

Research Article

Geographical and Socioeconomic Inequalities in the Utilization of Maternal Healthcare Services in Nigeria

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Abstract

Maternal healthcare utilization remains suboptimal in Nigeria, with persistent socioeconomic and geographical disparities undermining progress toward reducing maternal morbidity and mortality. This study aims to assess the geographical and socioeconomic inequalities of maternal healthcare utilization in Nigeria. Maternal healthcare utilization in Nigeria remains suboptimal, with persistent socioeconomic and geographical disparities hindering progress in reducing maternal morbidity and mortality. This study assessed inequalities in the utilization of antenatal care (ANC4+), facility-based delivery (FBD), and postnatal care (PNC) using data from the 2018 Nigeria Demographic and Health Survey. Socioeconomic inequalities were examined using Erreygers Normalized Concentration Indices (ENCI) and concentration curves disaggregated by region and residence, while decomposition analysis identified key drivers. Findings revealed significant pro-rich inequalities across all services. Facility-based delivery showed the widest gaps (urban ENCI = 0.295; rural = 0.121), particularly in the Northwest (0.398) and Northeast (0.254). ANC4+ visits displayed moderate inequality, highest in the Northwest (0.169). PNC showed minimal inequality, with ENCI values near zero. Wealth status was the strongest contributor to inequality, supported by education, parity, and religion, while age, marital status, employment, autonomy, and insurance played minor roles. Although overall utilization was higher in urban areas, inequality was more pronounced there, highlighting deep intra-urban socioeconomic divides. Substantial socioeconomic and geographic inequities persist in maternal healthcare utilization in Nigeria. Targeted interventions addressing financial, educational, and sociocultural barriers, especially in northern and urban-poor populations, are crucial to narrowing gaps and improving maternal outcomes.

Keywords

Maternal Healthcare, Socio-economic Inequalities, Geographical Disparities, Nigeria

1. Introduction

Maternal healthcare services, encompassing antenatal care (ANC), facility-based delivery (FBD), and postnatal care (PNC), are cornerstone interventions for reducing maternal

and neonatal mortality worldwide [59, 60]. These services facilitate the early detection of complications, ensure skilled attendance during childbirth, and provide timely postnatal support,

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thereby reducing the risk of preventable deaths. Despite global efforts to strengthen maternal health systems, maternal mortality remains a major public health concern, with approximately 287,000 maternal deaths reported worldwide in 2020. Strikingly, nearly 70% of these deaths occurred in sub-Saharan Africa, where systemic weaknesses in healthcare access and equity remain pervasive [61].

Persistent inequalities in maternal healthcare utilization have been documented across regions and income groups. For instance, studies from South Asia demonstrate substantial wealth-related gaps, with women in the poorest quintiles significantly less likely to receive skilled delivery care compared to wealthier groups [10]. Similarly, in Ethiopia and Tanzania, rural women face disproportionately low access to skilled birth attendance due to geographical barriers and weak health infrastructure [14, 30]. In contrast, countries that have successfully expanded maternal healthcare coverage, such as Rwanda and Ghana, attribute improvements to targeted pro-poor policies, health insurance schemes, and investments in rural health systems [52]. These examples highlight that while global progress is evident, inequalities remain entrenched and context-specific.

Nigeria bears a disproportionate share of this burden, accounting for nearly 20% of global maternal deaths while representing only 2.4% of the world's population [49, 62]. The country's maternal mortality ratio (MMR) of 512 per 100,000 live births and neonatal mortality rate of 39 per 1,000 live births remain among the highest globally [37]. These figures underscore the urgent need to improve access to and utilization of maternal healthcare services if Nigeria is to meet the Sustainable Development Goal (SDG) target of reducing the global MMR to below 70 per 100,000 live births by 2030 [57].

However, utilization of maternal healthcare services in Nigeria remains suboptimal. The 2018 Nigeria Demographic and Health Survey (NDHS) reported that while 67% of women received at least one ANC visit, only 51% completed the recommended four or more visits, 39% delivered in a health facility, and 42% received PNC within two days of delivery [2, 37]. These national averages conceal deep and persistent inequalities. Evidence shows that utilization is heavily stratified by geographical and socioeconomic factors: rural women and those in the poorest wealth quintiles are consistently less likely to access maternal healthcare compared to their urban, wealthier, and more educated counterparts [5, 44].

Geographical disparities reflect uneven distribution of health facilities, poor road networks, insecurity in northern regions, and regional variations in health system capacity [12, 24]. Socioeconomic inequalities are driven by poverty, low education, and limited employment opportunities, which restrict women's health literacy, financial autonomy, and ability to seek timely care [35]. These intersecting barriers contribute to Nigeria's persistently high maternal and neonatal mortality rates.

Although several policies and programs, including the Midwives Service Scheme and free maternal care initiatives, have

been implemented to improve access, progress has been uneven, and inequalities remain entrenched [42]. Previous studies have documented maternal health disparities in Nigeria, but many focus on single dimensions (e.g., urban–rural or wealth-related gaps) or specific services (ANC or FBD), limiting understanding of the intersectional nature of inequalities. Few employ advanced inequality measures, such as concentration indices and decomposition analysis, which are necessary to quantify the magnitude of disparities and identify their key drivers [5].

This study seeks to address these gaps by conducting a comprehensive analysis of geographical and socioeconomic inequalities in maternal healthcare utilization in Nigeria using nationally representative NDHS data. Specifically, it examines disparities in ANC, FBD, and PNC across wealth quintiles, educational levels, employment status, place of residence, and geopolitical zones, while accounting for relevant socio-demographic and contextual factors. The findings will provide evidence-based insights to inform targeted interventions, advance health equity, and accelerate progress towards achieving SDG 3.1 and universal health coverage in Nigeria.

2. Materials and Methods

2.1. Study Area and Study Design

Nigeria, the most populous country in Africa, has a population exceeding 195 million, with an annual growth rate of 2.61%. It ranks seventh globally in population size, after China, India, the United States, Indonesia, Brazil, and Pakistan [27, 49]. The country covers a land area of 923,768 km² with a population density of 212.04 persons per km² [49]. Administratively, Nigeria is divided into six geopolitical zones: South-South, South East, South West, North Central, North West, and North East, comprising 36 states and the Federal Capital Territory. Each state is further subdivided into Local Government Areas (LGAs), wards, and census enumeration areas (EAs) [58].

The sampling frame for the 2018 Nigeria Demographic and Health Survey (NDHS) was derived from the 2006 Population and Housing Census conducted by the National Population Commission. In the NDHS, the primary sampling unit, referred to as a cluster, was based on EAs from the census. Population estimates for the 774 LGAs, combined with cartographic materials, were used to identify EAs, estimate household numbers, and classify areas as urban or rural. Localities with a population size of 20,000 or more were categorized as urban, in line with the 2017 official definition.

Nigeria is ethnically and culturally diverse, with variations in norms, beliefs, and health-seeking behaviors. This diversity provides an important context for studying determinants of maternal healthcare utilization. Accordingly, the study employed an analytical cross-sectional design, utilizing secondary data from the 2018 NDHS, which is nationally representa-

tive and captures variations across geopolitical, socio-economic, and cultural settings within the country.

2.2. Population and Eligibility Criteria

The study population consists of women aged 15–49 who had at least one live birth in the five years preceding the 2018 NDHS (2013–2018). This population is selected because it captures recent maternal healthcare utilization experiences, aligning with WHO recommendations for assessing maternal health indicators [60]. The focus on women with recent births ensures relevance to current health system performance and policy priorities [45]. Based on the 2018 NDHS, approximately 21,488 women meet these criteria, providing a sufficient sample size for disaggregated analyses [37].

2.3. Variables

The outcome variables for this study were three key maternal healthcare indicators: antenatal care (ANC), facility-based delivery (FBD), and postnatal care (PNC). [37, 60]. These indicators align with global maternal health monitoring standards and Nigeria's health policy priorities [25].

The independent variables were grouped into geographical and socioeconomic factors. Place of residence was classified as urban or rural based on the NDHS variable v025. The geopolitical zone was captured as a categorical variable comprising North-Central, North-East, North-West, South-East, South-South, and South-West, following the NDHS variable v024 [24]. Socioeconomic indicators included educational attainment, categorised as no education, primary, secondary, or higher, based on NDHS variable v106; household wealth index, divided into quintiles of poorest, poorer, middle, richer, and richest, from NDHS variable v190; and employment status, coded as employed or unemployed using NDHS variable v714 [35].

2.4. Data Analysis

All data extraction, cleaning, and recoding were performed using SPSS (version 25), while further analyses were conducted with the Stata statistical package (version 15). Design weights were applied to account for the complex nature of the NDHS sample design and to ensure nationally representative estimates of the survey results as provided by Measure DHS. Descriptive statistics, including frequencies and percentages, were used to summarize the data. Geographical inequalities were assessed using the Theil index and between-group variance (BGV) to quantify relative and absolute inequalities across geopolitical zones.

Socioeconomic disparities were examined using concentration curves and the Erreygers-corrected concentration index (ECI) to capture wealth-related inequalities in ANC, FBD, and

PNC utilization. Decomposition analysis of the ECI was conducted to identify the percentage contributions of socioeconomic, demographic, and geographical factors to overall inequality.

2.5. Ethical Consideration

There was no ethical committee approval for this study because it utilized secondary data from the NDHS.

3. Results

The socio-demographic and healthcare characteristics of respondents are presented in Table 1 below. The results reveal that age distribution shows a balanced structure, with the highest proportions among adolescents aged 15–19 years (20.1%) and women aged 40–49 years (19.0%). The smallest group comprised women aged 35–39 years (12.9%).

Educational attainment was generally low, with 34.4% of women having no formal education and only 10.4% reporting higher education, while the largest proportion (39.9%) had secondary education. Most respondents were married or cohabiting (69.1%), while 25.5% had never married and 5.4% were widowed, divorced, or separated. Employment status indicated that nearly two-thirds (64.7%) of women were engaged in some form of work, compared to 35.3% who were unemployed.

Fertility patterns revealed that high parity was common, as 40.3% of respondents had five or more children, compared with 31.4% who had one to two children and 28.3% with three to four children. Religious affiliation was nearly evenly split between Muslims (50.1%) and Christians (49.0%), with only a small fraction (0.9%) reporting other religions.

For residence, 59.4% of women lived in urban areas, while 40.6% resided in rural areas. Regionally, the North-West had the largest share of respondents (24.2%), followed by the North Central (18.6%) and North-East (18.3%). In contrast, the southern zones, South-East (13.3%), South-South (12.2%), and South-West (13.5%), contributed smaller proportions.

Socioeconomic status, measured by the wealth index, showed a fairly even distribution, with 38.5% of women in the poorest or poorer households, 21.2% in the middle group, and 40.3% in the richest households. Media exposure was limited for most respondents, as 57.7% reported no exposure or less than weekly access, compared to 42.3% who had weekly exposure.

Decision-making autonomy was restricted for many women, with 56.1% lacking autonomy in healthcare decisions, while 43.9% reported having autonomy. Health insurance coverage was extremely low, with only 2.7% of respondents insured, compared to 97.3% without coverage, underscoring limited financial protection mechanisms within the health system.

Table 1. *Socio-Demographic & Healthcare Characteristics Distribution of Respondents.*

Variables	Frequency (%)
Age Group (years)	
15 – 19	8423 (20.14)
20 – 24	6844 (16.36)
25 – 29	7203 (17.22)
30 – 34	5997 (14.34)
35 – 39	5406 (12.93)
40 – 49	7948 (19.00)
Educational Level	
No Education	14398 (34.43)
Primary	6383 (15.26)
Secondary	16698 (39.93)
Higher	4342 (10.38)
Marital Status	
Never Married	10669 (25.51)
Married/Living together	28888 (69.08)
Widowed/Divorced/Separated	2264 (5.41)
Employment Status	
Unemployed	14766 (35.31)
Employed	27055 (64.69)
Parity	
1 – 2	9408 (31.37)
3 – 4	8493 (28.32)
5+	12091 (40.31)
Religion	
Christian	20506 (49.03)
Muslim	20959 (50.12)
Other	356 (0.85)
Place of Residence	
Urban	24837 (59.39)
Rural	16984 (40.61)
Region	
North Central	7772 (18.58)
North-East	7639 (18.27)
North-West	10129 (24.22)
South-East	5571 (13.32)
South-South	5080 (12.15)
South-West	5630 (13.46)

Variables	Frequency (%)
Wealth Index	
Poorest/Poorer	16093 (38.48)
Middle	8859 (21.18)
Richer/Richest	16869 (40.34)
Media Exposure	
None/Less than weekly	24130 (57.70)
At least weekly	17691 (42.30)
Decision Autonomy	
No autonomy	16210 (56.11)
Has autonomy	12678 (43.89)
Insurance	
Not covered	40704 (97.33)
Covered	1117 (2.67)

Concentration curve of ANC4+ visits by region of residence

The concentration curve of ANC4+ visits by region of residence is shown in Figure 1 below. The figure reveals the regional distribution of antenatal care with at least four visits

(ANC4+) across socioeconomic groups. The concentration curve lies below the line of equality for all regions, indicating that ANC4+ services are pro-rich, that is, disproportionately utilized by women from higher socioeconomic strata.

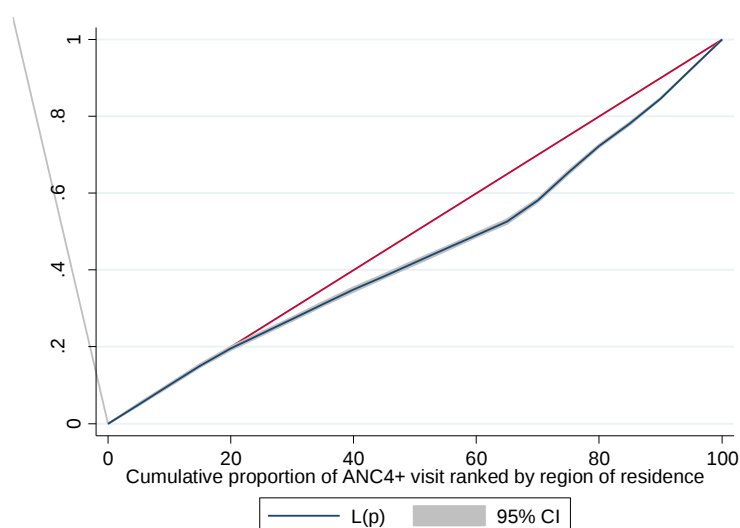


Figure 1. Concentration curve of ANC4+ visits by region of residence.

However, the distance from the line of equality varies by region, reflecting differing degrees of inequality. The North-West and North-East regions exhibit curves that are markedly concave and farthest from the equality line, signaling the strongest pro-rich inequality. This is consistent with their high concentration index values (Northwest: 0.169; Northeast: 0.109), suggesting that the wealthiest women are significantly

more likely to complete four or more ANC visits in these regions.

In contrast, Southwest and Southeast show curves that are closer to the line of equality, with the Southwest having the lowest regional index (0.030). These curves suggest milder inequality and potentially better access to ANC4+ services across wealthy quintiles. Nonetheless, no region achieves per-

fect equity, which underscores the need for region-specific interventions to expand access to antenatal care for the poor.

Concentration curve of ANC4+ visits by place of residence

The Concentration Curve of ANC4+ Visits by Place of Residence is presented in Figure 2. The figure distinguishes urban and rural areas in the use of ANC4+ services. As with regional data, both curves lie below the equality line, confirming pro-rich inequality. However, the urban curve lies further below than the rural curve, indicating that in urban areas, the inequality is more pronounced; wealthy women in cities disproportionately access ANC4+ compared to their poorer counterparts.

This pattern is supported by Erreygers' concentration indices: urban index = 0.163, rural index = 0.068. Although ANC coverage is generally higher in urban areas, these results highlight a deeper socioeconomic gap within urban communities, indicating that targeted outreach to urban poor women is necessary to enhance equity in service access.

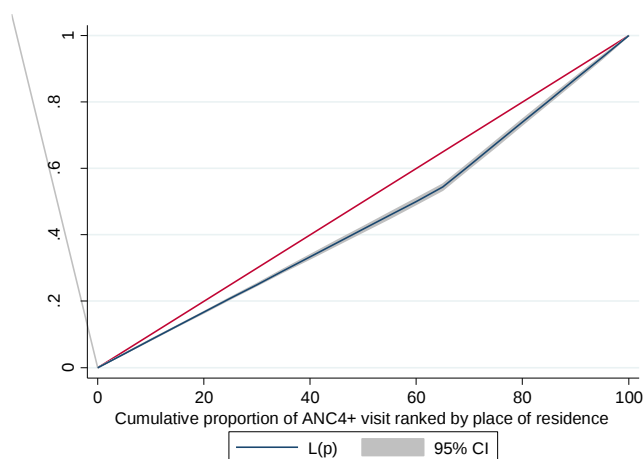


Figure 2. Concentration curve of ANC4+ visit by place of residence.

Concentration curve of Facility-Based Delivery by region of residence

The Concentration curve of facility-based delivery by region of residence is presented in Figure 3 below. The figure illustrates the inequality in facility-based deliveries by region. Again, all regional curves fall below the line of equality, denoting pro-rich distributions.

The inequality is especially acute in the Northwest and Northeast, with very steep curves and extremely high Erreygers indices: Northwest = 0.398, Northeast = 0.254. This indicates that wealth plays a significant role in determining facility delivery in these regions, with the poorest women facing substantial barriers.

Regions like the Southwest and Southeast exhibit flatter curves, with the South-West having the lowest inequality (index = 0.032). These findings suggest better socioeconomic equity in the southern zones, likely due to higher baseline health infrastructure, education, and urbanization.

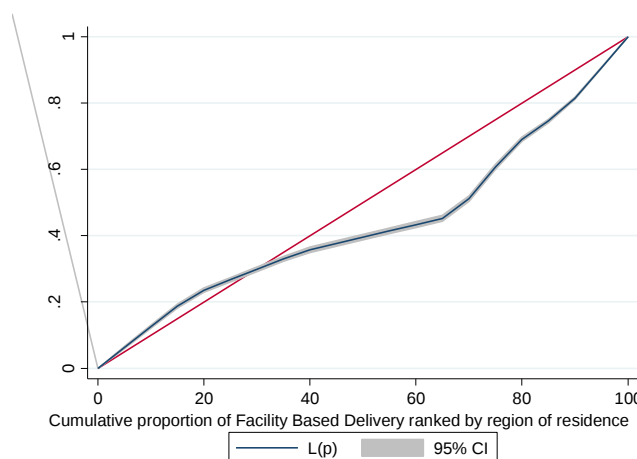


Figure 3. Concentration curve of Facility Based Delivery by region of residence.

Concentration curve of Facility-Based Delivery by place of residence

The Concentration Curve of Facility-Based Delivery by Place of Residence is presented in Figure 4 below. The figure continues the trend observed in ANC services, showing that urban women exhibit a steeper pro-rich inequality in facility delivery. The urban curve is significantly below the rural curve, even though urban areas generally have higher absolute utilization rates.

Urban index = 0.295 vs rural index = 0.121, reflecting more concentrated access among the wealthy in urban areas. This pattern suggests that despite geographical proximity to facilities in urban settings, financial and systemic barriers persist for poor women, including cost of services, informal payments, and indirect costs such as transportation and waiting time.

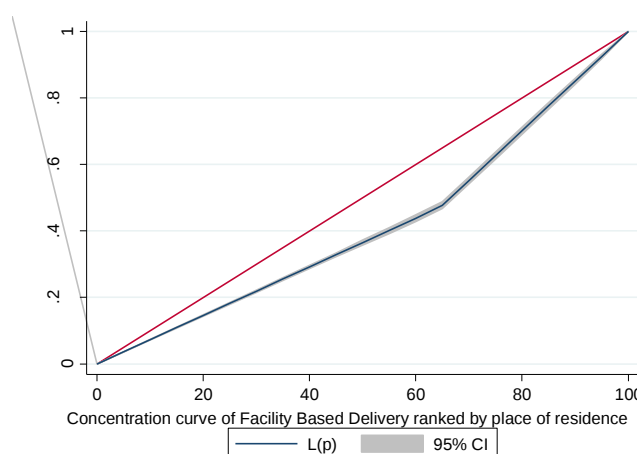


Figure 4. Concentration curve of Facility-Based Delivery by place of residence.

Concentration curve of Post-Natal Care by region of residence

The Concentration Curve of Postnatal Care by Region of Residence is shown in Figure 5 below. The figure reveals that Postnatal care (PNC) curves for all regions are closer to the line of equality compared to earlier services, indicating that PNC is more equitably distributed across wealth groups. However, inequality remains, especially in the Southeast (index = 0.020) and North-Central (index = 0.035), where PNC is

slightly skewed toward the rich.

The Northeast and Northwest, despite having lower overall coverage, show minimal inequality (indices = 0.005 and 0.010, respectively), possibly due to universally poor access across socioeconomic strata. These results suggest that PNC services may be less influenced by wealth but are still limited in absolute terms.

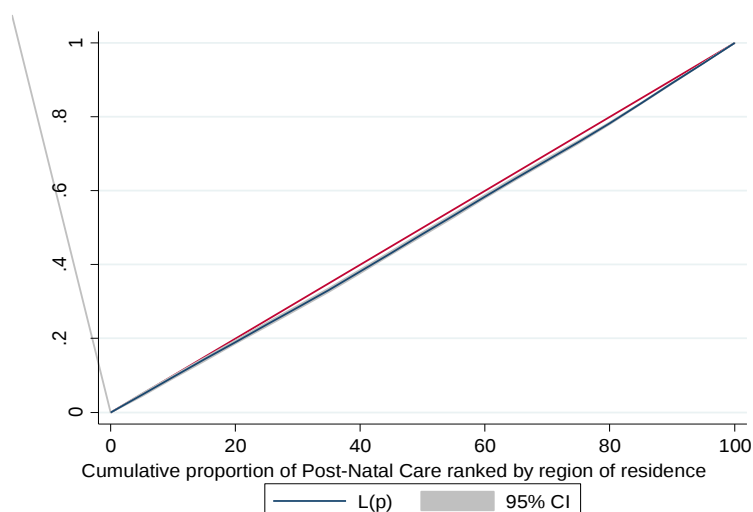


Figure 5. Concentration curve of Post-Natal Care by region of residence.

Concentration curve of Post-Natal Care by place of residence

The Concentration Curve of Postnatal Care by Place of Residence is shown in Figure 6 below. This figure continues the pattern seen in regional analysis. Urban and rural curves for PNC are very close to the equality line, with small positive indices: urban = 0.020, rural = 0.009. The curves imply that

wealth-related inequality in PNC is relatively minor in both urban and rural contexts.

Nevertheless, even small levels of inequality should not be overlooked, particularly given that PNC coverage is still suboptimal for some subgroups. This presents an opportunity for scaling up community-based PNC strategies to further level the playing field.

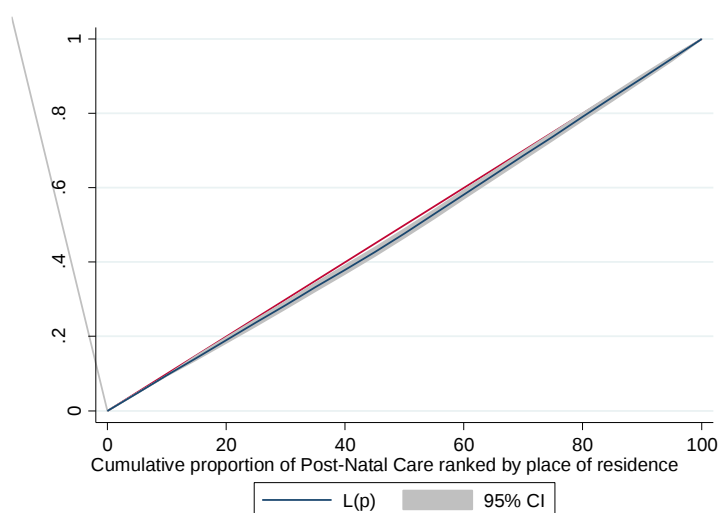


Figure 6. Concentration curve of Post-Natal Care by place of residence.

The Erreygers Normalised Concentration Indices for Maternal Healthcare Services by Region and Place of Residence are presented in Table 2 below. The table presents the Erreygers Normalised Concentration Indices (ENCI) for antenatal care with four or more visits (ANC4+), facility-based delivery, and postnatal care (PNC), disaggregated by both place

of residence and region. The results demonstrate that wealth-related inequalities in maternal healthcare are statistically significant across residence (urban vs. rural) and regional contexts (North Central, North-East, North-West, South-East, South-South, South-West), with variations in magnitude across the three services.

Table 2. Erreygers normalised concentration indices for Maternal Healthcare Services in Nigeria by Region & Place of residence.

Variables	Ante-Natal Care		Facility-Based Delivery		Post-Natal Care	
	Index Value (Std Error)	Z-stat (P-value)	Index Value (Std Error)	Z-stat (P-value)	Index Value (Std Error)	Z-stat (P-value)
Place of Residence		18.67 (<0.001)		24.22 (<0.001)		2.06 (0.0394)
Urban	0.163 (0.004)*		0.295 (0.006)*		0.020 (0.004)*	
Rural	0.068 (0.003)*		0.121 (0.004)*		0.009 (0.002)*	
Region		63.33 (<0.001)		131.39 (<0.001)		3.56 (0.0033)
North Central	0.157 (0.007)*		0.168 (0.008)*		0.035 (<0.001)*	
North-East	0.109 (0.008)*		0.254 (0.011)*		0.005 (0.008)	
North-West	0.169 (0.007)*		0.398 (0.013)*		0.010 (0.007)	
South-East	0.035 (0.004)*		0.097 (0.004)*		0.020 (0.005)*	
South-South	0.078 (0.007)*		0.157 (0.012)*		0.019 (0.007)*	
South-West	0.030 (0.003)*		0.032 (0.005)*		0.012 (0.003)*	

*Significant with $p < 0.001$

*Std Error: Standard Error

For antenatal care, the results indicate significant pro-rich inequalities. The z-statistic for residence was 18.67 ($p < 0.001$), confirming that the differences between urban and rural women were highly significant. Urban areas recorded a higher concentration index of 0.163 ($SE = 0.004$, $p < 0.001$), compared to 0.068 ($SE = 0.003$, $p < 0.001$) in rural areas. This suggests that while ANC utilization is higher in urban contexts, access is disproportionately concentrated among wealthier women, leaving poorer urban women relatively disadvantaged. Regionally, the inequalities were also highly significant ($z = 63.33$, $p < 0.001$). The North-West (0.169, $SE = 0.007$, $p < 0.001$) and North-Central (0.157, $SE = 0.007$, $p < 0.001$) showed the largest pro-rich inequalities, while the South-West (0.030, $SE = 0.003$, $p < 0.001$) and South-East (0.035, $SE = 0.004$, $p < 0.001$) had the lowest. These patterns suggest that in northern zones, wealth status plays a stronger role in determining who obtains recommended antenatal care, while the southern zones are relatively more equitable.

Facility-based delivery showed the most severe inequalities. The z-statistic for residence was 24.22 ($p < 0.001$), again highlighting significant urban–rural disparities. Urban women had a concentration index of 0.295 ($SE = 0.006$, $p < 0.001$), which

was more than twice that of rural women at 0.121 ($SE = 0.004$, $p < 0.001$). This finding reveals that delivery in health facilities is disproportionately concentrated among wealthier urban women, pointing to deep intra-urban disparities. At the regional level, the inequality was even more striking, with a z-statistic of 131.39 ($p < 0.001$). The North-West recorded the highest ENCI value of 0.398 ($SE = 0.013$, $p < 0.001$), followed by the North-East at 0.254 ($SE = 0.011$, $p < 0.001$). These results demonstrate entrenched wealth-driven inequities in facility-based delivery in the northern regions. In contrast, the South-West (0.032, $SE = 0.005$, $p < 0.001$) showed the lowest inequality, suggesting relatively fairer access in that zone.

Postnatal care revealed smaller inequalities compared to ANC4+ and facility delivery. For residence, the z-statistic was 2.06 ($p = 0.0394$), indicating that while the difference was statistically significant, the magnitude was modest. The ENCI values were 0.020 ($SE = 0.004$, $p < 0.001$) in urban areas and 0.009 ($SE = 0.002$, $p < 0.001$) in rural areas. Regionally, the z-statistic was 3.56 ($p = 0.0033$), showing significance but at a lower magnitude than ANC or facility delivery. The North-Central zone had the highest inequality at 0.035 ($SE < 0.001$,

$p < 0.001$), while the North-East (0.005, SE=0.008, not statistically significant) and North-West (0.010, SE=0.007) showed the smallest. This pattern suggests that although PNC utilization is still skewed toward wealthier women, the disparities are relatively minor compared to other maternal health services.

Decomposition of Maternal Healthcare Services in Nigeria

The decomposition of maternal healthcare Services in Nigeria is shown in Table 3 below. The decomposition analysis of socio-economic inequalities in the utilization of maternal healthcare services in Nigeria, specifically antenatal care with four or more visits (ANC4+), facility-based delivery, and postnatal care (PNC). Using the Erreygers decomposition method, the table quantifies the elasticity (η_k), the Erreygers' index (E_k), and the percentage contribution of various socio-demographic, economic, and contextual factors to the observed inequality. The results provide insights into the relative importance of these determinants in driving disparities in maternal healthcare access.

The analysis reveals that the age group contributes very little to inequality across all services. The reference group (15–19 years) serves as the baseline, with other age groups showing near-zero percentage contributions. The 25–34 age groups register slightly positive elasticities for ANC and facility delivery, but their contributions remain trivial. Notably, the 40–49 years age group shows small negative contributions (e.g., –0.030 for PNC), indicating that older women modestly reduce inequality, though the effect sizes are negligible. Overall, age does not significantly explain the wealth-related disparities observed.

Educational attainment emerges as a key but modest driver of inequality. Compared to women with no education, those with primary, secondary, and higher education exhibit negative percentage contributions across ANC, facility delivery, and PNC. For instance, secondary education contributes –0.002 for ANC and –0.006 for facility delivery, while higher education contributes –0.004 across the services. These negative contributions imply that educated women, who are more concentrated in wealthier households, disproportionately utilize maternal healthcare services, thereby reinforcing pro-rich inequality. Although education does not dominate the decomposition, its consistent influence highlights its role as a pathway through which wealth translates into differential healthcare access.

Marital status makes a negligible contribution to inequality across services. The categories of married/living together and widowed/divorced/separated display near-zero percentage contributions, indicating that differences in marital status do not drive socio-economic disparities in maternal healthcare use.

The role of employment status is similarly limited. Employed women show very small negative contributions (–0.003 for ANC4+ and facility delivery), suggesting that while employment is associated with increased utilization, its distribution across wealth quintiles is relatively balanced, thus

minimally affecting inequality patterns.

Parity exhibits more variation. High-parity women (five or more children) contribute positively to inequality in ANC (0.010), facility delivery (0.014), and PNC (0.001). This implies that wealthier women with higher parity disproportionately access services, reinforcing inequality. In contrast, women with 3–4 children contribute negatively, though weakly (–0.005 for facility delivery), hinting at a modest equalizing effect. Thus, while parity does not dominate inequality, it contributes small but meaningful differences across wealth groups.

Religion shows directional variation in contributions. Christians contribute positively (e.g., 0.017 for ANC4+), while Muslims contribute negatively (–0.016 for ANC4+). This pattern reflects the overrepresentation of Muslims among poorer populations, who have lower service uptake, compared to Christians, who are wealthier and more likely to use maternal health services. Though the absolute contributions are small, religious affiliation clearly interacts with wealth to shape disparities.

Place of residence demonstrates modest influence. Urban women exhibit small negative contributions (–0.002 for ANC4+ and PNC), indicating that urban wealthier women disproportionately utilize services, reinforcing inequality. Rural residence serves as the reference category, with contributions normalized at 1.000. This suggests that while residence explains some part of the inequality, it is less influential than wealth and education.

Regional disparities contribute modestly and variably to inequality. For example, the North-West contributes slightly positively to facility delivery inequality (0.002), while the South-East contributes negatively (–0.003 for ANC). These differences highlight regional heterogeneity in service use but suggest that regional variation explains only a limited share of overall socio-economic inequality.

As expected, the wealth index plays a dominant role in explaining disparities. Compared to the poorest/poorer reference group, the richer/richest quintiles contribute substantially to inequality: –0.012 for facility delivery and –0.011 for ANC, accounting for 11–12% of the total inequality. This confirms wealth as the primary axis of inequality, as richer women overwhelmingly drive the concentration of maternal healthcare services among the affluent.

Other contextual factors, media exposure, decision-making autonomy, and insurance coverage, have minimal contributions. Media exposure contributes weakly negatively (–0.001 for ANC), consistent with wealthier women having greater access to media and therefore higher service uptake. Decision autonomy contributes negligibly, suggesting that while autonomy is important for healthcare use, its distribution across wealth groups limits its role in inequality. Similarly, health insurance coverage contributes virtually nothing to inequality, reflecting extremely low insurance coverage rates nationally (less than 3%).

The total explained inequality is modest: 0.038 for ANC4+,

0.036 for facility-based delivery, and 0.016 for PNC. This indicates that while the decomposition identifies important drivers of inequality, much of the disparity remains unexplained, potentially linked to unobserved structural and systemic barriers.

Among the three services, PNC shows the lowest explained inequality, reflecting its relatively equitable distribution compared to ANC and facility delivery.

Table 3. *Decomposition of Maternal Healthcare Services in Nigeria.*

Variables	Maternal Healthcare					
	Ante-Natal Care		Facility-Based Delivery		Post-Natal Care	
	$\eta_k (E_k)$	% Contr.	$\eta_k (E_k)$	% Contr.	$\eta_k (E_k)$	% Contr.
Age Group						
15 – 19 yrs	1.000	1.000	1.000	1.000	1.000	1.000
20 – 24 yrs	-	-	-	-	-	-
25 – 29 yrs	0.003 (0.004)	-0.001	0.004 (0.002)	-0.0001	0.026 (0.005)	-0.001
30 – 34 yrs	0.038 (0.003)	-0.001	0.038 (0.001)	-0.0001	0.015 (0.006)	-0.0001
35 – 39 yrs	0.021 (0.003)	-0.0001	0.029 (0.001)	-0.0001	0.002 (0.004)	-0.0001
40 – 49 yrs	-0.005 (0.002)	0.00001	-0.008 (0.001)	0.00001	-0.030 (0.002)	-0.001
Educational Level						
No Education	1.000	1.000	1.000	1.000	1.000	1.000
Primary	-0.0001 (-0.001)	0.00001	-0.0001 (0.0001)	-0.0001	-0.0001 (0.008)	0.001
Secondary	-0.005 (0.003)	-0.002	-0.005 (0.009)	-0.006	-0.0001 (0.027)	-0.001
Higher	-0.004 (0.001)	-0.001	-0.004 (0.005)	-0.004	-0.001 (0.008)	-0.004
Marital Status						
Never Married	1.000	1.000	1.000	1.000	1.000	1.000
Married/Living together	0.0001 (0.0001)	0.0001	0.0001 (0.0001)	0.0001	0.0001 (0.0001)	0.0001
Widowed/Divorced/Separated	0.0001 (0.0001)	0.0001	0.0001 (0.0001)	0.0001	0.0001 (0.0001)	0.0001
Employment Status						
Unemployed	1.000	1.000	1.000	1.000	1.000	1.000
Employed	-0.003 (-0.0001)	0.0001	-0.003 (-0.0001)	0.0001	-0.001 (-0.011)	0.0001
Parity						
1 – 2	1.000	1.000	1.000	1.000	1.000	1.000
3 – 4	-0.002 (0.031)	-0.003	-0.002 (0.035)	-0.005	-0.001 (0.002)	0.0001
5+	0.007 (0.026)	0.010	0.007 (0.025)	0.014	0.001 (0.0001)	0.0001
Religion						
Christian	-0.006 (-0.030)	0.017	-0.0001 (-0.013)	0.008	-0.0001 (-0.018)	0.001
Muslim	0.003 (-0.026)	-0.016	-0.002 (-0.009)	-0.009	0.0001 (0.001)	0.0001
Other	1.000	1.000	1.000	1.000	1.000	1.000
Place of Residence						
Urban	-0.001 (0.003)	-0.002	-0.001 (-0.0001)	0.0001	-0.001 (0.007)	-0.002
Rural	1.000	1.000	1.000	1.000	1.000	1.000

Variables	Maternal Healthcare					
	Ante-Natal Care		Facility-Based Delivery		Post-Natal Care	
	$\eta_k (E_k)$	% Contr.	$\eta_k (E_k)$	% Contr.	$\eta_k (E_k)$	% Contr.
Region						
North Central	1.000	1.000	1.000	1.000	1.000	1.000
North-East	-0.001 (-0.001)	-0.001	-0.001 (-0.0001)	0.0001	-0.0001 (-0.004)	-0.002
North-West	-0.001 (-0.002)	-0.001	-0.003 (0.001)	0.002	-0.0001 (-0.002)	0.0001
South-East	0.001 (-0.003)	0.003	0.002 (-0.001)	0.001	0.0001 (0.001)	-0.0001
South-South	0.0001 (-0.0001)	0.0001	0.0001 (-0.0001)	0.0001	-0.0001 (-0.0001)	-0.0001
South-West	-0.001 (0.002)	0.001	-0.001 (0.002)	-0.002	-0.0001 (-0.003)	0.001
Wealth Index						
Poorest/Poorer	1.000	1.000	1.000	1.000	1.000	1.000
Middle	-0.001 (-0.003)	0.001	-0.001 (-0.005)	0.001	0.001 (-0.004)	-0.0001
Richer/Richest	-0.005 (-0.006)	0.004	-0.012 (-0.016)	0.011	-0.004 (-0.014)	0.003
Media Exposure						
None/Less than weekly	1.000	1.000	1.000	1.000	1.000	1.000
At least weekly	-0.0001 (0.002)	-0.001	-0.0001 (0.0001)	-0.0001	-0.0001 (-0.001)	0.0001
Decision Autonomy						
No autonomy	1.000	1.000	1.000	1.000	1.000	1.000
Has autonomy	-0.0001 (0.0001)	-0.0001	-0.0001 (0.001)	-0.0001	-0.0001 (-0.003)	0.0001
Insurance						
Not covered	1.000	1.000	1.000	1.000	1.000	1.000
Covered	-0.0001 (-0.0001)	0.0001	-0.0001 (-0.001)	0.0001	-0.0001 (-0.0001)	0.0001
Total	0.038 (-0.010)	0.008	0.036 (-0.001)	0.010	0.016 (0.001)	-0.001

η_k is the elasticity of the k th variable, is the Erreygers' normalised corrected concentration index, Contr. is the contribution, % Contr. is the percentage contribution

4. Discussion

This study examined inequalities in maternal healthcare utilization in Nigeria across three critical service indicators: antenatal care with at least four visits (ANC4+), facility-based delivery (FBD), and postnatal care within two days of delivery (PNC). Using nationally representative data from the 2018 Nigeria Demographic and Health Survey (NDHS) and advanced inequality measures such as the Erreygers-corrected concentration index and decomposition analysis, the study provides a multidimensional understanding of disparities across geographical, socioeconomic, and demographic lines.

The analysis of ANC4+ visits by region of residence revealed pronounced pro-rich inequality nationwide. In all regions, the

concentration curve lay below the line of equality, indicating that wealthier women disproportionately utilized ANC services. The degree of inequality, however, varied substantially across regions. The Northwest and Northeast exhibited the strongest pro-rich inequality, showing that women from higher socioeconomic strata in these regions were considerably more likely to achieve four or more ANC visits. These findings are consistent with previous studies documenting limited maternal healthcare access in northern Nigeria due to socioeconomic constraints, weak health infrastructure, and cultural barriers [41, 11]. By contrast, the Southwest and Southeast displayed much milder inequality, reflecting relatively more equitable access across wealth quintiles. This pattern corroborates earlier findings that southern regions benefit from higher ANC coverage, stronger health infrastructure, and better maternal education [54, 48]. Nonetheless, no region achieved equity, underscoring the persistent

need for region-specific interventions to improve ANC access for poorer women.

Analysis by place of residence reinforced these findings. Both urban and rural areas exhibited pro-rich inequality, but disparities were more pronounced in urban areas. The Erreygers-normalized concentration indices confirmed this trend, with metropolitan areas recording higher values than rural settings. While absolute ANC coverage was higher in urban contexts, utilization was concentrated among wealthier women, reflecting deep intra-urban socioeconomic divides. This outcome aligns with evidence from other sub-Saharan African countries, where urban residence does not automatically guarantee equitable access to maternal healthcare; pro-rich biases often persist within cities [14, 15, 29, 44] a study in Bangladesh; [36].

Geographical disparities were also evident, with rural and northern zones experiencing the most limited access. Women in rural areas were less likely to receive facility-based delivery or skilled birth attendance (SBA), largely due to barriers such as distance to health facilities, poor road networks, and shortages of skilled health workers [50, 44]. For example, the South-West zone recorded a facility delivery rate of 71%, compared to just 12% in the North-West, highlighting stark regional divides. These inequalities are further compounded by insecurity, especially in the Northeast, where insurgency has forced the closure of many healthcare facilities, reducing both access and provider availability [12].

Despite national programs such as the Midwives Service Scheme (MSS), which aimed to deploy health personnel to rural areas, coverage has remained inadequate, reaching only a fraction of the target population [22].

In general, the combined regional and residence analyses confirm that wealth remains the strongest determinant of ANC4+ utilization in Nigeria. The Northwest, Northeast, and urban centers exhibited the highest levels of inequality, reinforcing the need for targeted interventions to bridge socioeconomic and geographical gaps in maternal healthcare access [3, 41].

The current findings showing pro-rich inequality in facility-based delivery (FBD) across all regions are consistent with evidence from other studies. A study by [9] in a multi-country analysis of sub-Saharan countries reported that institutional deliveries are disproportionately concentrated among wealthier women, especially in sub-Saharan Africa. Additionally, [16] found that the poorest quintiles across many African countries still lag in accessing skilled birth attendance, with Nigeria ranking among the most unequal.

The sharp inequalities in the Northwest and Northeast align with the findings of [47] and [19], who noted that cultural norms favoring home delivery, weak infrastructure, and widespread poverty exacerbate inequities in northern Nigeria. A recent DHS-based analysis [32] reported that women in the northern regions are significantly less likely to deliver in facilities, and those who do are overwhelmingly from wealthier households.

By contrast, the flatter curves in the South (especially the Southwest) corroborate the findings of [8], who showed that higher female literacy, urbanization, and health infrastructure in the South reduce socioeconomic inequality in maternal healthcare utilization. Also, [23] similarly observed that the wealth gradient in facility-based delivery is weaker in southern Nigeria, indicating relatively better equity.

The place-of-residence analysis, where urban areas showed higher inequality compared to rural areas, corroborates the findings of [30], who highlighted that in African cities, the urban poor face severe disadvantages despite physical proximity to facilities. They are often excluded from high-quality private or tertiary facilities and struggle with indirect costs such as transport, user fees, and informal payments. Comparable evidence from [20] in government health care facility in Uganda also confirmed that the urban poor are systematically underserved compared to their wealthier counterparts.

In broader regional context, studies from Ethiopia [56] and Ghana [21] also report pro-rich inequalities in institutional delivery, particularly in rural and socioeconomically deprived regions. These similarities highlight structural determinants, such as poverty, health system weaknesses, and sociocultural norms, which transcend national boundaries.

The concentration curves of postnatal care (PNC) by region (Figure 5) and place of residence (Figure 6) suggest that PNC is more equitably distributed across wealth groups compared to antenatal care (ANC) and facility-based delivery. The closeness of the regional and residential curves to the line of equality indicates that socioeconomic inequality plays a smaller role in determining PNC utilization. Nonetheless, slight pro-rich inequalities are observed in the Southeast (0.020), North-Central (0.035), and urban areas (0.020). However, the Northeast and Northwest exhibit very low inequality, but this is likely explained by uniformly low coverage across all wealth quintiles rather than equitable access.

These findings align with earlier research in Nigeria and other sub-Saharan countries [14]. The study by [46] revealed that while wealth strongly predicts ANC and facility delivery, its influence is weaker for PNC, partly because women who deliver outside health facilities may still receive some postnatal checks from lower-level providers or community health workers. Similarly, [17] in India and [36] demonstrated that PNC services were distributed more evenly across socioeconomic groups than ANC or delivery services, although overall coverage levels remained low.

The minimal inequality in the northern regions resonates with the findings of [19] and [48], who observed that in areas with very low overall service uptake, wealth-based gradients tend to flatten, not because of equity in access but due to universally poor utilization. This also aligns with the findings of [39], where apparent equality masks uniformly low coverage across all wealth quintiles.

The small but noticeable pro-rich inequality in the Southeast and urban areas mirrors the results [63] in a pooled analysis of 23 countries and [34] at comprehensive health centers

in Hamedan City demonstrated that in contexts where overall PNC coverage is higher, disparities become more evident, with wealthier women more likely to receive timely and higher-quality postnatal checks. Likewise, [31] and [51]. Evidence from 27 selected countries in Sub-Saharan Africa highlighted that in urban centers, private facilities and better-resourced hospitals are disproportionately accessed by wealthier women, contributing to subtle but persistent inequalities in postnatal services.

Beyond Nigeria, studies from Ethiopia [56] and Ghana [21] also reported relatively low wealth-related inequality in PNC compared to other maternal health services, reinforcing the idea that postnatal care tends to be more uniformly distributed across socioeconomic strata. However, these studies caution that equity in PNC should not overshadow the critical issue of suboptimal coverage, which remains a major driver of poor maternal and neonatal outcomes.

The findings validate previous research showing that PNC in Nigeria is more equitably distributed than ANC and facility-based delivery, echoing trends observed in sub-Saharan Africa and other LMICs [48, 53]. However, the apparent equity in the North is driven by universally low coverage, while the slight pro-rich inequality in the South and urban areas reflects better access among wealthier groups. These results highlight the need to scale up community-based PNC interventions to ensure both equitable and adequate coverage nationwide.

The Erreygers normalized concentration indices in Table 2 reaffirm the presence of significant socioeconomic inequalities in maternal healthcare utilization across Nigeria. All indices are positive and statistically significant ($p < 0.001$), underscoring a consistent pro-rich distribution of antenatal care (ANC), facility-based delivery (FBD), and postnatal care (PNC). However, the magnitude of inequality varies across services, regions, and places of residence.

By place of residence, urban areas show higher inequality than rural areas for both ANC and FBD. This pattern highlights that, while overall utilization is higher in urban settings, access is disproportionately concentrated among wealthier households. This urban–rural disparity is consistent with the findings of [44] in Nigeria; [40] in Tanzania; and [9] in Bangladesh, who documented sharper gradients in urban areas across sub-Saharan Africa due to the dominance of wealthier populations in accessing private or higher-quality facilities. Conversely, the lower, but still significant indices in rural areas suggest more uniformly limited access, reflecting systemic barriers such as distance, weak infrastructure, and shortage of skilled providers, as highlighted by [46] in Nigeria.

By region, striking differences emerge. The Northwest and Northeast record the steepest inequalities, particularly for facility-based delivery. These results are consistent with [19] and [7], who reported that institutional delivery in the northern zones of Nigeria is both very low in absolute terms and highly concentrated among the wealthiest women. Cultural practices

favoring home births, early marriage, and limited female autonomy further reinforce these inequities [1].

In contrast, the Southern regions display much lower inequality, particularly for facility-based delivery. This aligns with [23] and [8], who showed that higher education levels, urbanization, and better health infrastructure in southern Nigeria translate into more equitable maternal healthcare utilization.

Postnatal care (PNC) exhibits the lowest inequality across all regions and places of residence, with indices ranging from 0.005 in the Northeast to 0.035 in the North-Central. The relatively low magnitude of inequality for PNC echoes findings from [53], and [18].

The decomposition analysis provides insight into the relative contributions of different socioeconomic and demographic factors to inequality in antenatal care (ANC), facility-based delivery (FBD), and postnatal care (PNC) in Nigeria. While all services show overall pro-rich distributions, the drivers of inequality differ across dimensions.

The contribution of age is generally small and negative across services, with younger women (15–19 years) serving as the reference group. This suggests that age itself is not a strong driver of inequality, consistent with findings by [19] and [55], who found that wealth and education are far more influential determinants of maternal healthcare utilization than age. Parity shows modest effects, with higher parity (5+) women contributing slightly positively to inequality, particularly for ANC and FBD. This aligns with the evidence from [38] in Bangladesh and [4] in Nigeria, who reported that multiparity reduces the likelihood of facility use, especially among poorer women, often due to cost-saving strategies and prior delivery experience.

Educational level emerges as a key driver of inequality. Women with secondary or higher education contribute negatively to the concentration indices, indicating that education disproportionately benefits wealthier women in accessing services. This finding aligns with [44, 46], and [8], who documented strong positive associations between women's education and maternal healthcare utilization in Nigeria. Also, [13] in a comparative analysis of 39 developing countries, showed that education is among the most consistent predictors of maternal health inequalities.

Marital status contributes minimally to inequality, with negligible differences between married and unmarried groups. This is consistent with [23], who noted that wealth and education overshadow marital status in predicting service use. Employment also shows little contribution, though employed women slightly reduce inequality in PNC, reflecting their greater ability to afford healthcare, a finding corroborated by [26] in Ethiopia.

Religion contributes modestly to inequality, with Christians associated with slightly higher pro-rich inequality compared to Muslims. This echoes findings from [44], who observed the influence of religion on maternal healthcare choices in Nigeria, particularly in the North, where sociocultural and religious

norms reinforce home deliveries. Regional decomposition reveals that the Northwest and Northeast contribute significantly to inequality in ANC and FBD, consistent with [44], who reported persistent structural inequities in these zones. The South, particularly the Southwest, contributes the least, reflecting more equitable access.

Wealth index remains the strongest factor driving inequality. The wealthiest households make significant contributions to pro-rich inequality across ANC, FBD, and PNC. This aligns with global research from [43, 14, 44], and [35], who found that wealth quintiles consistently explain the largest part of inequality in maternal healthcare use in developing countries.

The effects of media exposure and decision-making autonomy are small, but they trend toward reducing inequality. Women with greater autonomy and weekly media exposure are more likely to use services, particularly ANC, echoing findings by [6, 28] and [33], who emphasized that exposure to health messages and female decision-making power significantly improve maternal health behaviors.

Insurance plays an almost negligible role, reflecting Nigeria's low health insurance penetration. This finding aligns with [24], who reported that the lack of functional health insurance schemes limits their impact on maternal healthcare access and inequality.

In summary, the total decomposition shows that wealth, education, and region are the most influential factors driving inequality in maternal healthcare services. This pattern is consistent with other Nigerian and sub-Saharan African studies [44, 56] which highlight socioeconomic status, geographic disparities, and education as the principal sources of inequity.

5. Conclusion

This study concludes that maternal healthcare utilization among women in rural areas and in the North-East and North-West zones is the most disadvantaged, with utilization levels of facility-based delivery far below national averages. Socio-economic inequality is deeply entrenched, with education and wealth acting as gatekeepers to maternal health access. The pro-rich concentration of ANC4+ and facility delivery confirms that Nigeria's healthcare delivery system disproportionately serves the better-off, undermining efforts toward universal health coverage and equity in reproductive health.

Furthermore, the decomposition analysis highlights the structural nature of these disparities, indicating that inequality is not merely the result of individual-level behaviour but a reflection of systemic and institutional constraints. While individual determinants like media exposure and health insurance coverage are associated with improved utilization, their limited reach, especially in rural areas, means they cannot compensate for broader systemic inequities.

Ultimately, without targeted, context-sensitive, and equity-focused interventions, Nigeria risks continued failure to meet Sustainable Development Goal 3.1, which seeks to reduce the global maternal mortality ratio to less than 70 per 100,000 live

births by 2030 [57, 63]. Reducing maternal mortality in Nigeria requires addressing both the visible and hidden barriers that prevent women, especially the poorest, least educated, and most geographically isolated from accessing life-saving care.

Based on the findings, it is recommended that targeted equity-driven policies, expansion of affordable maternal health services, community-based interventions, and broader structural reforms are required to bridge the persistent gaps in maternal healthcare utilization across Nigeria.

Abbreviations

ANC	Antenatal Care
FBD	Facility-Based Delivery
PNC	Postnatal Care
NDHS	Nigeria Demographic and Health Survey
WHO	World Health Organisation
SDG	Sustainable Development Goal
LMICs	Low and Middle Income Countries
UN	United Nation
BGV	Between-group Variance
ECI	Erreygers-corrected Concentration Index

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Conflicts of Interest

The authors have no conflicts of interest to declare for this study.

References

- [1] Adatar, P., Strumpher, J., Ricks, E., & Mwini-Nyaledzigbor, P. P. (2019). Cultural beliefs and practices of women influencing home births in rural Northern Ghana. *International journal of women's health*, 11, 353–361.
<https://doi.org/10.2147/IJWH.S190402>

- [2] Adedokun, S. T., & Uthman, O. A. (2022). Women's autonomy and maternal healthcare utilization in Nigeria: Evidence from the 2018 NDHS. *BMJ Global Health*, 7(4), e008123.
- [3] Adewuyi, E. O., Auta, A., Adewuyi, M. I., Philip, A. A., Olu-tuase, V., Zhao, Y., & Khanal, V. (2024). Antenatal care utilization and receipt of its components in Nigeria: Assessing disparities between rural and urban areas-A nationwide population-based study. *PloS one*, 19(7), e0307316. <https://doi.org/10.1371/journal.pone.0307316>
- [4] Adejorin, M. V., Salman, K. K., Adenegan, K. O., Obi-Egbedi, O., Dairo, M. D., & Omotayo, A. O. (2024). Utilization of maternal health facilities and rural women's well-being: towards the attainment of sustainable development goals. *Health economics review*, 14(1), 40. <https://doi.org/10.1186/s13561-024-00515-5>
- [5] Adeyanju, O., Tubeuf, S., & Ensor, T. (2021). Socioeconomic inequalities in maternal healthcare utilization in Nigeria: Evidence from 2003–2018 Demographic and Health Surveys. *Health Policy and Planning*, 36(6), 839–849.
- [6] Adjiwanou, V., & LeGrand, T. (2014). Gender inequality and the use of maternal healthcare services in rural sub-Saharan Africa. *Health & place*, 29, 67–78.
- [7] Afape, A. O., Azubuike, P. C., Ibikunle, O. O., & Barrow, A. (2024). Prevalence and determinants of skilled birth attendance among young women aged 15–24 years in Northern Nigeria: evidence from Multiple Indicator Cluster Survey 2011 to 2021. *BMC public health*, 24(1), 2471. <https://doi.org/10.1186/s12889-024-19976-8>
- [8] Akinyemi, Y. C. (2021). Spatiotemporal patterns and determinants of reproductive health care utilization in Nigeria: 2008–2018. *Papers in Applied Geography*, 7(4), 453–481.
- [9] Alam, C. E., Abou-Abbas, L., Ramadan, M. S., & Asmar, M. K. (2025). Exploring the barriers to accessing antenatal care at the primary health care center level of a tertiary hospital in Lebanon: a qualitative study. *BMC Health Services Research*, 25(1), 1–14.
- [10] Ali, B., & Chauhan, S. (2020). Inequalities in the utilization of maternal health Care in Rural India: Evidences from National Family Health Survey III & IV. *BMC public health*, 20(1), 369. <https://doi.org/10.1186/s12889-020-08480-4>
- [11] Alibhai, K. M., Ziegler, B. R., Meddings, L., Batung, E., & Luginaah, I. (2022). Factors impacting antenatal care utilization: a systematic review of 37 fragile and conflict-affected situations. *Conflict and health*, 16(1), 33.
- [12] Al-Mujtaba, M., Sam-Agudu, N. A., & Khatri, R. (2022). Impact of insecurity on maternal healthcare access in northern Nigeria: A mixed-methods study. *BMC Health Services Research*, 22(1), 987.
- [13] Anindya, K., Marthias, T., Vellakkal, S., Carvalho, N., Atun, R., Morgan, A., & Lee, J. T. (2021). Socioeconomic inequalities in effective service coverage for reproductive, maternal, newborn, and child health: a comparative analysis of 39 low-income and middle-income countries. *E Clinical Medicine*, 40.
- [14] Asefa, A., Gebremedhin, S., Marthias, T., Nababan, H., Christou, A., Semaan, A., & Beňová, L. (2023). Wealth-based inequality in the continuum of maternal health service utilization in 16 sub-Saharan African countries. *International journal for equity in health*, 22(1), 203.
- [15] Biswas, B., Kumar, N., Rahaman, M. M., Das, S., & Hoque, M. A. (2024). Socioeconomic inequality and urban-rural disparity of antenatal care visits in Bangladesh: A trend and decomposition analysis. *Plos one*, 19(3), e0301106.
- [16] Bobo, F. T., Asante, A., Woldie, M., Dawson, A., & Hayen, A. (2021). Spatial patterns and inequalities in skilled birth attendance and caesarean delivery in sub-Saharan Africa. *BMJ global health*, 6(10), e007074. <https://doi.org/10.1136/bmjgh-2021-007074>
- [17] Chi, H., Jung, S., Subramanian, S. V., & Kim, R. (2024). Socioeconomic and geographic inequalities in antenatal and postnatal care components in India, 2016–2021. *Scientific reports*, 14(1), 10221. <https://doi.org/10.1038/s41598-024-59981-w>
- [18] Dickson, K. S., Ayebeng, C., Adu-Gyamfi, A. B., & Okyere, J. (2023). Postnatal care service utilization for babies within the first two months after childbirth: an analysis of rural-urban differences in eleven Sub-Saharan African countries. *BMC pregnancy and childbirth*, 23(1), 423. <https://doi.org/10.1186/s12884-023-05758-4>
- [19] Doctor, H. V., & Dahiru, T. (2020). Utilization of maternal healthcare services in Nigeria: An analysis of regional differences. *African Population Studies*, 34(1), 23–39.
- [20] Dowhaniuk, N. (2021). Exploring country-wide equitable government health care facility access in Uganda. *International journal for equity in health*, 20(1), 38. <https://doi.org/10.1186/s12939-020-01371-5>
- [21] Dzomeku, V. M., Duodu, P. A., Okyere, J., Aduse-Poku, L., Dey, N. E. Y., Mensah, A. B. B., Nakua, E. K., Agbadi, P., & Nutor, J. J. (2021). Prevalence, progress, and social inequalities of home deliveries in Ghana from 2006 to 2018: insights from the multiple indicator cluster surveys. *BMC pregnancy and childbirth*, 21(1), 518. <https://doi.org/10.1186/s12884-021-03989-x>
- [22] Exley, J., Pitchforth, E., Okeke, E., Glick, P., Abubakar, I. S., Chari, A., & Onwujekwe, O. (2016). Persistent barriers to care: a qualitative study to understand women's experiences in areas served by the midwives service scheme in Nigeria. *BMC Pregnancy and Childbirth*, 16(1), 232.
- [23] Fagbamigbe, A. F., & Idemudia, E. S. (2017). Wealth and antenatal care utilization in Nigeria: policy implications. *Health care for women international*, 38(1), 17–37.
- [24] Fagbamigbe, A. F., Idemudia, E. S., & Adebawale, A. S. (2023). Spatial and socioeconomic inequalities in maternal healthcare utilization in Nigeria: Evidence from the 2018 NDHS. *PLoS ONE*, 18(4), e0284267.
- [25] Federal Ministry of Health. (2023). Nigeria Health Sector Strategic Plan 2023–2027. Abuja: Federal Ministry of Health.

- [26] Fetene, S. M., Fentie, E. A., Shewarega, E. S., & Kidie, A. A. (2024). Socioeconomic inequality in postnatal care utilization among reproductive age women in sub-Saharan African countries with high maternal mortality: a decomposition analysis. *BMJ open*, 14(10), e076453.
- [27] Gu, D., Andreev, K., & Dupre, M. E. (2021). Major Trends in Population Growth Around the World. *China CDC weekly*, 3(28), 604–613. <https://doi.org/10.46234/ccdcw2021.160>
- [28] Imo, C. K. (2022). Influence of women's decision-making autonomy on antenatal care utilization and institutional delivery services in Nigeria: evidence from the Nigeria Demographic and Health Survey 2018. *BMC Pregnancy and Childbirth*, 22(1), 141.
- [29] Kurji, J. (2021). *Assessing the determinants of maternal healthcare service utilization and effectiveness of interventions to improve institutional births in Jimma Zone, Ethiopia* (Doctoral dissertation, Université d'Ottawa/University of Ottawa).
- [30] Kruk, M. E., Gage, A. D., & Arsenault, C. (2022). High-quality health systems in the Sustainable Development Goals era: Time for a revolution. *The Lancet Global Health*, 10(3), e347–e355.
- [31] Langlois, É. V., Miskurka, M., Zunzunegui, M. V., Ghaffar, A., Ziegler, D., & Karp, I. (2015). Inequities in postnatal care in low- and middle-income countries: a systematic review and meta-analysis. *Bulletin of the World Health Organization*, 93(4), 259–270G. <https://doi.org/10.2471/BLT.14.140996>
- [32] Lateef, M. A., Kuupiel, D., Mchunu, G. G., & Pillay, J. D. (2024). Utilization of Antenatal Care and Skilled Birth Delivery Services in Sub-Saharan Africa: A Systematic Scoping Review. *International journal of environmental research and public health*, 21(4), 440. <https://doi.org/10.3390/ijerph21040440>
- [33] Majumder, K., Sarkar, M., Mallick, R., Mondal, S., & Chouhan, P. (2024). Does women's decision-making autonomy matter in utilization of antenatal care services in India? An analysis from nationally representative survey. *Plos one*, 19(8), e0308576.
- [34] Maleki, A., Soltani, F., Abasalizadeh, M., & Bakht, R. (2024). Sociodemographic disparities in postnatal care coverage at comprehensive health centers in Hamedan City. *Frontiers in public health*, 12, 1329787. <https://doi.org/10.3389/fpubh.2024.1329787>
- [35] Mekonen, A. M., Kebede, N., Dessie, A., Mihret, S., & Tsiga, Y. (2024). Wealth disparities in maternal health service utilization among women of reproductive age in Ethiopia: findings from the mini-EDHS 2019. *BMC health services research*, 24(1), 1034. <https://doi.org/10.1186/s12913-024-11515-w>
- [36] Misu, F., Gasbarro, D., & Alam, K. (2025). Inequality in Utilization of Maternal Healthcare Services in Low- and Middle-Income Countries: A Scoping Review of the Literature. *Maternal and child health journal*, 29(6), 741–766. <https://doi.org/10.1007/s10995-025-04111-9>
- [37] National Population Commission [NPC] & ICF. (2019). Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.
- [38] Nayeem, J., Stennett, C., Sharmeen, A., Hossain, M. M., & Al Kibria, G. M. (2023). Rural-urban differences in distributions and determinants of facility delivery among women in Bangladesh. *Global Health Journal*, 7(4), 222–229.
- [39] Ntawukuriyayo, J. T., VanderZanden, A., Amberbir, A., Teklu, A., Huda, F. A., Maskey, M., Sall, M., Garcia, P. J., Subedi, R. K., Sayinzoga, F., Hirschhorn, L. R., & Binagwaho, A. (2024). Inequity in the face of success: understanding geographic and wealth-based equity in success of facility-based delivery for under-5 mortality reduction in six countries. *BMC pediatrics*, 23(Suppl 1), 651. <https://doi.org/10.1186/s12887-023-04387-2>
- [40] Ntegwa, M. J., Mcharo, E. G., & Mlay, J. F. (2023). What explains the rural–urban inequalities in maternal health services utilization in Tanzania? A fairlie decomposition analysis. *Asian Journal of Social Health and Behavior*, 6(2), 47–55.
- [41] Nwosu, C. O., & Ataguba, J. E. (2019). Socioeconomic inequalities in maternal health service utilization: a case of antenatal care in Nigeria using a decomposition approach. *BMC Public Health*, 19(1), 1493.
- [42] Okeke, E. N., Abubakar, I. S., & De Allegri, M. (2021). The impact of free maternal healthcare policies in Nigeria: A quasi-experimental study. *Health Policy and Planning*, 36(7), 1023–1034.
- [43] Okeke, E. N., Wagner, Z., & Abubakar, I. S. (2020). Maternal Cash Transfers Led To Increases In Facility Deliveries And Improved Quality Of Delivery Care In Nigeria: Study examines the prevalence of delayed entry, the reasons for the delays, and their effect on Medicaid spending in a recent cohort of brand-name medications. *Health Affairs*, 39(6), 1051–1059.
- [44] Okoli, C., Hajizadeh, M., Rahman, M. M., & Khanam, R. (2020). Geographical and socioeconomic inequalities in the utilization of maternal healthcare services in Nigeria: 2003–2017. *BMC Health Services Research*, 20(1), 849.
- [45] Okonofua, F., Ntoimo, L., & Yaya, S. (2022). Cultural and social barriers to maternal healthcare utilization in rural Nigeria. *BMC Pregnancy and Childbirth*, 22(1), 345.
- [46] Ononokpono, D. N., & Odimegwu, C. O. (2020). Determinants of maternal healthcare utilization in Nigeria: A multilevel approach. *Journal of Biosocial Science*, 52(4), 567–582.
- [47] Ononokpono, D. N., Odimegwu, C. O., Adedini, S. A., & Imasiku, E. N. (2016). Ethnic diversity and maternal health care in Nigeria. *Women's Reproductive Health*, 3(1), 45–59.
- [48] Oyedele, O. K., Fagbamigbe, A. F., Akinyemi, O. J., & Adebawale, A. S. (2023). Coverage-level and predictors of maternity continuum of care in Nigeria: implications for maternal, newborn and child health programming. *BMC Pregnancy and Childbirth*, 23(1), 36.
- [49] Pison, G., Couppi E., & Caporali, A. (2022). The population of the world, 2022. *Population & Societies*, 603(8), 1–8.
- [50] Ruktanonchai, C. W., Ruktanonchai, N. W., Nove, A., Lopes, S., Pezzulo, C., Bosco, C., & Tatem, A. J. (2016). Equality in maternal and newborn health: modelling geographic disparities in utilization of care in five East African countries. *Plos one*, 11(8), e0162006.

- [51] Samuel, O., Zewotir, T., & North, D. (2021). Decomposing the urban–rural inequalities in the utilization of maternal health care services: evidence from 27 selected countries in Sub-Saharan Africa. *Reproductive Health*, 18(1), 216.
- [52] Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A. B., Daniels, J., Gülmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: a WHO systematic analysis. *The Lancet. Global health*, 2(6), e323–e333. [https://doi.org/10.1016/S2214-109X\(14\)70227-X](https://doi.org/10.1016/S2214-109X(14)70227-X)
- [53] Sserwanja, Q., Nuwabaine, L., Kamara, K., & Musaba, M. W. (2022). Prevalence and factors associated with utilization of postnatal care in Sierra Leone: a 2019 national survey. *BMC public health*, 22(1), 102. <https://doi.org/10.1186/s12889-022-12494-5>
- [54] Stephen, A. A., & Odunayo, J. (2016). Determinants of maternal utilization of health services and nutritional status in a rural community in South-West Nigeria. *African journal of reproductive health*, 20(2), 72-85.
- [55] Shanto, H. H., Al-Zubayer, M. A., Ahammed, B., Sarder, M. A., Keramat, S. A., Hashmi, R., Haque, R., & Alam, K. (2023). Maternal Healthcare Services Utilization and Its Associated Risk Factors: A Pooled Study of 37 Low- and Middle-Income Countries. *International journal of public health*, 68, 1606288. <https://doi.org/10.3389/ijph.2023.1606288>
- [56] Tessema, Z. T., Teshale, A. B., Tesema, G. A., & Tamirat, K. S. (2021). Determinants of completing recommended antenatal care utilization in sub-Saharan from 2006 to 2018: evidence from 36 countries using Demographic and Health Surveys. *BMC pregnancy and childbirth*, 21(1), 192.
- [57] United Nations. (2020). The Sustainable Development Goals Report 2020. New York: United Nations.
- [58] Wong, K. L., Radovich, E., Owolabi, O. O., Campbell, O. M., Brady, O. J., Lynch, C. A., & Benova, L. (2018). Why not? Understanding the spatial clustering of private facility-based delivery and financial reasons for homebirths in Nigeria. *BMC health services research*, 18(1), 397.
- [59] World Health Organization. (2020a). WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: WHO.
- [60] World Health Organization. (2020b). WHO recommendations on postnatal care of the mother and newborn. Geneva: WHO.
- [61] World Health Organization. (2022). World Health Statistics 2022: Monitoring health for the SDGs. Geneva: WHO.
- [62] World Health Organization. (2023). Trends in Maternal Mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division. Geneva: WHO.
- [63] Zhao, S., Zhang, Y., Xiao, A. Y., He, Q., & Tang, K. (2023). Key factors associated with quality of postnatal care: a pooled analysis of 23 countries. *E Clinical Medicine*, 62, 102090. <https://doi.org/10.1016/j.eclim.2023.102090>