipate recall bias in the process of collecting this data among the respondents.

Conclusion and public health implications

In Sierra Leon, SBA utilisation has greatly improved in the last decade. Utilisation is higher in the urban compared to the rural areas. Region of residence, exposure to mass media, and distance to the nearest health facility had a significant association with SBA uptake in both rural and urban areas. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of initiation ANC were only significant in rural areas. Hence ensuring context specific policies and strategies is crucial to ensure effective SBA utilisation. Generally, maternal stakeholders need to focus on Western region, use of mass media for awareness and sensitization and ensuring increased availability of affordable and accessible health facilities in both rural and urban areas. In addition, urban specific programs need to focus on women residing in larger households and rural specific

programs need to focus on use of field health workers, women educated to primary level and below and ensuring timely initiation of ANC services. Further research is need to explore reasons why maternal mortality is high despite the high SBA focusing on areas such as quality of care provided.

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Author contributions

QS Conceived the idea, drafted the manuscript, performed analysis and interpreted the results. IM, KK and MWM reviewed and interpreted the results, reviewed the first draft and drafted the subsequent versions of the manuscript. All authors read and approved the final manuscript.

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Competing interests

None declared

Patient consent for publication Not required.

Data availability statement The data that support the finding of this study are available from the Demographic and Health Surveys website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) upon registration [11, 62]. Data are available from the authors with the permission of DHS.

Ethics statement

High international ethical standards are ensured during MEASURE DHS surveys and the 2019 SLDHS protocol was reviewed and approved by the Sierra Leone Ethics and Scientific Review Committee and the ICF Institutional Review Board. Besides, the local authorities before implementing the survey and well-informed verbal consent are sought from the respondents prior to data collection. This data set was obtained from the MEASURE DHS website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) after getting their permission, and no formal ethical clearance was obtained since we conducted a secondary analysis of publicly available data.

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Table 1: Categorisation of independent variables

Variable	Categorization	Explanation
Maternal age	15-19 years, 20–34 years and 35–49 years	-
Wealth index	poorest, poorer, middle, richer and richest quintiles	Wealth index is a measure of relative household economic status and was calculated by SLDHS from information on household asset ownership using Principal Component Analysis [63] . Among rural women, only 0.9% and 5.7% belonged to the richest and richer quintiles, hence these were combined into one to have rich, middle, poorer and poorest quintiles in logistic regression. Among urban women, only 0.3% and 3.0% belonged to the poorest and poorer

		quintiles, hence these were combined into one to have poor, middle, richer and richest quintiles in logistic regression.
Region	Northern, Eastern, Southern, Western and Northwestern	Among rural women, only 1.1% belonged to the Western region hence in logistic regression, Western and Northwestern regions were combined.
Education	No education, primary education, secondary and tertiary education	Among rural women, only 0.5% of the women had tertiary education and only 7.1% in urban hence secondary and tertiary were combined to have post-primary in the logistic regression analysis.
Household size	Less than seven members and seven and above members	Based on the dataset average of seven members per household
Sex of household head	Male or female	
Marital status	Married and Not Married	Marriage included those in formal and informal unions while not married included the never married, divorced, separated and widowed.
Religion	Muslims and Christians and others	

Problem seeking permission to access healthcare	Big problem and no big problem	In the questionnaire, seeking permission to access healthcare had three original responses: no problem, no big problem and big problem. However, none of the study participants reported no problem hence we only had two responses.
Difficulties accessing nearest health facility	big problem and no big problem	In the questionnaire, problems with distance to the nearest health facility had three original responses: no problem, no big problem and big problem. However, none of the study participants reported no problem hence we only had two responses.
Exposure to media	Yes and No	Yes included women who had exposure to any of the four mass media (radio, television (TV) and newspapers and internet)
Working	Yes and No	-
Visited by fieldworker	Yes and No	-
Parity	5 and above, 2-4 and 1	-
ANC frequency	8 and above ANC contacts and less than 8 ANC contacts	-

ANC timing	Within the first trimester and after first trimester	-

Table 2: Socio-demographic characteristics of women in Sierra Leone as per the 2019 SLDHS

	Rural		Urban	
Characteristics	**N=4531**	**%**	**N=2795**	**%**
Age				
15 to 19	375	8.3	223	8.0
20 to 34	2835	62.6	1995	71.4
35 to 49	1322	29.2	577	20.6
Visited by field worker				
No	3126	69.0	1933	69.2
Yes	1405	31.0	862	30.8
Region				
Western	51	1.1	1428	51.1
Eastern	1059	23.4	483	17.3
Northwestern	1096	24.2	285	10.2
Northern	1082	23.9	351	12.6
Southern	1244	27.5	248	8.9
Religion				
Islam	3729	82.3	2036	72.9
Christianity and others	802	17.7	758	27.1
Sex household head				
Male	3663	80.8	1857	66.4
Female	868	19.2	938	33.6
Household Size				
7 and above	2083	46.0	1236	44.2
Less than 7	2448	54.0	1559	55.8
Working status				
Not working	684	15.1	998	35.7
Working	3847	84.9	1796	64.3
Marital status				
Not married	606	13.4	723	25.9
Married	3925	86.6	2072	74.1
Education Level				
No Education	2866	63.2	992	35.5
Primary Education	729	16.1	304	10.9
Secondary Education	913	20.1	1302	46.6
Tertiary	24	0.5	197	7.1

Wealth Index				
Poorest	1576	34.8	11	0.4
Poorer	1466	32.4	85	3.0
Middle	1192	26.3	296	10.6
Richer	258	5.7	1184	42.4
Richest	40	0.9	1219	43.6
Parity				
1	1011	22.3	977	35.0
2-4	2522	55.7	1493	53.4
5 and above	998	22.0	324	11.6
Exposure to mass media				
No	2890	63.8	846	30.3
Yes	1641	36.2	1948	69.7
Permission to access healthcare				
Big problem	1427	31.5	399	14.3
Not big problem	3104	68.5	2396	85.7
Distance to health facility				
Big problem	2732	60.3	722	25.8
Not big problem	1799	39.7	2073	74.2
ANC timing [a]				
First trimester	2048	45.5	1165	42.9
After first trimester	2451	54.5	1549	57.1
ANC attendance				
8 contacts and above	988	21.8	622	22.3
Less than 8 contacts	3543	78.2	2173	77.7

[a]= missing 32 (0.7%) respondents in rural and 81 (2.9%) in urban areas

Table 3: Factors associated with skilled birth attendance in rural Sierra Leone as per the 2019 SLDHS

Characteristics	Not by SBA n (%)	Delivered by SBA n (%)	Crude model cOR (95% CI)	P-value	Adjusted model aOR (95% CI)
Age				0.002	
35 to 49	249 (34.8)	1073 (28.1)	1		1
20 to 34	424 (59.3)	2410 (63.2)	**1.3 (1.1-1.6)**		1.2 (0.9-1.5)
15 to 19	42 (5.9)	333 (8.7)	**1.9 (1.3-2.8)**		1.5 (0.9-2.3)
Visited by fieldworker				0.004	
No	540 (75.6)	2586 (67.8)	1		1
Yes	175 (24.4)	1230 (32.2)	**1.5 (1.1-1.9)**		**1.4 (1.1-1.8)**
Region				<0.001	
West and Northwestern	339 (47.4)	808 (21.2)	1		1
Southern	165 (23.1)	1079 (28.3)	**2.7 (1.8-4.1)**		**3.1 (2.1-4.7)**

Northern	134 (18.7)	947 (24.8)	**3.0 (1.9-4.6)**		**2.9 (1.9-4.4)**
Eastern	77 (10.8)	982 (25.7)	**5.4 (3.0-9.8)**		**5.7 (3.1-10.7)**
Religion				0.199	
Christianity and others	109 (15.2)	693 (18.2)	1		1
Islam	606 (84.8)	3123 (81.8)	0.8 (0.6-1.1)		1.4 (0.9-1.9)
Sex household head				0.269	
Male	590 (82.5)	3072 (80.5)	1		
Female	125 (17.5)	744 (19.5)	1.2 (0.9-1.5)		
Household Size				0.065	
7 and above	358 (50.1)	1725 (45.2)	1		1
Less than 7	357 (49.9)	2091 (54.8)	1.2 (1.0-1.5)		1.1 (0.9-1.4)
Working status				0.745	
Not working	104 (14.5)	581 (15.2)	1		
Working	611 (85.5)	3235 (84.8)	1.0 (0.7-1.3)		
Marital status				<0.001	
Not married	64 (8.9)	542 (14.2)	1		1
Married	651 (91.1)	3274 (85.8)	**0.6 (0.4-0.8)**		0.8 (0.6-1.1)
Education Level				<0.001	
No Education	525 (73.4)	2340 (61.3)	1		1
Primary	108 (15.1)	621 (16.3)	1.3 (1.0-1.7)		1.1 (0.8-1.4)
Post-primary	82 (11.5)	855 (22.4)	**2.3 (1.7-3.2)**		**1.8 (1.3-2.5)**
Wealth Index				0.282	
Poorest	265 (37.1)	1311 (34.4)	1		
Poorer	244 (34.1)	1222 (32.0)	1.0 (0.8-1.3)		
Middle	173 (24.2)	1018 (26.7)	1.2 (0.9-1.6)		
Rich	33 (4.6)	265 (6.9)	1.6 (1.0-2.7)		
Parity				0.018	
5 and above	175 (24.4)	823 (21.6)	1		1
2-4	409 (57.3)	2112 (55.3)	1.1 (0.9-1.3)		0.9 (0.7-1.1)
1	131 (18.3)	881 (23.1)	**1.4 (1.1-1.9)**		1.0 (0.7-1.3)
Exposure to media				0.001	
No	514 (71.9)	2378 (62.3)	1		1
Yes	201 (28.1)	1440 (37.7)	**1.6 (1.2-2.0)**		**1.5 (1.1-1.9)**
Permission to access				0.916	
Big problem	224 (31.3)	1204 (31.6)	1		
Not big problem	491 (68.7)	2612 (68.4)	1.0 (0.8-1.3)		
Distance to health				<0.001	
Big problem	539 (75.4)	2193 (57.5)	1		1
Not big problem	176 (24.6)	1623 (42.5)	**2.3 (1.7-3.1)**		**2.3 (1.7-3.0)**
ANC timing [a]				0.001	
First trimester	260 (37.4)	1788 (47.0)	1		1
After first trimester	436 (62.6)	2015 (53.0)	**0.7 (0.5-0.9)**		**0.8 (0.6-0.9)**
ANC attendance				0.615	
8 contacts and above	163 (22.8)	825 (21.6)	1		
Less than 8	552 (77.2)	2991 (78.4)	1.1 (0.8-1.4)		

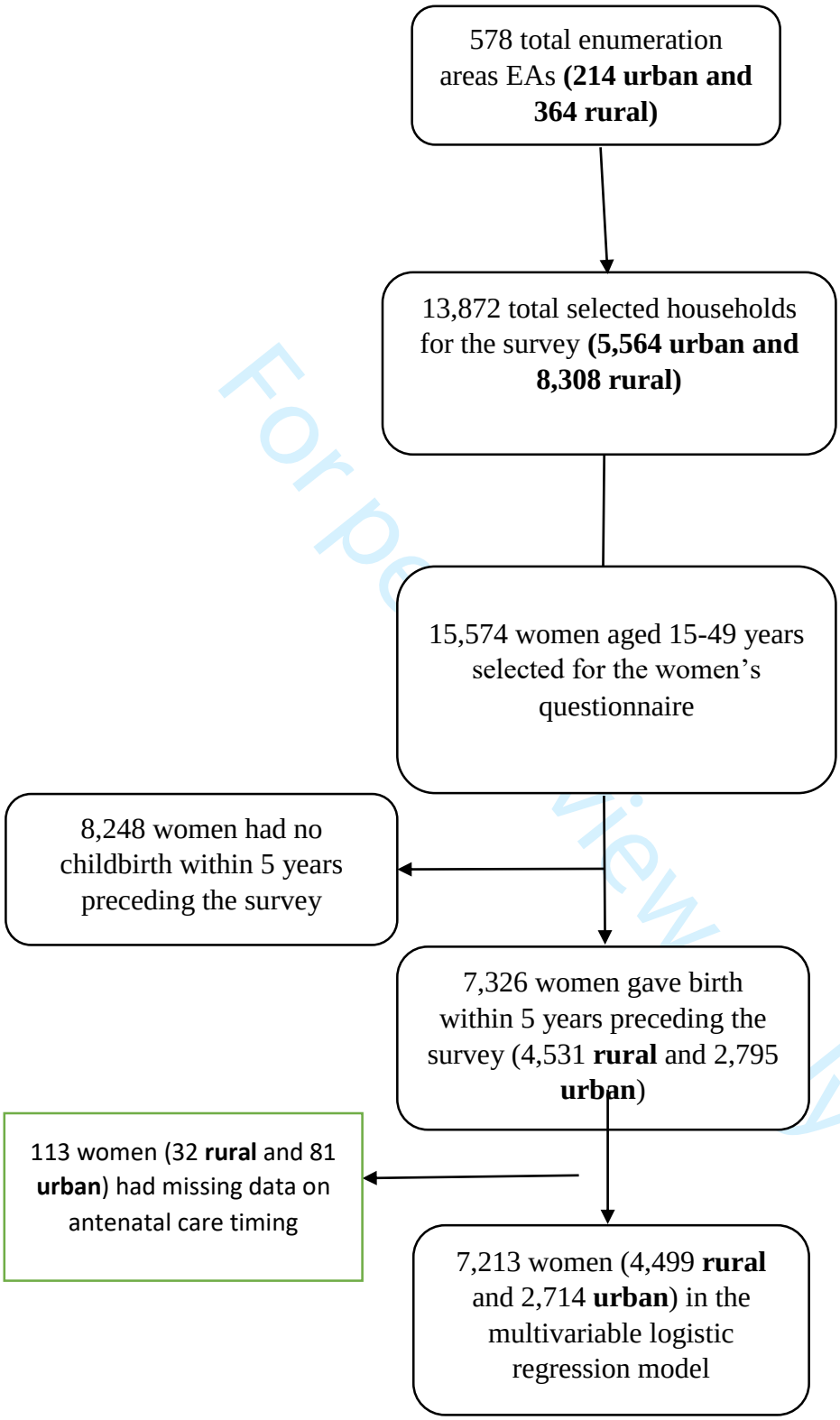
bold= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio

Table 4: Factors associated with skilled birth attendance in urban Sierra Leone as per the 2019 SLDHS

Characteristics	Not by SBA n (%)	Delivered by SBA n (%)	Crude model cOR (95% CI)	P-value	Adjusted model aOR (95% CI)
Age				0.825	
35 to 49	28 (19.7)	549 (20.7)	1		
20 to 34	101 (71.1)	1894 (71.4)	0.9 (0.6-1.6)		
15 to 19	13 (9.2)	210 (7.9)	0.8 (0.4-1.7)		
Visited by fieldworker				0.625	
No	102 (71.8)	1831 (69.0)	1		
Yes	40 (28.2)	822 (31.0)	1.1 (0.7-1.9)		
Region				<0.001	
West and Northwestern	116 (81.7)	1597 (60.1)	1		1
Southern	4 (2.8)	244 (9.2)	**4.3 (1.6-11.4)**		**5.1 (2.0-13.3)**
Northern	16 (11.3)	336 (12.7)	1.6 (0.7-3.3)		2.0 (0.9-4.5)
Eastern	6 (4.2)	477 (18.0)	**6.1 (2.7-13.6)**		**11.7 (4.6-30.2)**
Religion				0.094	
Christianity and others	27 (19.0)	732 (27.6)	1		1
Islam	115 (81.0)	1921 (72.4)	0.6 (0.3-1.1)		0.9 (0.5-1.7)_
Sex household head				0.522	
Male	90 (63.4)	1767 (66.6)	1		
Female	52 (36.6)	886 (33.4)	0.9 (0.6-1.3)		
Household Size				0.036	
7 and above	79 (55.6)	1157 (43.6)	1		1
Less than 7	63 (44.4)	1496 (56.4)	**1.6 (1.1-2.6)**		**1.5 (1.1-2.3)**
Working status				0.080	
Not working	40 (28.2)	958 (36.1)	1		1
Working	102 (71.8)	1695 (63.9)	0.7 (0.5-1.0)		0.8 (0.5-1.3)
Marital status				0.885	
Not married	38 (26.8)	686 (25.8)	1		
Married	104 (73.2)	1967 (74.2)	1.0 (0.7-1.6)		
Education Level				0.020	
No Education	72 (50.7)	920 (34.7)	1		1
Primary	12 (8.5)	292 (11.0)	1.9 (1.0-3.8)		1.7 (0.8-3.6)
Post-primary	58 (40.8)	1441 (54.3)	**1.9 (1.2-3.2)**		1.4 (0.8-2.5)
Wealth Index				0.200	
Poor	7 (4.3)	90 (3.4)	1		1
Middle	19 (13.5)	277 (10.4)	1.0 (0.3-3.3)		1.2 (0.4-3.5)
Richer	73 (51.8)	1110 (41.9)	1.1 (0.4-3.0)		1.5 (0.6-3.4)
Richest	43 (30.5)	1176 (44.3)	2.0 (0.7-5.7)		2.5 (1.0-6.5)

Parity				0.106	
5 and above	25 (17.6)	299 (11.3)	1		1
2-4	79 (55.6)	1414 (53.3)	1.5 (0.8-2.9)		1.0 (0.5-1.2)
1	38 (26.8)	940 (35.4)	**2.1 (1.1-4.3)**		1.3 (0.6-2.7)
Exposure to media				<0.001	
No	68 (47.9)	779 (29.4)	1		1
Yes	74 (52.1)	1874 (70.6)	**2.2 (1.4-3.4)**		**1.8 (1.1-2.9)**
Permission to access				0.398	
Big problem	16 (11.3)	383 (14.4)	1		
Not big problem	126 (88.7)	2270 (85.6)	0.8 (0.4-1.4)		
Distance to health				0.104	
Big problem	47 (32.6)	676 (25.5)	1		1
Not big problem	95 (67.4)	1977 (74.5)	1.4 (0.9-2.2)		**1.6 (1.1-2.5)**
ANC timing [a]				0.041	
First trimester	46 (33.3)	1120 (43.5)	1		1
After first trimester	92 (66.7)	1457 (56.5)	0.7 (0.4-1.0)		0.8 (0.5-1.2)
ANC attendance				0.060	
8 contacts and above	21 (14.8)	601 (22.7)	1		**1**
Less than 8	121(85.2)	2052 (77.3)	0.6 (0.4-1.0)		0.6 (0.4-1.1)

bold= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio



Additional file Figure 1: flow chat of sampling process

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4,5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	5
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7

		(*b*) Report category boundaries when continuous variables were categorized	6-7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Table 1: Factors associated with non-utilisation of skilled birth attendance in Sierra Leone as per the 2019 SLDHS

Characteristics	Crude model cOR (95% CI)	P-value	Adjusted model aOR (95% CI)
Age		<0.001	
35 to 49	1		1
20 to 34	**0.7 (0.6-0.9)**		0.9 (0.8-1.2)
15 to 19	**0.6 (0.4-0.8)**		0.9 (0.6-1.4)
Residence		<0.001	
Urban	1		**1**
Rural	**3.5 (2.6-4.8)**		**1.8 (1.2-2.7)**
Visited by fieldworker		0.006	
Yes	1		**1**
No	**1.4 (1.1-1.8)**		**1.3 (1.1-1.7)**
Region		<0.001	
Western	1		1
Southern	**2.3 (1.4-3.8)**		**0.5 (0.3-0.9)**
North-western	**6.8 (4.4-10.6)**		**1.8 (1.2-2.9)**
Northern	**2.1 (1.3-3.4)**		0.6 (0.4-1.0)
Eastern	1.0 (0.5-1.9)		**0.3 (0.2-0.5)**
Religion			
Islam	1	0.006	1
Christianity and others	**0.7 (0.5-0.9)**		1.3 (0.9-1.8)
Sex household head		0.012	
Male	1		1
Female	**0.8 (0.6-0.9)**		1.0 (0.8-1.3)
Household Size		0.006	
7 and above	1		1
Less than 7	**0.8 (0.6-0.9)**		0.8 (0.7-1.1)
Working status		0.002	
Not working	1		1
Working	**1.5 (1.2-2.0)**		1.10 (0.8-1.4)
Marital status		<0.001	
Not married	1		1
Married	**1.7 (1.4-2.2)**		1.10 (0.8-1.4)
Education Level		<0.001	
No Education	1		1
Primary	**0.7 (0.6-0.9)**		0.9 (0.7-1.1)
Secondary	**0.3 (0.3-0.5)**		**0.6 (0.4-0.8)**
Tertiary	**0.2 (0.1-0.4)**		0.5 (0.2-1.3)
Wealth Index		<0.001	
Richest	1		1
Richer	**1.9 (1.2-3.2)**		1.5 (0.9-2.4)
Middle	**3.8 (2.3-6.3)**		1.5 (0.9-2.6)
Poorer	**4.9 (3.0-8.2)**		1.6 (0.9-2.9)
Poorest	**5.1 (3.1-8.4)**		**1.9 (1.1-3.4)**

Parity		<0.001	
5 and above	1		1
2-4	**0.8 (0.6-0.9)**		1.1 (0.9-1.4)
1	**0.5 (0.4-0.7)**		0.9 (0.7-1.2)
Exposure to media		<0.001	
Yes	1		1
No	**2.2 (1.8-2.8)**		**1.5 (1.2-1.9)**
Permission to access		0.164	
Big problem	1		1
Not big problem	0.8 (0.7-1.1)		1.3 (1.0-1.7)
Distance to health facility		<0.001	
Big problem	1		1
Not big problem	**0.4 (0.3-0.5)**		**0.5 (0.4-0.6)**
ANC timing [a]		<0.001	
First trimester	1		1
After first trimester	**1.4 (1.2-1.8)**		**1.3 (1.1-1.6)**
ANC attendance		0.787	
8 contacts and above	1		-
Less than 8	1.0 (0.8-1.3)		

bold= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio

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Rural-urban correlates of skilled birth attendance utilisation in Sierra Leone: evidence from the 2019 Sierra Leone demographic health survey

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Abstract

Objectives Understanding the rural - urban context specific correlates of skilled birth attendance (SBA) is important to designing relevant strategies and programs. This analysis aimed to assess for the rural-urban correlates of SBA in Sierra Leone.

Setting The latest nationally representative Sierra Leone Demographic and Health Survey (SLDHS) of 2019.

Participants The study included a weighted sample of 7,326 women aged 15–49 years. Each of them had a live birth within five years prior to the survey (4,531 in rural areas and 2,795 women in urban areas)**.**

Primary and secondary outcome measure Skilled birth attendance (primary) and predictors of skilled birth attendance (secondary).

Results SBA was higher in urban areas at 94.9% (95% CI: 94.1-95.7) compared to 84.2% (95% CI: 83.8-85.9) in rural areas. Rural women resident in the Southern, Northern and Eastern regions, with post-primary education (aOR = 1.8; 95% CI 1.3 to 2.5), exposure to mass media (aOR = 1.5; 95% CI 1.1 to 1.9), not having difficulties with distance to the nearest health facility (aOR = 2.3; 95% CI 1.7 to 3.0) were associated with higher odds of SBA. Urban women resident in the Southern, Eastern region, with households having less than seven members (aOR = 1.5; 95% CI 1.1 to 2.3), exposure to mass media (aOR = 1.8; 95% CI 1.1 to 2.9) and not having difficulties with distance to the nearest health facility (aOR = 1.6; 95% CI 1.1 to 2.5) were associated with higher odds of SBA.

Conclusion Given the observed differences, improving SBA requires programmes and strategies that are context-specific.

Keywords: Skilled birth attendance, Sierra Leone, Rural-Urban, Women, DHS

Strengths and limitations of the study

- This is the first nationally representative analysis that explores the rural-urban correlates of SBA in Sierra Leone
- We used the latest nationally representative sample from the 2019 SLDHS, hence findings are generalisable to women in Sierra Leone.
- Given the cross-sectional nature of the data, we could not establish the temporal relationship between the outcome variable and the independent variables.
- Since the data was collected from women who had childbirths within five years prior to data collection, we anticipate recall bias in the process of collecting this data among the respondents.

Introduction

Globally, 83% of births in 2020 occurred with skilled birth attendance (SBA), but coverage continues to be uneven around the world with significant discrepancies between regions with only 64% of births in sub-Saharan Africa (SSA) being attended to by SBA [1]. About 303,000 maternal deaths are registered annually with ninety-nine percent being recorded in low- and middle-income countries [2, 3]. SBA has been documented as an effective intervention for reducing maternal and neonatal deaths [4, 5]. Skilled attendance at birth can reduce intrapartum-related complications by up to 20% [6]. Therefore, ensuring increased utilisation of SBA can substantially contribute towards achievement of the "*Sustainable Development Goal (SDG) 3 that aims at reducing the global maternal mortality ratio (MMR) to less than 70 per 100, 000 and neonatal mortality ratio (NMR) of ≤12 per 1,000 live births by 2030"* [6-8]. A skilled birth attendant is "an accredited health professional such as a midwife, doctor, or nurse

who have been trained with adequate skills needed to handle uncomplicated pregnancies, childbirth, and the immediate postnatal period, and in the identification, management, and referral of complications in women and newborns" [6].

Besides the women losing their lives, effects of maternal mortality and morbidity are also experienced at the household and community level [9, 10]. Children left behind after maternal deaths have increased odds of mortality or other health challenges including undernutrition and the society loses resources when women die in their most productive years [9]. In Sierra Leone, pregnancy is associated with a 1 in 17 lifetime risk of maternal death making it among the highest globally [6]. Despite several measures being implemented in the country, utilisation of maternal health services such as utilisation of at least four or more antenatal (ANC) contacts marginally increased by three percent points (76% to 79%) between 2013 and 2019 while initiation in the first trimester decreased by one percent point (45% to 44%) [11]. In 2017, the Ministry of Health adopted the latest 2016 WHO guidelines for ANC, recommending eight or more ANC contacts during pregnancy [12]. To date, there is no data available about the progress made regarding the utilisation of eight or more ANC contacts. The latest SLDHS only reported on the utilisation of at least four ANC contacts [11].

Post-civil war and Ebola epidemic Sierra Leone era has witnessed left a fragile health system having poor infrastructure and inadequate skilled health personnel who are irregularly paid low salaries [13]. Despite the government's efforts to improve maternal health with approaches such as exemption of user fees for maternal healthcare services [14], the country ranks among the top three countries with the highest MMR, globally [3, 6, 15]. Furthermore, the exemption of user fees is challenged by inadequate skilled health personnel, increasing workload and

inadequate supplies and equipment [16, 17]. Secondary and tertiary care in Sierra Leone is provided by 14 district and regional governmental hospitals [17]. At national level, there are four tertiary referral hospitals which are all located in the Western Area Urban District [18]. The country has one of the lowest nurse densities in the world, at approximately 0.2 nurses and midwives per 1000 people [13].

Although differences in the levels of utilisation of SBA between Sierra Leone's rural and urban women have been documented [6, 11], there is a paucity of information on this topic as it is not adequately explored. Therefore, it is important to further understand these factors when stratifying by rural-urban place of residence among women because this may be key to designing effective context-specific strategies and interventions targeting rural and urban areas. We aimed to determine the correlates of SBA in Sierra Leone, stratified by rural-urban place of residence.

Methods

Data source

Secondary data from the 2019 Sierra Leone Demographic and Health Survey (SLDHS) was analysed for this study. SLDHS data collection occurred between May and August 2019 by Statistics Sierra Leone (Stats SL) with technical assistance from ICF international through the DHS Program.

Study sampling and participants

A stratified, two-stage cluster sampling design was used for the survey leading to 13,872 households [11]. The 2019 SLDHS final report contains a detailed description of the sampling procedures [11, 19]. Women of reproductive age who had a live birth within five years preceding

the SLDHS were included in this secondary analysis. Originally, a weighted sample of 15,574 women was included in the individual women's data set of which 7,326 had given birth within five years prior the survey (with 4,531 in rural areas and 2,795 in urban areas) [3], as shown in **the supplementary file 1.**

Variables

Dependent variables

SBA was defined as delivery conducted by a doctor, nurse or midwife [11] and was coded as one (1) while un skilled birth attendance was coded as zero (0).

Independent variables

The analysis included independent variables based on evidence from available literature and data [6, 9, 20]. Sixteen explanatory variables were included and categorized as shown in **Table1**:

Statistical analysis

Due to the multi-stage cluster study design used by SLDH, complex sample package of SPSS (version 25.0) statistical software was used with the analysis plan designed to include sample : individual weight, strata for sampling errors/design, and cluster number [21-23]. Associations between independent variables and SBA were assessed by cross tabulation and p-values presented**.** Before the final adjusted model, each independent variable was assessed individually for its association with SBA using bivariable logistic regression and the crude odds ratio (COR), 95% confidence interval (CI) and p-values are presented and independent variables with a p-value ≤ 0.25 , and not strongly collinear with other independent variables were included in

the final multivariable logistic regression model [24]. In the final adjusted model, adjusted odds ratios (AOR), 95% CI and p-values were calculated at significance level set at p-value < 0.05. **Supplementary file 2 shows the STROBE checklist.** Sensitivity analysis was done with unskilled birth attendance as the outcome and the results are shown in **supplementary file 3.**

Patient and public involvement

Patients were not involved. However, local authorities in the different regions were contacted before data collection. A comprehensive report on the survey results was released and openly available on the DHS website.

Ethics approval

SLDHS ensured that recommended ethical standards are followed. *"The protocol was reviewed and approved by the Sierra Leone Ethics and Scientific Review Committee and the ICF Institutional Review Board" [11].* Furthermore, during data collection, local authorities' permission and well-informed verbal consent from participants were sought. Ethical approval ID was not provided in the SLDHS survey report. Authors received written permission from DHS to access this dataset.

Results

Table 2 shows a comparison of background characteristics of study participants. Rural areas had more participants (4,531) compared to urban areas (2,795). Remarkable differences were observed in region with 1.1% of rural women residing in Western region compared to 51.1% in urban areas. Furthermore, 63.2% of rural women had no education compared to 35.5% in urban areas, 34.8% in rural areas belonged to the poorest quintile compared to 0.4% in urban areas and 36.2% had exposure to mass media in rural areas compared to 69.7% in urban areas. Over 60.3% of rural women had big problems with distance to the nearest health facility compared to 25.8%

in urban areas. Overall, 88.3% (6468/7,326, 95% CI: 87.9-89.4) of the women had skilled birth attendance. Skilled birth attendance was higher in urban areas at 94.9% (2,653/2,795, 95% CI: 94.1-95.7) compared to 84.2% (3,816/4,531, 95% CI: 83.8-85.9) in rural areas.

Factors associated with skilled birth attendance

Tables 3 and 4 presents the predictors of rural and urban SBA. Our analysis revealed that region of residence, exposure to mass media and distance to the nearest health facility have significant positive association with SBA among women from both regions of residence. In the rural areas, the likelihood of being delivered by a skilled birth attendant was three times higher in the Southern (aOR = 3.1; 95% CI 2.1 to 4.7), Northern (aOR = 2.9; 95% CI 1.9 to 4.4) and six times higher in the Eastern regions (aOR = 5.7; 95% CI 3.1 to 10.7), one and a half times higher among women who had been visited a field worker (aOR = 1.4; 95% CI 1.1 to 1.8), two times higher among women with post-primary education (aOR = 1.8; 95% CI 1.3 to 2.5), one and a half times higher among women with exposure to mass media (aOR = 1.5; 95% CI 1.1 to 1.9), twice higher among women not having big problems with distance to the nearest health facility (aOR = 2.3; 95% CI 1.7 to 3.0) while the likelihood was 0.8 times lower among women who initiated ANC after the first trimester (aOR = 0.8; 95% CI 0.6 to 0.9).

In the urban areas, the likelihood of being delivered by a skilled birth attendant was five times higher in the Southern (aOR = 5.1; 95% CI 2.0 to 13.3), 12 times higher in the Eastern region (aOR =11.7; 95% CI 4.6 to 30.2), one and a half times higher among women from households with less than seven members (aOR = 1.5; 95% CI 1.1 to 2.3), twice among women who had exposure to mass media (aOR = 1.8; 95% CI 1.1 to 2.9) and one and a half times among women who had no big problems with distance to the nearest health facility (aOR = 1.6; 95% CI 1.1 to 2.5) compared to those from the western and northwestern regions, households with seven and

above household members, with no mass media exposure and those with big problems with distance respectively. Wealth index was imprecisely significant with urban women belonging to the richest quintile (aOR = 2.5; 95% CI 1.0 to 6.5) being more likely to have SBA compared to those in the poor quintile.

Discussion

In this study, we looked at factors associated with SBA utilisation in Sierra Leone stratified by rural-urban place of residence. Overall, 88.3% (95% CI: 87.9-89.4) of the women had SBA. The overall, urban, rural and SBA prevalence in our study shows 28, 15 and 31 percentage point increases respectively compared to that of 2013 [6, 25]. This shows a tremendous improvement in the uptake of the SBA between 2013 and 2019 in Sierra Leone which could be attributed to the changes in health-seeking behaviour and transformation of the health systems witnessed after the Ebola epidemic [26, 27]. The introduction of free maternal health care services in 2010 could also partly have contributed to the observed increase in SBA utilisation [28, 29]. SBA was higher in urban areas at 94.9% (95% CI: 94.1-95.7) compared to 84.2% (95% CI: 83.8-85.9) in rural areas. Higher SBA utilization among urban women has also been shown by Ameyaw et al. [6] and this could be partly explained by factors such as the huge negative effects of the conflict on the rural healthcare system, high concentration of health centres and hospitals and healthcare workers in urban areas enabling easier access to maternal healthcare services [6, 30, 31]. Higher SBA utilization among urban women compared to rural women has been shown in several other studies [32-34]. The mismatch between high coverage of SBA and the persistently high numbers of maternal and perinatal deaths is not only unique to Sierra Leone. This may be partly attributed to delayed seeking of childbirth care and inadequate quality of care provided by skilled birth attendants [35-37]. Available evidence from similar low resource settings in Sub-Saharan points

towards poor quality of services offered [29, 38]. The inadequate quality of care may be attributed to factors such as; poor remuneration which demotivates health workers, increased workload on health workers, lack of essential drugs and low quality pre-service and refresher training [36, 37]. In Sierra Leone, pre-service training for SBAs produces three cadres of nursing staff, namely; maternal and child health assistants who train for two years, state enrolled community health nurses spend two and half years in training, and state registered nurses whose training lasts three years. These cadres then have the option to undertake further midwifery training that lasts between 18 – 24 months depending on the nursing qualification and experience [39, 40]. However, the quality of training is affected by factors such as; poor student attendance, delayed and low tutor allowances and poor schools' infrastructure especially for rural training schools [30, 40].

Region of residence, exposure to mass media, and distance to the nearest health facility had higher likelihood of SBA uptake in both rural and urban areas. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of initiation ANC were only significant in rural areas. Being a resident of the South, the Eastern and Northern regions was associated with more odds of SBA utilisation among rural areas compared to those in the Western and North-western regions which was a similar finding for urban women in the Eastern and Southern regions. This is an unexpected finding since the Western region has the highest concentration of skilled personnel and health facilities, the most developed and is the most economically vibrant region and therefore has better quality social amenities compared to other regions [28, 30]. However, the Western areas have witnessed increasing numbers of urban poor who are experiencing high standards of living and inequitable distribution of social amenities hence negatively affecting their ability to access

quality healthcare [41, 42]. Furthermore, the documented staff challenges in urban areas such as poor delegation, favoritism and a lack of autonomy could partly affect quality of services in public health facilities which further limits utilisation of healthcare [28, 30]. The government's efforts to ensure better service delivery in the less developed regions that are far away from the developed Western region could also have contributed to this observation [12]. Region has been documented to have an association with SBA in other studies [43].

Exposure to mass media was associated with more odds of SBA utilisation in both rural and urban areas. Mass media have been documented to improve health literacy by sensitizing communities on the positive outcomes of timely healthcare seeking and utilisation hence leading to positive attitudes, challenging negative social norms and improving health seeking behavior [44, 45]. Furthermore, women who are exposed to mass media are more likely to be educated, have discussions with their peers which interpersonal interactions contribute greatly in challenging negative norms that might affect health seeking and hence lead to positive health seeking behavioral change [46, 47]. Hence, enhancing mass media exposure can be used to provide targeted maternal health messaging that can lead to increase in the utilisation of SBA [48]. Exposure to media has been shown in previous studies done in similar contexts to have a positive association with SBA [6, 49, 50].

Rural and urban women who reported that distance to health facilities was not a major challenge had higher odds of SBA utilization. Our study observed that the mothers in rural areas and urban areas who had no big problem with distance to a health facility had 2.25 and 1.62 higher odds respectively of being attended to by a skilled birth attendant compared to their counterparts who had challenges of distance to the nearest health facility. The strong association between distance to health facility and SBA utilization among the rural mothers compared to urban can be partly

explained by the fact that rural areas of Sierra Leone have poor road networks compared to urban areas with most roads being only accessible by off-road vehicles or motorbikes. This is further compounded by the lack of access to affordable transport and health facilities that far apart from each other, which contributes to delays faced by women in rural areas [35, 51]. Distance to health facilities has been shown to impede access to maternal child health services including SBA in several other studies [9, 52, 53].

Unlike in urban areas, being visited by a field health worker, such as a community health worker (CHW) among rural women was significantly associated with SBA utilization. The high demand of CHWs in rural areas due to limited accessibility of healthcare because of shortage of health facilities and large distances needed to be covered by rural women [30, 51] compared to easier access of health facilities in urban areas could partly explain the observed difference in association. The increased SBA utilization among rural women who were visited by field health workers could be partly explained by the fact these field health workers equip mothers with knowledge on the dangers of using unskilled birth attendants and complications of pregnancies in addition to encouraging them to seek care within health facilities [54]. Being visited by field health workers has been shown to be associated with SBA in several other studies [55, 56].

Level of education was significantly associated with SBA in rural areas but not urban areas. Women with post-primary education had more odds of SBA utilisation compared to women with no education. Educated women are believed to easily understand counseling given from healthcare workers, more health literate hence informed on obstetric danger signs, which enables them to seek early maternal healthcare [48]. Educated women have also been shown to develop greater confidence, be more conscious of their health and better abilities to make wise decisions about their own health, hence better SBA utilisation [6, 9]. Furthermore, higher levels of

education have an influence on women's positive interpretation of mass media messages leading to positive healthcare seeking behavior change [48]. In predominantly patriarchal African societies and mainly in rural areas [57], men are the main providers with the highest decision making powers [58]. Women in rural areas are usually less empowered due to the more conservative societies in rural areas hence factors such as education that might increase women's status and decision making are more likely to have an impact on healthcare seeking [59-62]. This might partly explain the significance of education in rural areas and the non-significance in urban areas. Our findings indicate the need for government to strengthen access to quality girl child education among rural areas to at least secondary school level. Level of education has been shown to be associated with SBA utilisation among several other studies [48, 63, 64]. Delayed initiation of ANC among rural women was associated with less odds of SBA utilization. ANC utilization has been shown to be associated with several other studies [48, 52, 65]. Delayed initiation could partly reflect poor health seeking behaviour which is further observed by reduced odds of SBA utilization. However, there is need for further studies to explore the association of ANC utilization and SBA given the fact that ANC frequency was not significantly associated with SBA but timing of ANC initiation was.

Besides the three factors that were significant in both rural and urban areas, household size was the only factor that showed significance in urban areas. Women who belonged to households with less than seven members had more odds of SBA utilization compared to their counterparts. This is in agreement with a study done in Nigeria and India [66, 67]. Although wealth index was marginally significant in urban areas, women belonging to the richest wealth quintile had 2.5 odds of SBA utilisation compared to their counterparts in the poorest households. We hypothesize that families with smaller sizes tend to have less expenditure which enables savings

that can be used for the direct and indirect costs involved in accessing healthcare [67]. Furthermore, smaller sizes could be attributed to better maternal healthcare seeking such as modern contraceptives utilization which is further translated into SBA utilisation [67]. Lastly, having smaller family size might lead to less time spent by women while doing household chores and providing care to other family members and increase their time to seek healthcare [68]. However, given the dearth of information regarding household size and SBA utilisation, we recommend further studies to explore this.

Strengths and limitations

The study used a nationally representative sample for the analysis and thus the results can be generalised to all Sierra Leone women. Since the data was extracted from DHS surveys, we are confident that standardized procedures such as validated questionnaires were used in data collection to ensure the validity of the results. This being a cross-sectional study, this creates a limitation in establishing casual relationships from the established associations. In addition, since most of the data was for women who had childbirths within five years preceding the survey, we anticipate recall bias in the process of collecting this data among the respondents.

Conclusion and public health implications

In Sierra Leon, SBA utilisation has greatly improved in the last decade. Utilisation is higher in the urban compared to the rural areas. Region of residence, exposure to mass media, and distance to the nearest health facility had a significant association with SBA uptake in both rural and urban areas. Household size was only significantly associated with SBA in urban areas while being visited by a fieldworker, level of education and timing of initiation ANC were only significant in rural areas. Hence ensuring context specific policies and strategies is crucial to

ensure effective SBA utilisation. Generally, maternal stakeholders need to focus on Western region, use of mass media for awareness and sensitization and ensuring increased availability of affordable and accessible health facilities in both rural and urban areas. In addition, urban specific programs need to focus on women residing in larger households and rural specific programs need to focus on use of field health workers, women educated to primary level and below and ensuring timely initiation of ANC services. Further research is need to explore reasons why maternal mortality is high despite the high SBA focusing on areas such as quality of care provided.

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Author contributions

QS conceived the idea, drafted the manuscript, performed data analysis and results interpretation. IM, KK and MWM reviewed and interpreted the results and drafted the subsequent versions of the manuscript. All authors read and approved the final manuscript.

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Competing interests

None

Patient consent for publication Not required.

Data availability statement This study's data are available from the DHS website (URL: https://www.dhsprogram.com/data/available-datasets.cfm) upon registration [11, 19]. Data are available from the authors with the permission of DHS.

Ethics statement

SLDHS ensured that recommended ethical standards are followed. *"The protocol was reviewed and approved by the Sierra Leone Ethics and Scientific Review Committee and the ICF Institutional Review Board" [11].* Furthermore, during data collection, local authorities' permission and well-informed verbal consent from participants were sought. Ethical approval ID was not provided in the SLDHS survey report. Authors received written permission from DHS to access this dataset.

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Table 1: Categorisation of independent variables

Variable	Categorization	Explanation

Maternal age	15-19 years, 20–34 years and 35–49 years	-
Wealth index	poorest, poorer, middle, richer and richest quintiles	The SLDHS collected data on household asset ownership and calculated wealth index using Principal Component Analysis [69] . Among rural women, only 0.9% and 5.7% belonged to the richest and richer quintiles, hence these were combined into one to have rich, middle, poorer and poorest quintiles in logistic regression. Among urban women, only 0.3% and 3.0% belonged to the poorest and poorer quintiles, hence these were combined into one to have poor, middle, richer and richest quintiles in logistic regression.
Region	Northern, Eastern, Southern, Western and Northwestern	Among rural women, only 1.1% belonged to the Western region hence in logistic regression, Western and Northwestern regions were combined.

Education	No education, primary education, secondary and tertiary education	Among rural women, only 0.5% of the women had tertiary education and only 7.1% in urban hence secondary and tertiary were combined to have post-primary in the logistic regression analysis.
Household size	Less than seven members and seven and above members	Based on the dataset average of seven members per household
Sex of household head	Male or female	
Marital status	Married and Not Married	Marriage included those in formal and informal unions while not married included the never married, divorced, separated and widowed.
Religion	Muslims and Christians and others	
Problem seeking permission to access healthcare	Big problem and no big problem	In the original SLDHS questionnaire, three responses had been suggested : no problem, no big problem and big problem. However, the no problem response was not reported by anyone .
Difficulties accessing nearest health facility	big problem and no big problem	In the original SLDHS questionnaire, three responses had been suggested : no problem, no big problem and big

		problem. However, the no problem response was not reported by anyone
Exposure to media	Yes and No	Yes included women who had exposure to any of the four mass media (radio, television (TV) and newspapers and internet)
Working	Yes and No	-
Visited by fieldworker	Yes and No	-
Parity	5 and above, 2-4 and 1	-
ANC frequency	8 and above ANC contacts and less than 8 ANC contacts	-
ANC timing	Within the first trimester and after first trimester	-

Table 2: Socio-demographic characteristics of women in Sierra Leone as per the 2019 SLDHS

	Rural		**Urban**	
Characteristics	**N=4531**	**%**	**N=2795**	**%**
Age				
15 to 19	375	8.3	223	8.0
20 to 34	2835	62.6	1995	71.4
35 to 49	1322	29.2	577	20.6
Visited by field worker				
No	3126	69.0	1933	69.2
Yes	1405	31.0	862	30.8
Region				
Western	51	1.1	1428	51.1
Eastern	1059	23.4	483	17.3
Northwestern	1096	24.2	285	10.2

Northern	1082	23.9	351	12.6
Southern	1244	27.5	248	8.9
Religion				
Islam	3729	82.3	2036	72.9
Christianity and others	802	17.7	758	27.1
Sex household head				
Male	3663	80.8	1857	66.4
Female	868	19.2	938	33.6
Household Size				
7 and above	2083	46.0	1236	44.2
Less than 7	2448	54.0	1559	55.8
Working status				
Not working	684	15.1	998	35.7
Working	3847	84.9	1796	64.3
Marital status				
Not married	606	13.4	723	25.9
Married	3925	86.6	2072	74.1
Education Level				
No Education	2866	63.2	992	35.5
Primary Education	729	16.1	304	10.9
Secondary Education	913	20.1	1302	46.6
Tertiary	24	0.5	197	7.1
Wealth Index				
Poorest	1576	34.8	11	0.4
Poorer	1466	32.4	85	3.0
Middle	1192	26.3	296	10.6
Richer	258	5.7	1184	42.4
Richest	40	0.9	1219	43.6
Parity				
1	1011	22.3	977	35.0
2-4	2522	55.7	1493	53.4
5 and above	998	22.0	324	11.6
Exposure to mass media				
No	2890	63.8	846	30.3
Yes	1641	36.2	1948	69.7
Permission to access healthcare				
Big problem	1427	31.5	399	14.3
Not big problem	3104	68.5	2396	85.7
Distance to health facility				
Big problem	2732	60.3	722	25.8
Not big problem	1799	39.7	2073	74.2
ANC timing [a]				
First trimester	2048	45.5	1165	42.9
After first trimester	2451	54.5	1549	57.1
ANC attendance				

8 contacts and above	988	21.8	622	22.3
Less than 8 contacts	3543	78.2	2173	77.7

[a]= missing 32 (0.7%) respondents in rural and 81 (2.9%) in urban areas

Table 3: Factors associated with skilled birth attendance in rural Sierra Leone as per the 2019 SLDHS

Characteristics	Not by SBA n (%)	Delivered by SBA n (%)	Crude model cOR (95% CI)	P-value	Adjusted model aOR (95% CI)
Age				0.002	
35 to 49	249 (34.8)	1073 (28.1)	1		1
20 to 34	424 (59.3)	2410 (63.2)	**1.3 (1.1-1.6)**		1.2 (0.9-1.5)
15 to 19	42 (5.9)	333 (8.7)	**1.9 (1.3-2.8)**		1.5 (0.9-2.3)
Visited by fieldworker				0.004	
No	540 (75.6)	2586 (67.8)	1		1
Yes	175 (24.4)	1230 (32.2)	**1.5 (1.1-1.9)**		**1.4 (1.1-1.8)**
Region				<0.001	
West and Northwestern	339 (47.4)	808 (21.2)	1		1
Southern	165 (23.1)	1079 (28.3)	**2.7 (1.8-4.1)**		**3.1 (2.1-4.7)**
Northern	134 (18.7)	947 (24.8)	**3.0 (1.9-4.6)**		**2.9 (1.9-4.4)**
Eastern	77 (10.8)	982 (25.7)	**5.4 (3.0-9.8)**		**5.7 (3.1-10.7)**
Religion				0.199	
Christianity and others	109 (15.2)	693 (18.2)	1		1
Islam	606 (84.8)	3123 (81.8)	0.8 (0.6-1.1)		1.4 (0.9-1.9)
Sex household head				0.269	
Male	590 (82.5)	3072 (80.5)	1		
Female	125 (17.5)	744 (19.5)	1.2 (0.9-1.5)		
Household Size				0.065	
7 and above	358 (50.1)	1725 (45.2)	1		1
Less than 7	357 (49.9)	2091 (54.8)	1.2 (1.0-1.5)		1.1 (0.9-1.4)
Working status				0.745	
Not working	104 (14.5)	581 (15.2)	1		
Working	611 (85.5)	3235 (84.8)	1.0 (0.7-1.3)		
Marital status				<0.001	
Not married	64 (8.9)	542 (14.2)	1		1
Married	651 (91.1)	3274 (85.8)	**0.6 (0.4-0.8)**		0.8 (0.6-1.1)
Education Level				<0.001	
No Education	525 (73.4)	2340 (61.3)	1		1
Primary	108 (15.1)	621 (16.3)	1.3 (1.0-1.7)		1.1 (0.8-1.4)
Post-primary	82 (11.5)	855 (22.4)	**2.3 (1.7-3.2)**		**1.8 (1.3-2.5)**
Wealth Index				0.282	
Poorest	265 (37.1)	1311 (34.4)	1		

Poorer	244 (34.1)	1222 (32.0)	1.0 (0.8-1.3)		
Middle	173 (24.2)	1018 (26.7)	1.2 (0.9-1.6)		
Rich	33 (4.6)	265 (6.9)	1.6 (1.0-2.7)		
Parity				0.018	
5 and above	175 (24.4)	823 (21.6)	1		1
2-4	409 (57.3)	2112 (55.3)	1.1 (0.9-1.3)		0.9 (0.7-1.1)
1	131 (18.3)	881 (23.1)	**1.4 (1.1-1.9)**		1.0 (0.7-1.3)
Exposure to media				0.001	
No	514 (71.9)	2378 (62.3)	1		1
Yes	201 (28.1)	1440 (37.7)	**1.6 (1.2-2.0)**		**1.5 (1.1-1.9)**
Permission to access				0.916	
Big problem	224 (31.3)	1204 (31.6)	1		
Not big problem	491 (68.7)	2612 (68.4)	1.0 (0.8-1.3)		
Distance to health				<0.001	
Big problem	539 (75.4)	2193 (57.5)	1		1
Not big problem	176 (24.6)	1623 (42.5)	**2.3 (1.7-3.1)**		**2.3 (1.7-3.0)**
ANC timing [a]				0.001	
First trimester	260 (37.4)	1788 (47.0)	1		1
After first trimester	436 (62.6)	2015 (53.0)	**0.7 (0.5-0.9)**		**0.8 (0.6-0.9)**
ANC attendance				0.615	
8 contacts and above	163 (22.8)	825 (21.6)	1		
Less than 8	552 (77.2)	2991 (78.4)	1.1 (0.8-1.4)		

555 **bold**= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio

556 **Table 4: Factors associated with skilled birth attendance in urban Sierra Leone as per the**

557 **2019 SLDHS**

Characteristics	**Not by SBA** **n (%)**	**Delivered by SBA** **n (%)**	**Crude model** **cOR (95% CI)**	**P-value**	**Adjusted model** **aOR (95% CI)**
Age				0.825	
35 to 49	28 (19.7)	549 (20.7)	1		
20 to 34	101 (71.1)	1894 (71.4)	0.9 (0.6-1.6)		
15 to 19	13 (9.2)	210 (7.9)	0.8 (0.4-1.7)		
Visited by fieldworker				0.625	
No	102 (71.8)	1831 (69.0)	1		
Yes	40 (28.2)	822 (31.0)	1.1 (0.7-1.9)		
Region				<0.001	
West and Northwestern	116 (81.7)	1597 (60.1)	1		1
Southern	4 (2.8)	244 (9.2)	**4.3 (1.6-11.4)**		**5.1 (2.0-13.3)**
Northern	16 (11.3)	336 (12.7)	1.6 (0.7-3.3)		2.0 (0.9-4.5)
Eastern	6 (4.2)	477 (18.0)	**6.1 (2.7-13.6)**		**11.7 (4.6-30.2)**
Religion				0.094	

Christianity and others	27 (19.0)	732 (27.6)	1		1
Islam	115 (81.0)	1921 (72.4)	0.6 (0.3-1.1)		0.9 (0.5-1.7)_
Sex household head				0.522	
Male	90 (63.4)	1767 (66.6)	1		
Female	52 (36.6)	886 (33.4)	0.9 (0.6-1.3)		
Household Size				0.036	
7 and above	79 (55.6)	1157 (43.6)	1		1
Less than 7	63 (44.4)	1496 (56.4)	**1.6 (1.1-2.6)**		**1.5 (1.1-2.3)**
Working status				0.080	
Not working	40 (28.2)	958 (36.1)	1		1
Working	102 (71.8)	1695 (63.9)	0.7 (0.5-1.0)		0.8 (0.5-1.3)
Marital status				0.885	
Not married	38 (26.8)	686 (25.8)	1		
Married	104 (73.2)	1967 (74.2)	1.0 (0.7-1.6)		
Education Level				0.020	
No Education	72 (50.7)	920 (34.7)	1		1
Primary	12 (8.5)	292 (11.0)	1.9 (1.0-3.8)		1.7 (0.8-3.6)
Post-primary	58 (40.8)	1441 (54.3)	**1.9 (1.2-3.2)**		1.4 (0.8-2.5)
Wealth Index				0.200	
Poor	7 (4.3)	90 (3.4)	1		1
Middle	19 (13.5)	277 (10.4)	1.0 (0.3-3.3)		1.2 (0.4-3.5)
Richer	73 (51.8)	1110 (41.9)	1.1 (0.4-3.0)		1.5 (0.6-3.4)
Richest	43 (30.5)	1176 (44.3)	2.0 (0.7-5.7)		2.5 (1.0-6.5)
Parity				0.106	
5 and above	25 (17.6)	299 (11.3)	1		1
2-4	79 (55.6)	1414 (53.3)	1.5 (0.8-2.9)		1.0 (0.5-1.2)
1	38 (26.8)	940 (35.4)	**2.1 (1.1-4.3)**		1.3 (0.6-2.7)
Exposure to media				<0.001	
No	68 (47.9)	779 (29.4)	1		1
Yes	74 (52.1)	1874 (70.6)	**2.2 (1.4-3.4)**		**1.8 (1.1-2.9)**
Permission to access				0.398	
Big problem	16 (11.3)	383 (14.4)	1		
Not big problem	126 (88.7)	2270 (85.6)	0.8 (0.4-1.4)		
Distance to health				0.104	
Big problem	47 (32.6)	676 (25.5)	1		1
Not big problem	95 (67.4)	1977 (74.5)	1.4 (0.9-2.2)		**1.6 (1.1-2.5)**
ANC timing [a]				0.041	
First trimester	46 (33.3)	1120 (43.5)	1		1
After first trimester	92 (66.7)	1457 (56.5)	0.7 (0.4-1.0)		0.8 (0.5-1.2)
ANC attendance				0.060	
8 contacts and above	21 (14.8)	601 (22.7)	1		**1**
Less than 8	121(85.2)	2052 (77.3)	0.6 (0.4-1.0)		0.6 (0.4-1.1)

bold= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio

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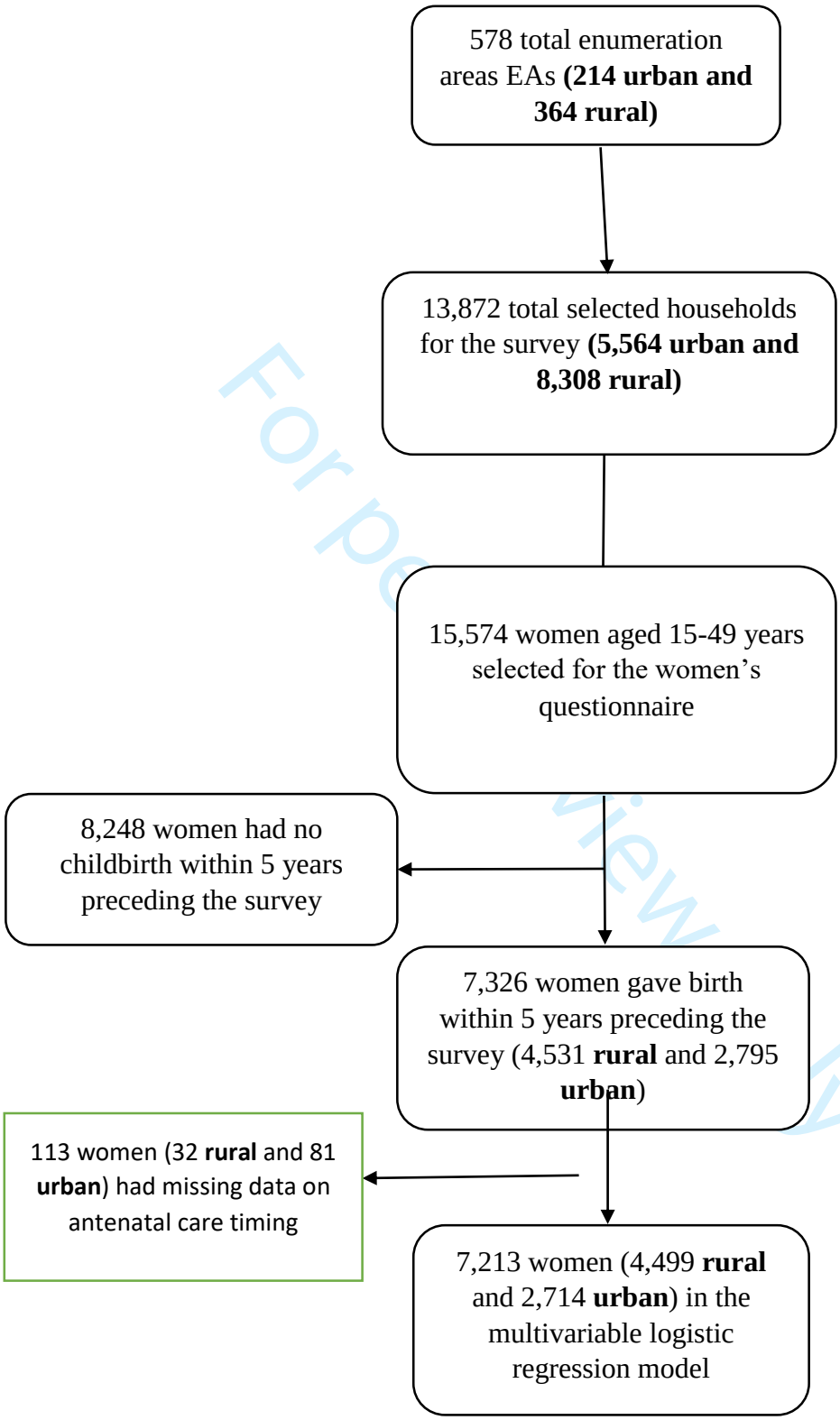

Additional file Figure 1: flow chat of sampling process

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4,5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	5
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7

		(*b*) Report category boundaries when continuous variables were categorized	6-7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Table 1: Factors associated with non-utilisation of skilled birth attendance in Sierra Leone as per the 2019 SLDHS

Characteristics	Crude model cOR (95% CI)	P-value	Adjusted model aOR (95% CI)
Age		<0.001	
35 to 49	1		1
20 to 34	**0.7 (0.6-0.9)**		0.9 (0.8-1.2)
15 to 19	**0.6 (0.4-0.8)**		0.9 (0.6-1.4)
Residence		<0.001	
Urban	1		**1**
Rural	**3.5 (2.6-4.8)**		**1.8 (1.2-2.7)**
Visited by fieldworker		0.006	
Yes	1		**1**
No	**1.4 (1.1-1.8)**		**1.3 (1.1-1.7)**
Region		<0.001	
Western	1		1
Southern	**2.3 (1.4-3.8)**		**0.5 (0.3-0.9)**
North-western	**6.8 (4.4-10.6)**		**1.8 (1.2-2.9)**
Northern	**2.1 (1.3-3.4)**		0.6 (0.4-1.0)
Eastern	1.0 (0.5-1.9)		**0.3 (0.2-0.5)**
Religion			
Islam	1	0.006	1
Christianity and others	**0.7 (0.5-0.9)**		1.3 (0.9-1.8)
Sex household head		0.012	
Male	1		1
Female	**0.8 (0.6-0.9)**		1.0 (0.8-1.3)
Household Size		0.006	
7 and above	1		1
Less than 7	**0.8 (0.6-0.9)**		0.8 (0.7-1.1)
Working status		0.002	
Not working	1		1
Working	**1.5 (1.2-2.0)**		1.10 (0.8-1.4)
Marital status		<0.001	
Not married	1		1
Married	**1.7 (1.4-2.2)**		1.10 (0.8-1.4)
Education Level		<0.001	
No Education	1		1
Primary	**0.7 (0.6-0.9)**		0.9 (0.7-1.1)
Secondary	**0.3 (0.3-0.5)**		**0.6 (0.4-0.8)**
Tertiary	**0.2 (0.1-0.4)**		0.5 (0.2-1.3)
Wealth Index		<0.001	
Richest	1		1
Richer	**1.9 (1.2-3.2)**		1.5 (0.9-2.4)
Middle	**3.8 (2.3-6.3)**		1.5 (0.9-2.6)
Poorer	**4.9 (3.0-8.2)**		1.6 (0.9-2.9)
Poorest	**5.1 (3.1-8.4)**		**1.9 (1.1-3.4)**

Parity		<0.001	
5 and above	1		1
2-4	**0.8 (0.6-0.9)**		1.1 (0.9-1.4)
1	**0.5 (0.4-0.7)**		0.9 (0.7-1.2)
Exposure to media		<0.001	
Yes	1		1
No	**2.2 (1.8-2.8)**		**1.5 (1.2-1.9)**
Permission to access		0.164	
Big problem	1		1
Not big problem	0.8 (0.7-1.1)		1.3 (1.0-1.7)
Distance to health facility		<0.001	
Big problem	1		1
Not big problem	**0.4 (0.3-0.5)**		**0.5 (0.4-0.6)**
ANC timing [a]		<0.001	
First trimester	1		1
After first trimester	**1.4 (1.2-1.8)**		**1.3 (1.1-1.6)**
ANC attendance		0.787	
8 contacts and above	1		-
Less than 8	1.0 (0.8-1.3)		

bold= Significant at p-value <0.05, aOR: Adjusted odds ratio. cOR: Crude Odds Ratio