

Original Article

# Decomposition and Spatiotemporal Analysis of Barriers to Healthcare Access among Women of Childbearing age in Nigeria, using Nigeria Demographic and Health Survey from 2003 to 2018

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**Abstract:** Barriers to Healthcare Access (BHA) amidst cultural demands and abject poverty aggravate the prevailing health challenge among Nigerian women. We aimed to assess the BHA among women of reproductive age (15-49 years) in Nigeria. Four consecutive rounds of the Nigeria Demographic and Health Survey conducted every 5 years (2003, 2008, 2013, and 2018) were used for this cross-sectional study design. BHA classified into small and big barrier was generated based on 4 questions: getting permission to go for treatment, getting the money needed for treatment, distance to the health facility, and not wanting to visit a health facility alone. Data were analyzed using Logistic Regression Model, Wagstaff decomposition, and spatial mapping in ArcGIS ( $\alpha=0.05$ ). Experiencing big BHA was 41.0% (2003), 67.2% (2008), 52.7% (2013), and 53.7% (2018) among the women and was higher in the rural areas across the survey years. The odds of a big BHA reduced consistently with increasing level of education. Factors that contributed mostly to wealth inequality in big BHA from 2003 to 2018 included education (36.7%), partner's education (41.1%) and residence (35.5%). Hot-spot for big BHA was mostly prevalent in the North West, North East, and South East geopolitical zones. Efforts should be geared towards alleviating BHA in Nigeria.

**Keywords:** Health care access, Maternal health, Barrier to health care, Nigerian women

## 1. Introduction

Healthcare is the services provided by allied health professionals to preserve health. Access to healthcare is the ability to utilize healthcare services and not mere adequacy of supply (1). Universal access to healthcare remains a challenge to most women in developing countries including Nigeria (2). Lack of access to health care predisposes pregnant women to a high risk of prolonged labor, disabilities, maternal mortality, and poor birth outcomes including low birth weight, birth defects, and neonatal mortality (3,4). Nigeria, having a population of about 215 million people and women constituting about 49% of this population is among the countries with the highest rates of maternal mortality (512 maternal deaths per 100,000 live births) and infant mortality (69 per 1,000 live birth) worldwide (5). These poor health indicators could be attributed to a lack of access to healthcare and under-utilization of effective and efficient healthcare services (4,6). Barriers to maternal healthcare access amidst cultural demands and abject poverty which ravages the nation aggravate the prevailing maternal health challenge in Nigeria. The target of SDG 3.1 to reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030 might be unrealizable if the proper

framework is not in place to improve universal health coverage, particularly among women of reproductive age in Nigeria (7).

About 50% of the world's population lacks access to essential health services (8,9) and many families become impoverished on the account of having to pay for health care. In developed regions like Europe, North America, etc., basic healthcare services are more available than in Sub-Saharan Africa and Southern Asia (10,11). The COVID-19 pandemic's emergence and spread have exposed many countries in sub-Saharan Africa's capacity to provide basic healthcare services. In Nigeria, the health care system is weak and the provision of health care services is sub-optimal, especially in the rural areas. Most public health facilities are characterized by poor coordination, lack of essential drugs and supplies, inadequate medical personnel, and a deplorable state of infrastructure (12). As a - low-income country, the poverty rate is high with about half of Nigeria's population living on less than \$1.90 a day and the cost of service provision at both private and public health facilities is not affordable to most Nigerians (13,14). Unfortunately, not more than 4% of Nigeria's population has been covered by the National Health Insurance Scheme (NIHS) (15). Consequently, the patronage of traditional and alternative medicine has increased in the past few decades. Nigeria was ranked 187 out of 191 countries worldwide in its level of compliance with Universal Health Coverage (UHC) according to the 2018 world ranking (16,17). According to a national survey's report, 67% of women of reproductive age who gave birth in the 5 years preceding the survey received antenatal care (ANC) from a skilled provider during the pregnancy, 57% had at least four ANC visits, 39% of live births took place in a health facility, 43% of births were assisted by a skilled provider, and 42% received a postnatal check in the first 2 days after birth (18).

In any nation, access to health care is an important determinant of the indicators of the state of health like infant and childhood mortality, maternal mortality, contraceptive prevalence rate, life expectancy, and overall well-being. Research suggests that the barriers to healthcare access among women aged 15-49 years being caused by demographic, socioeconomic, cultural, environmental, and health system factors (19,20). Findings from previous studies have identified several barriers associated with the limited access to health care utilization in this Africa sub-region particularly Nigeria, the most populous country in the region (21,22). These include; long distances to the health facility particularly for those who are residence in rural areas, delays in the decision to seek health care, poor transportation system and deplorable state of the road networks, illiteracy, poverty, cultural practices, maltreatment from the health service providers amidst others (22-25). Disproportionate distribution of health care facilities regions is one of the challenges facing the Nigerian health sector (26,27). The regional differential in both cultural norms and socioeconomic factors suggests the need to uncover hotspot areas where women have poor healthcare service access in Nigeria.

Numerous factors have been identified as influencing women's capacity to access health care but such studies were either conducted at the national or community level, the regional peculiarity points to the need for regional based studies (10,28). Such studies are still a grey area for research in Nigeria, particularly a comparative study that addresses the barriers to healthcare access among women of reproductive age who are one of the most vulnerable groups in terms of healthcare needs. Studies on the trends of barrier to healthcare access among reproductive-age women in Nigeria are scarce in the literature. Trend analysis provides a better understanding of the situations concerning maternal access to health care over years and predicts future state and practices based on the current situation (26,29). Thus, the objectives of this study are to: examine the trends and pattern of barriers to healthcare access in Nigeria, identify the hotspot areas of barriers to healthcare access among women in Nigeria, identify factors associated with the barrier to healthcare access in Nigeria, and decompose factors responsible for income inequality in barrier to healthcare access among women of reproductive health age in Nigeria.

Women play a primary role in care provision for their immediate family (30). Promotion of good health in Nigeria will require improvement in the health of women in Nigeria. Findings from this study will provide healthcare advocates, professionals, and public health influencers with information regarding hotspot areas of elevated risk, areas in greatest need of health service, and underlying factors responsible for high rate of maternal healthcare access challenges specific to each region in Nigeria.

## 2. Materials and Methods

### Study Area

The study was conducted in Nigeria. The country is the most populous in Africa. Nigeria has 6 geo-political zones namely: South-West, South-East, North-West, South-South, North-East, and North-Central, and three major ethnic

groups in the country (Yoruba, Hausa/Fulani, and Igbo). Currently, 48.8% of the Nigerian population of about 215 million lives in the rural area (31). The demographic landscape shows that the population is young and the majority earn below 2 dollars per day. Islam constituted 53.5% of the religious group in Nigeria while Christianity was 45.9% and traditional religions 0.6%. Medical and health services are provided mostly by the government while private clinics, and maternity centers are within the reach of people in the urban centers. Healthcare services are inadequate in many parts of the country owing to a shortage of medical personnel, modern equipment, and supplies, and a lack of essential drugs (32).

### **Study Design and Population**

The design of this study which focused on women of reproductive age (15-49 years) was cross-sectional. Secondary data which involved four consecutive rounds of the Nigeria Demographic and Health Survey (NDHS) – 2003, 2008, 2013, and 2018 were used. The design of the data collection process in each of the survey rounds was nationally representative.

### **Sampling and Data Collection Procedure**

A multi-stage stratified cluster sampling technique was employed in each survey. The primary sampling unit referred to as clusters were defined based on census Enumeration Areas (EAs). For 2003; 2008; 2013 and 2018 NDHS, 365 clusters, 886 clusters, 904 clusters, and 74 sampling strata consisting of both rural and urban areas were selected respectively. An average of 22 households were selected from each of the 365 clusters, 41 households from each of the 886 clusters, and 45 households from each of the 904 clusters by equal probability systematic sampling. The sample size for each survey is 7,620; 33,385; 38,948 and 41,821 for 2003; 2008; 2013 and 2018 respectively. Because the samples are not self-weighting, sampling weights were added to account for unequal probability of selection at the level of clusters as well as to reduce non-response and selection bias. Detailed information on sample size calculation and sampling procedure was presented in the full NDHS published reports available in the public domain for easy access. Therefore, interested readers should visit the website of the data originator (<https://www.dhsprogram.com/>) for more complete information on the sampling and data collection processes. Although there are differences in the number of variables collected for each year, the basic structure of the sampling and some relevant variables remain the same. Therefore, comparing variables across years is feasible.

### **Variable Definition**

The main outcome variable in this analysis is the barrier to health care access. This was defined by women's perceived problem concerning four indicators – getting permission to go see a doctor, getting money for treatment, not wanting to visit a health facility alone, and distance to health facility (21,33). These indicators were therefore collapsed into two categories as no barrier/small barrier and big barrier. This approach was the standard used by the data originator (18). Data were extracted for the relevant set of variables selected based on the analytical framework and empirical evidence described in previous studies (33,34). The socio-economic characteristics included in this study are age, education, partner's education, wealth status, occupational status, religion, and place of residence. Others included religion, exposure to media, decision maker on women's healthcare, and the number of under-5 children in the family.

### **Data Analysis**

Data were weighted to guarantee the representativeness of the survey before any statistical analysis was carried out. The sample weighting provided in the data was designed to account for unequal cluster sizes and stratifications, as well as to ensure that the study's findings accurately represent the population of interest for each state (18). Stata version 16 software was employed in conducting the descriptive and inferential statistics. ArcGIS software was employed in carrying out the hotspot and cold-spot analysis.

### **Logistic Regression Model**

**Logistic** regression is a classic predictive modeling method that remains a frequently used technique in modeling binary categorical variables. It models a relationship between predictor variables and a categorical response variable. The logistic regression gives each predictor a coefficient that measures its independent contribution to variation in the dependent variable (35). The outcome variable in this study is a big barrier to healthcare access which takes a

dichotomous response. The model generates the odds ratio for the outcome and the predicted probabilities is expressed as a natural logarithm of the odds ratio:

$$\ln \ln \left[ \frac{P(Y)}{1 - P(Y)} \right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_K X_K \quad (1)$$

$$\frac{P(Y)}{1 - P(Y)} = \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_K X_K) \quad (2)$$

$$P(Y) = \frac{\exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_K X_K)}{1 + \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_K X_K)} \quad (3)$$

Where,  $\ln \ln \left[ \frac{P(Y)}{1 - P(Y)} \right]$  is the log (odds) of a big barrier to healthcare access,  $P(Y)$  is the probability of the dichotomous outcome (big barrier to healthcare access),  $X_1, X_2, \dots, X_K$  are the predictor variables,  $\beta_1, \beta_2, \dots, \beta_K$  are the regression coefficients and  $\beta_0$  is the intercept. The regression coefficients indicate the degree of association between each independent variable and the outcome (36). All predictor variables that are useful in predicting the outcome variable (BHA) are included in the model and the results of the analysis are in the form of an odds ratio.

#### **Wagstaff decomposition**

Wagstaff-type of decomposition analysis was conducted to identify the concentration and contribution of background characteristics to the economic inequality in barrier to healthcare access. It gives an insight into income-related inequality on healthcare access barriers by decomposing the concentration index of the big barrier into contributions of each covariate (37). However, the analysis was restricted to 2003 and 2018 data to examine the factors that are responsible for the economic inequality in barriers to healthcare access within the period. This analysis was based on the concentration curve (CC) and the concentration index (Ci) which requires four stages including regression analysis, computation of the elasticity (weighted coefficient), calculation of the concentration index of the covariates, and percentage contribution of each covariate. This approach has been in earlier studies involving public health research (38–41). The mathematical exposition of the Wagstaff Decomposition Model is as follows:

For the additive regression model of big barrier to healthcare access ( $y$ ), such that

$$y = \alpha + \sum_{j=1}^q \beta_j x_{ij} + \varepsilon_i \quad (4)$$

The concentration index (Ci) for big barrier to healthcare access ( $y$ ) can be expressed as:

$$Ci(y) = \sum_{j=1}^q \frac{\beta_j \bar{x}_j}{\mu_y} Ci(x_j) + \frac{GC_\varepsilon}{\mu_y} \quad (5)$$

Where  $Ci(y)$  is the concentration index for the big barrier to healthcare access,  $\bar{x}_j$  is the mean of the covariate ( $x_j$ ),  $\mu_y$  is the mean of big barrier to healthcare access,  $Ci(x_j)$  is the concentration index for the covariate ( $x_j$ ), and  $GC_\varepsilon$  is the generalized concentration index for the error term ( $\varepsilon$ ). The first part of equation (5) is the weighted sum of the concentration index for the covariate ( $x_j$ ). The weight of each regressor is determined by the elasticity ( $\beta_j \bar{x}_j$ ) of big barrier ( $y$ ) concerning covariate ( $x_j$ ). The second part of the equation is the residual of the economic inequalities in barriers to healthcare access that cannot be explained by the concentration index of the regressors. A negative concentration index (Ci) value implies that a big barrier to healthcare access is concentrated among the poor while a positive value indicates concentration among the rich (37).

#### **Spatial Analysis**

Hotspot spatial analysis was conducted using ArcGIS version pro 2.8 software to assess the density of points of big barrier prevalence and explore the spatiotemporal distribution of big barriers to healthcare access in Nigeria. The use of spatiotemporal analysis is becoming more important in the field of health and social sciences. Geographic information system (GIS) mapping is useful in biomedical research because of its strength in providing useful information about the

distribution of health facilities and tracking access to healthcare across localities or geographical points in a country. It has been used to identify hot spot regions concerning a particular health outcome or disease in several studies (28,42,43). In doing this, Anselin Local Moran's I is often used because its output provides information that reveals the hot-spot (Getis–Ord  $G_i^*$ ) and cold-spot areas of big barriers to healthcare access. The global spatial autocorrelation indicates whether there is dispersion or clustering or random distribution of big barriers to healthcare access in Nigeria. The global Moran's I index value shows the clustering distribution pattern required to discover where high and low-risk clusters are situated in the country.

$$I = \frac{n \sum_{i=1}^n \sum_{j=1}^n W_{ij} Z_i Z_j}{s_0 \sum_{i=1}^n Z_i^2} \quad (6)$$

$$s_0 = \sum_{i=1}^n \sum_{j=1}^n W_{ij} \quad (7)$$

$$Z = \frac{I - E(I)}{\sqrt{V(I)}} \quad (8)$$

Where,  $W_{ij}$  represents the spatial weight between feature  $i$  and  $j$ ,  $n$  is the total number of features,  $Z_i = (x_i - \bar{x})$  and  $Z$  statistic is the standardization of Moran's I (44). The prevalence of big barriers to healthcare access per state in Nigeria is inputted as analysis field data. This data is joined with the attribute table of the already loaded base map (shape file) in ArcGIS containing a polygon grid of states as the geographical feature of the Nigeria map. The density of identical dots for a big barrier per state is generated, followed by an optimized hotspot in the cluster mapping toolbox to create the hotspot map with a defined legend threshold.

### 3. Results

The percentage distribution of the respondents by background characteristics is presented in Table 1. The mean age of the respondents ranges from 31.8±8.75 years in 2003 to 33.6±8.25 years in 2018. The data depict that across the rounds of the survey, most respondents belong to the age group 25-29 years, and predominantly, the majority had no formal education. The proportion of women with no formal education follows a downward trend as this reduces from 52.1% in 2003 to 43.9% in 2018. However, an upward trend was observed for the percentage of women with secondary and higher education during the same period. A similar pattern and trend to that of women was observed for the partner's educational level. The majority of the women were engaged in a work activity or the other and most of the women in the sample for each survey round belong to Islamic religious groups. For instance, women in the Islamic religious group constituted 57.3%, 55.8%, 56.4%, and 56.5% of the sample selected for 2003, 2008, 2013, and 2018 survey rounds respectively.

Across all the survey rounds, the majority of the women were exposed to media information (radio, television, newspaper), and most respondents belong to the poor wealth quintile with the highest proportion of respondents who were poor found in 2008 (48.9%) and least in 2003 (42.9%). The majority of the respondents said that only their husband has the final say in the household decisions including their health. While 70.9% of women said their husband had the final say on their health in 2003, 57.1%, 59.6%, and 55.7% said the same in 2008, 2013, and 2018, respectively. Women living in rural areas and those who reside in the North-West geopolitical zones constituted the majority of the respondents across all the survey rounds.

Table 1: Percentage Distribution of the Respondents according to Background Characteristics

Background Characteristics	Year			
	2003	2008	2013	2018
Total	N=5011	N=22885	N=26930	N=28495
<b>Age</b>				
15-19	9.2 (463)	8.3 (1889)	7.4 (2000)	6.2 (1769)
20-24	15.8 (791)	15.6 (3570)	15.2 (4090)	15.0 (4263)
25-29	21.8 (1093)	21.9 (5019)	21.1 (5687)	20.6 (5882)
30-34	16.3 (816)	17.3 (3957)	17.4 (4697)	18.4 (5236)
35-39	14.6 (730)	15.0 (3432)	15.8 (4247)	16.7 (4743)
40-44	11.9 (596)	11.4 (2616)	12.0 (3231)	12.3 (3506)
45-49	10.4 (522)	10.5 (2402)	11.1 (2978)	10.9 (3096)
<b>Highest Educational Level</b>				
No education	52.1 (2609)	51.1 (11682)	45.8 (12335)	43.9 (12508)
Primary	22.8 (1142)	21.4 (4891)	20.5 (5517)	16.6 (4725)
Secondary	20.1 (1009)	21.2 (4861)	25.9 (6973)	30.4 (8672)
Higher	5.0 (251)	6.3 (1451)	7.8 (2105)	9.1 (2590)
<b>Partner's Educational Level</b>				
No education	41.0 (2053)	42.0 (9600)	37.6 (10126)	34.4 (9803)
Primary	24.2 (1212)	20.7 (4736)	19.3 (5193)	15.6 (4436)
Secondary	22.8 (1140)	25.3 (5799)	28.5 (7662)	34.3 (9769)
Higher	12.1 (606)	12.0 (2750)	14.7 (3949)	15.8 (4487)
<b>Employment Status</b>				
Not working	34.5 (1731)	34.1 (7798)	29.4 (7904)	29.8 (8497)
Working	65.5 (3280)	65.9 (15087)	70.7 (19026)	70.2 (19998)
<b>Religion</b>				
Christian	40.6 (2032)	42.2 (9655)	41.9 (11285)	42.7 (12160)
Islam	57.5 (2880)	55.8 (12759)	56.6 (15228)	56.5 (16106)
Others	2.0 (99)	2.1 (471)	1.6 (417)	0.8 (229)
<b>Media Exposure</b>				
Not Exposed	25.4 (1271)	34.0 (7782)	32.3 (8699)	37.7 (10729)
Exposed	74.6 (3740)	66.0(15103)	67.7 (18231)	62.4 (17766)
<b>Wealth Index</b>				
Poor	42.9 (2151)	48.9 (11191)	43.3 (11648)	43.8 (12479)
Middle	19.8 (991)	18.9 (4321)	19.2 (5162)	20.2 (5755)
Rich	37.3 (1869)	32.2 (7373)	37.6 (10120)	36.0 (10261)
<b>Number of Under-5 Children</b>				
None	24.6 (1234)	23.1 (5291)	23.1 (6232)	22.7 (6462)
One	29.8 (1493)	28.4 (6495)	29.3 (7888)	30.0 (8554)
Two	26.0 (1303)	28.1 (6419)	27.3 (7351)	27.5 (7841)
Three and above	19.6 (981)	20.5 (4680)	20.3 (5459)	19.8 (5638)
<b>Has Final Say on Own Health Care</b>				
Woman alone	13.8 (689)	8.7 (1996)	6.5 (1757)	10.2 (2897)
Husband alone	70.9 (3551)	57.1 (13056)	59.6 (16062)	55.7 (15876)
Woman and Husband	12.2 (610)	33.8 (7740)	33.4 (8987)	33.8 (9644)
Others	3.2 (161)	0.4 (93)	0.3 (82)	0.3 (78)
<b>Place of Residence</b>				
Urban	36.2 (1815)	27.5 (6283)	34.7 (9343)	36.1 (10290)
Rural	63.8 (3196)	72.6 (16602)	65.3 (17587)	63.9 (18205)
<b>Region</b>				

North Central	16.7 (839)	18.6 (4256)	15.4 (4154)	18.3 (5204)
North East	21.6 (1083)	21.5 (4926)	19.5 (5243)	19.7 (5603)
North West	29.9 (1499)	27.0 (6185)	30.3 (8171)	27.9 (7949)
South East	9.9 (497)	8.1 (1844)	8.7 (2332)	11.2 (3181)
South South	9.1 (458)	11.2 (2555)	12.1 (3269)	10.3 (2936)
South West	12.7 (635)	13.6 (3119)	14.0 (3761)	12.7 (3622)

Table 2 depicts the percentage distribution of respondents according to big barriers to healthcare access by some background characteristics. The data show that experiencing big BHA was 41.0% (2003), 67.2% (2008), 52.7% (2013), and 53.7% (2018) among the women and was higher in the rural areas across the survey years. The big barrier to healthcare access reduces consistently as the level of education increases and this pattern was observed in all the survey rounds. In the survey year 2018 for instance, the percentage of women who had big barriers to healthcare access was 65.1% among women with no formal education compared to 27.4% reported by women in the higher education category. The percentage of women who had big barriers to healthcare access was higher among those who are not working than their counterparts who engaged in any form of work activity and this situation cuts across all the survey rounds. Except for the survey year 2003, the big barrier to healthcare access was steadily higher among women who belong to the Islamic religion than those who are Christians. However, the gap in a disparity between these two prominent religious groups in Nigeria was not so pronounced.

The data further show that across the survey rounds, the proportion of women with big barriers to healthcare access falls consistently with media exposure and as the level of wealth index increases. In 2018 for instance, the percentage of women with big barriers to health care access was 65.6% among those who were not exposed to media compared to 46.7% observed among their counterparts who were exposed to media access. According to the wealth index, 68.5% of women who are in the category of the poor wealth quintile had experienced big barriers to healthcare access while 36.4% were found among those in the rich wealth quintile (2018 survey year).

**Table 2:** Percentage Distribution of Respondents according to BIG BARRIER by Background Characteristics: 2003-2018

Background Characteristics	Year			
	2003	2008	2013	2018
Total	41.0 (2057)	67.2 (15382)	52.7 (14200)	53.7 (15309)
<b>Age</b>				
15-19	48.4 (224)	72.9 (1377)	59.0 (1180)	59.7 (1056)
20-24	40.8 (323)	68.5 (2445)	55.3 (2260)	55.8 (2377)
25-29	38.9 (425)	65.9 (3305)	51.4 (2922)	53.5 (3146)
30-34	38.6 (315)	65.3 (2582)	50.7 (2380)	52.1 (2727)
35-39	39.3 (287)	66.3 (2275)	51.9 (2206)	52.5 (2488)
40-44	42.5 (253)	67.7 (1771)	53.0 (1713)	52.4 (1837)
45-49	44.1 (230)	67.7 (1627)	51.7 (1539)	54.2 (1678)
<b>Highest Educational Level</b>				
No education	49.9 (1303)	75.1 (8768)	61.8 (7628)	65.1 (8137)
Primary	41.8 (477)	69.3 (3389)	56.5 (3116)	54.2 (2563)
Secondary	23.2 (234)	55.2 (2685)	42.6 (2968)	45.0 (3900)
Higher	17.1 (43)	37.2 (540)	23.2 (488)	27.4 (709)
<b>Partner's Educational Level</b>				
No education	51.1 (1048)	76.9 (7378)	63.5 (6426)	68.2 (6690)
Primary	46.2 (560)	70.4 (3334)	59.8 (3103)	57.8 (2563)
Secondary	30.4 (347)	59.8 (3470)	45.8 (3505)	48.5 (4738)
Higher	16.8 (102)	43.6 (1200)	29.5 (1166)	29.4 (1318)
<b>Occupation</b>				
Not working	43.6 (755)	68.4 (5330)	57.3 (4528)	55.8 (4743)
Working	39.7 (1302)	66.6 (10052)	50.8 (9672)	52.8 (10566)
<b>Religion</b>				
Christian	40.9 (830)	64.7 (6246)	50.2 (5669)	52.2 (6352)
Islam	40.2 (1158)	68.5 (8743)	54.1 (8234)	55.0 (8864)
Others	69.7 (69)	83.4 (393)	71.2 (297)	40.6 (93)
<b>Media Exposure</b>				
Not Exposed	57.1 (726)	77.7 (6048)	65.3 (5679)	65.6 (7040)
Exposed	35.6 (1331)	61.8 (9334)	46.7 (8521)	46.5 (8269)
<b>Wealth Index</b>				
Poor	60.5 (1301)	79.4 (8884)	66.3 (7722)	68.5 (8550)
Middle	40.9 (405)	67.1 (2900)	56.0 (2890)	52.6 (3028)
Rich	18.8 (351)	48.8 (3598)	35.5 (3588)	36.4 (3731)
<b>Number of Under-5 Children</b>				
None	39.7 (490)	63.3 (3349)	48.4 (3014)	49.8 (3215)
One	41.2 (615)	66.4 (4315)	50.5 (3981)	52.0 (4446)
Two	41.4 (539)	68.8 (4413)	54.7 (4017)	55.1 (4320)
Three and above	42.1 (413)	70.6 (3305)	58.4 (3188)	59.0 (3328)
<b>Has Final Say on Own Health Care</b>				
Woman alone	32.1 (221)	61.1 (1219)	52.1 (916)	46.4 (1343)
Husband alone	43.3 (1539)	70.1 (9149)	55.4 (8896)	55.3 (8777)
Woman and Husband	36.9 (225)	63.8 (4937)	47.9 (4307)	53.3 (5137)
Others	44.7 (72)	82.8 (77)	69.5 (57)	66.7 (52)
<b>Place of Residence</b>				
Urban	22.3 (404)	50.4 (3167)	36.8 (3435)	40.6 (4178)
Rural	51.7 (1653)	73.6 (12215)	61.2 (10765)	61.1 (11131)
<b>Region</b>				



North central	39.9 (335)	70.1 (2983)	51.1 (2124)	55.5 (2889)
North east	42.9 (465)	74.8 (3685)	58.7 (3077)	72.0 (4034)
North west	46.0 (690)	69.6 (4306)	55.2 (4514)	48.5 (3858)
South east	44.9 (223)	73.2 (1350)	62.4 (1454)	56.2 (1789)
South south	53.9 (247)	56.6 (1446)	55.7 (1822)	51.9 (1525)
South west	15.3 (97)	51.7 (1612)	32.2 (1209)	33.5 (1214)

The unadjusted logistic regression model of factors influencing big barriers to healthcare access is displayed in Table 3. The data revealed that age, education, partner's level of education, religion, media exposure, wealth index, the final say on own health care, place of residence, and region were the common factors related to big barriers to health care access across the survey rounds. However, while the occupation was related to the big barrier to health care access in only the 2013 survey year, the number of under-five children living with the respondents was not associated with the big barrier in the 2003 survey year.

**Table 3: Unadjusted logistic regression model of factors influencing big barrier to health care access in Nigeria, 2003 – 2013**

Background Characteristics	Year			
	2003 uOR(95% C.I)	2008 uOR(95% C.I)	2013 uOR(95% C.I)	2018 uOR(95% C.I)
<b>Age</b>				
15-19	1.00	1.00	1.00	1.00
20-24	0.84 (0.73-0.97)*	0.96 (0.89-1.04)	1.00 (0.94-1.07)	0.98 (0.91-1.04)
25-29	0.85 (0.74-0.98)*	0.92 (0.85-0.99)*	0.90 (0.84-0.96)*	0.96 (0.90-1.02)
30-34	0.86 (0.73-1.02)	0.94 (0.87-1.02)	0.89 (0.83-0.95)*	0.93 (0.87-1.00)
35-39	0.89 (0.75-1.06)	1.00 (0.92-1.09)	0.96 (0.90-1.04)	0.96 (0.89-1.03)
40-44	1.09 (0.91-1.30)	1.09 (1.00-1.20)*	1.01 (0.94-1.10)	1.00 (0.93-1.08)
45-49	1.12 (0.93-1.34)	1.12 (1.02-1.23)*	0.95 (0.88-1.03)	1.08 (1.00-1.16)*
<b>Education</b>				
No education	1.00	1.00	1.00	1.00
Primary	0.80 (0.71-0.91)*	0.79 (0.74-0.84)*	0.88 (0.83-0.94)*	0.70 (0.66-0.75)*
Secondary	0.43 (0.39-0.48)*	0.45 (0.43-0.48)*	0.55 (0.52-0.57)*	0.48 (0.46-0.51)*
Higher	0.22 (0.17-0.28)*	0.23 (0.21-0.25)*	0.24 (0.22-0.26)*	0.24 (0.22-0.26)*
<b>Partner's Educational Level</b>				
No education	1.00	1.00	1.00	1.00
Primary	0.83 (0.73-0.95)*	0.74 (0.68-0.80)*	0.88 (0.83-0.94)*	0.64 (0.59-0.69)*
Secondary	0.43 (0.37-0.50)*	0.46 (0.43-0.49)*	0.50 (0.47-0.53)*	0.44 (0.41-0.46)*
Higher	0.21 (0.17-0.26)*	0.24 (0.22-0.27)*	0.25 (0.23-0.27)*	0.19 (0.18-0.21)*
<b>Occupation</b>				
Not Working	1.00	1.00	1.00	1.00
Working	0.95 (0.86-1.04)	1.04 (0.99-1.09)	0.91 (0.88-0.95)*	1.03 (0.99-1.08)
<b>Religion</b>				
Christian	1.00	1.00	1.00	1.00
Islam	0.84 (0.77-0.92)*	1.12 (1.07-1.17)*	0.99 (0.95-1.03)	0.98 (0.94-1.02)
Others	2.96 (2.03-4.33)*	2.45 (1.98-3.02)*	2.09 (1.74-2.52)*	0.60 (0.48-0.74)*
<b>Media Exposure</b>				
Not Exposed	1.00	1.00	1.00	1.00
Exposed	0.39 (0.35-0.44)*	0.45 (0.43-0.48)*	0.48 (0.46-0.50)*	0.48 (0.46-0.50)*
<b>Wealth Index</b>				
Poor	1.00	1.00	1.00	1.00
Middle	0.50 (0.44-0.56)*	0.54 (0.51-0.58)*	0.68 (0.64-0.72)*	0.55 (0.52-0.58)*
Rich	0.18 (0.16-0.20)*	0.27 (0.25-0.28)*	0.31 (0.30-0.33)*	0.30 (0.29-0.31)*
<b>Number of Under-5 Children</b>				
None	1.00	1.00	1.00	1.00
One	1.10 (0.98-1.24)	1.19 (1.12-1.26)*	1.12 (1.06-1.18)*	1.12 (1.06-1.17)*
Two	1.11 (0.98-1.26)	1.33 (1.25-1.41)*	1.27 (1.21-1.34)*	1.23 (1.17-1.30)*
Three and above	1.09 (0.95-1.26)	1.45 (1.36-1.55)*	1.44 (1.36-1.53)*	1.39 (1.31-1.47)*
<b>Has Final Say on Own Health Care</b>				
Woman	1.00	1.00	1.00	1.00
Husband alone	1.31 (1.14-1.49)*	1.48 (1.35-1.63)*	1.14 (1.03-1.25)*	1.41 (1.30-1.53)*
Woman & Husband	0.96 (0.79-1.16)	1.12 (1.02-1.24)*	0.85 (0.76-0.94)*	1.32 (1.21-1.43)*
Others	1.23 (1.06-1.43)*	2.94 (1.57-5.53)*	2.17 (1.26-3.73)*	2.69 (1.60-4.50)*
<b>Place of Residence</b>				
Urban	1.00	1.00	1.00	1.00
Rural	3.12 (2.82-3.45)*	2.61 (2.48-2.74)*	2.49 (2.39-2.59)*	2.08 (1.99-2.16)*

Region				
North Central	1.00	1.00	1.00	1.00
North East	1.09 (0.94-1.27)	1.41 (1.30-1.52)*	1.34 (1.25-1.44)*	2.00 (1.88-2.14)*
North West	1.15 (0.99-1.33)	0.98 (0.91-1.05)	1.11 (1.04-1.18)*	0.71 (0.67-0.75)*
South East	1.34 (1.14-1.58)*	1.32 (1.20-1.44)*	1.81 (1.67-1.96)*	1.17 (1.09-1.25)*
South South	1.74 (1.47-2.07)*	0.63 (0.58-0.68)*	1.35 (1.26-1.45)*	0.98 (0.91-1.05)
South West	0.31 (0.26-0.38)*	0.48 (0.44-0.52)*	0.49 (0.45-0.52)*	0.43 (0.40-0.46)*

\*Significant at 5%; uOR: unadjusted odds ratio; CI: Confidence interval

The adjusted logistic regression model of determinants of big barriers in Nigeria, 2003 – 2018 is presented in Table 4. Education, partner's level of education, religion, media exposure, wealth, residence, and region were the common predictors of big barriers to healthcare access across all the survey rounds ( $p < 0.05$ ). The odds of a big barrier to healthcare access reduced consistently with increasing levels of education and this pattern persisted from the survey year 2003 to 2018. In 2018, the likelihood of a big barrier to health care access was 0.75(C.I=0.69-0.82,  $p < 0.05$ ), 0.65(C.I=0.60-0.71,  $p < 0.05$ ), and 0.46(C.I=0.40-0.53,  $p < 0.05$ ) times lower among women who have a primary, secondary, and higher level of education respectively compared with their counterparts who have no formal education. A similar pattern to the observed pattern of the relationship between women's level of education and big barriers to health care access for the survey year 2018 was observed across other survey years included in this study. This situation was similar to the partner's level of education.

The risk of having experienced big barrier to healthcare access was consistently lower among the women who belong to Islamic religious group in the survey year 2003 (OR=0.61: C.I=0.49-0.75,  $p < 0.05$ ), 2008 (OR=0.63: C.I=0.58-0.69,  $p < 0.05$ ), 2013 (OR=0.82: C.I=0.76-0.89,  $p < 0.05$ ), and 2018 (OR=0.70: C.I=0.65-0.76,  $p < 0.05$ ) compared to their counterparts who are Christians. The likelihood of having a big barrier to health care access was significantly lower among women who are working (OR=0.88, 95% C.I=0.82-0.93) compared to those who are not working. Both higher exposure to media information, higher wealth quintile, and having final say on own health care are protective factors against big barriers to healthcare access while living in the rural areas predisposes women to big barriers to healthcare access.

**Table 4: Adjusted logistic regression model of determinants of big barrier to healthcare access in Nigeria, 2003 – 2018**

Background Characteristics	Year			
	2003	2008	2013	2018
<b>Age</b>	<b>OR(C.I)</b>	<b>OR(C.I)</b>	<b>OR(C.I)</b>	<b>OR(C.I)</b>
15-19	1.00	1.00	1.00	1.00
20-24	0.92 (0.72-1.19)	0.99 (0.87-1.12)	1.02 (0.91-1.14)	1.04 (0.92-1.17)
25-29	0.93 (0.73-1.19)	0.95 (0.84-1.08)	0.94 (0.84-1.06)	1.00 (0.89-1.13)
30-34	0.85 (0.66-1.10)	0.93 (0.82-1.06)	0.94 (0.84-1.06)	0.99 (0.87-1.12)
35-39	0.87 (0.67-1.13)	0.95 (0.83-1.09)	0.98 (0.87-1.10)	0.97 (0.86-1.10)
40-44	0.86 (0.66-1.12)	0.96 (0.84-1.11)	0.96 (0.85-1.09)	0.91 (0.80-1.04)
45-49	0.81 (0.61-1.06)	0.87 (0.75-1.00)	0.88 (0.78-1.00)	0.97 (0.85-1.10)
<b>Education</b>				
No education	1.00	1.00	1.00	1.00
Primary	0.82 (0.69-0.98)*	0.95 (0.86-1.04)	0.94 (0.87-1.03)	0.75 (0.69-0.82)*
Secondary	0.59 (0.47-0.75)*	0.72 (0.64-0.80)*	0.73 (0.67-0.81)*	0.65 (0.60-0.71)*
Higher	0.63 (0.42-0.95)*	0.49 (0.42-0.58)*	0.45 (0.39-0.52)*	0.46 (0.40-0.53)*
<b>Partner's Educational Level</b>				
No education	1.00	1.00	1.00	1.00
Primary	0.95 (0.80-1.13)	0.82 (0.75-0.91)*	0.94 (0.87-1.03)	0.66 (0.60-0.72)*
Secondary	0.77 (0.63-0.95)*	0.71 (0.64-0.79)*	0.72 (0.66-0.79)*	0.57 (0.52-0.62)*
Higher	0.48 (0.36-0.63)*	0.55 (0.49-0.62)*	0.55 (0.49-0.61)*	0.38 (0.35-0.43)*
<b>Occupation</b>				
Not Working	1.00	1.00	1.00	1.00
Working	0.96 (0.84-1.11)	1.08 (1.01-1.16)*	0.88 (0.82-0.93)*	1.04 (0.98-1.10)
<b>Religion</b>				
Christian	1.00	1.00	1.00	1.00
Islam	0.61 (0.49-0.75)*	0.63 (0.58-0.69)*	0.82 (0.76-0.89)*	0.70 (0.65-0.76)*
Others	1.30 (0.83-2.03)	1.17 (0.91-1.52)	1.38 (1.10-1.75)*	0.41 (0.31-0.54)*
<b>Media Exposure</b>				
Not Exposed	1.00	1.00	1.00	1.00
Exposed	0.78 (0.67-0.91)*	0.90 (0.83-0.97)*	0.87 (0.82-0.93)*	0.92 (0.87-0.98)*
<b>Wealth Index</b>				
Poor	1.00	1.00	1.00	1.00
Middle	0.52 (0.44-0.61)*	0.63 (0.58-0.69)*	0.67 (0.62-0.73)*	0.61 (0.57-0.66)*
Rich	0.29 (0.24-0.35)*	0.46 (0.42-0.51)*	0.45 (0.41-0.49)*	0.43 (0.39-0.46)*
<b>Number of Under-5 Children</b>				
None	1.00	1.00	1.00	1.00
One	0.94 (0.79-1.11)	1.13 (1.04-1.23)*	1.09 (1.01-1.17)*	1.06 (0.99-1.14)
Two	0.92 (0.77-1.11)	1.16 (1.06-1.26)*	1.17 (1.08-1.27)*	1.11 (1.03-1.20)*
Three and above	0.86 (0.70-1.04)	1.14 (1.03-1.25)*	1.22 (1.12-1.32)*	1.15 (1.06-1.26)*
<b>Has Final Say on Own Health Care</b>				
Woman alone	1.00	1.00	1.00	1.00
Husband alone	1.00 (0.83-1.21)	1.02 (0.92-1.14)	0.72 (0.64-0.81)*	1.01 (0.92-1.10)
Woman & Husband	0.89 (0.70-1.14)	0.99 (0.88-1.10)	0.77 (0.68-0.86)*	1.28 (1.17-1.40)*
Others	1.14 (0.82-1.57)	1.87 (0.95-3.68)	1.54 (0.86-2.76)	1.94 (1.10-3.40)*
<b>Place of Residence</b>				
Urban	1.00	1.00	1.00	1.00
Rural	1.63 (1.40-1.89)*	1.44 (1.33-1.55)*	1.50 (1.40-1.60)*	1.18 (1.11-1.26)*
<b>Region</b>				
North central	1.00	1.00	1.00	1.00

North east	0.90 (0.72-1.12)	0.92 (0.83-1.02)	0.77 (0.70-0.85)*	1.34 (1.23-1.47)*
North west	1.17 (0.94-1.46)	0.74 (0.67-0.82)*	0.66 (0.60-0.72)*	0.46 (0.42-0.51)*
South east	1.46 (1.12-1.89)*	1.41 (1.23-1.62)*	2.03 (1.80-2.29)*	1.32 (1.19-1.47)*
South south	2.51 (1.94-3.25)*	0.65 (0.58-0.73)*	1.48 (1.33-1.65)*	1.16 (1.05-1.29)*
South west	0.37 (0.28-0.49)*	0.71 (0.64-0.79)*	0.71 (0.64-0.79)*	0.63 (0.57-0.70)*

\*Significant at 5%; uOR: unadjusted odds ratio; CI: Confidence interval

The hot-spot for a big barrier across the 36 states in Nigeria including Federal Capital Territory, Abuja was indicated in Figures 1 (a-d). In 2003, a high prevalence (ranging from 59.9% - 89.9%) of big barriers to healthcare access was found in Sokoto, Zamfara, Jigawa, Benue, Ebonyi, Bayelsa, and Akwa Ibom. The hotspot for barriers to healthcare access was clustered around states in the south-south and southeast region of Nigeria (Figure 1a). In 2008, a high prevalence (ranging from 79.1% - 91.9%) of big barriers to healthcare access was observed in 7 states including Borno, Niger, Taraba, Benue, Enugu, Ebonyi, and Imo but significantly low prevalence clustered around three states in southwest Nigeria namely Osun, Ekiti and Ondo (Figure 1b). According to the 2013 survey’s data, the hot spot for big barriers to healthcare access was identified in some states. These are; Kebbi, Kastina, Niger, Plateau, Taraba, Enugu, and Abia whereas, low prevalence (cold-spot) for barrier to healthcare access clustered majorly in the south west region covering all the 6 south west states and Kwara state in the north central (Figure 1c). In Figure 1d, the spatial distribution shows that a somewhat higher range (71.3% - 91.7%) of big barriers to healthcare access compared to the preceding survey round was observed in the year 2018 where the hotspots were evident in some states like Jigawa, Adamawa, Oyo, Kogi, Benue, Delta, and Ebonyi. However, there was an indication that cold-spot is a big barrier to healthcare access clustering in some states in the south west region, Nigeria.

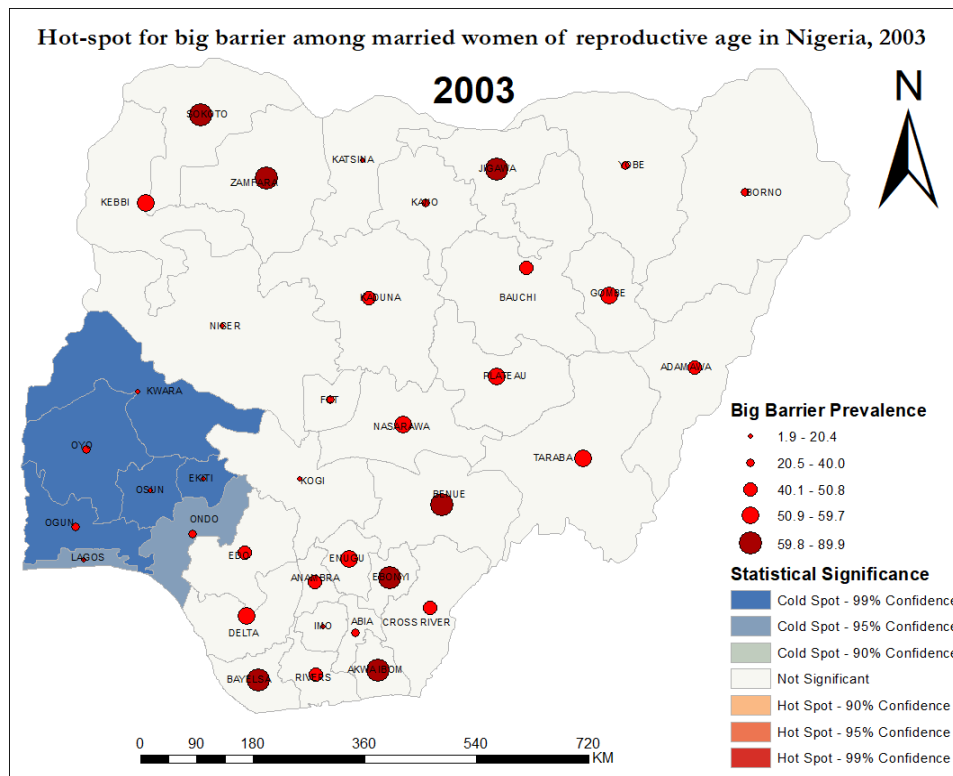


Figure 1a: Hot-spot for big barrier in Nigeria -2003

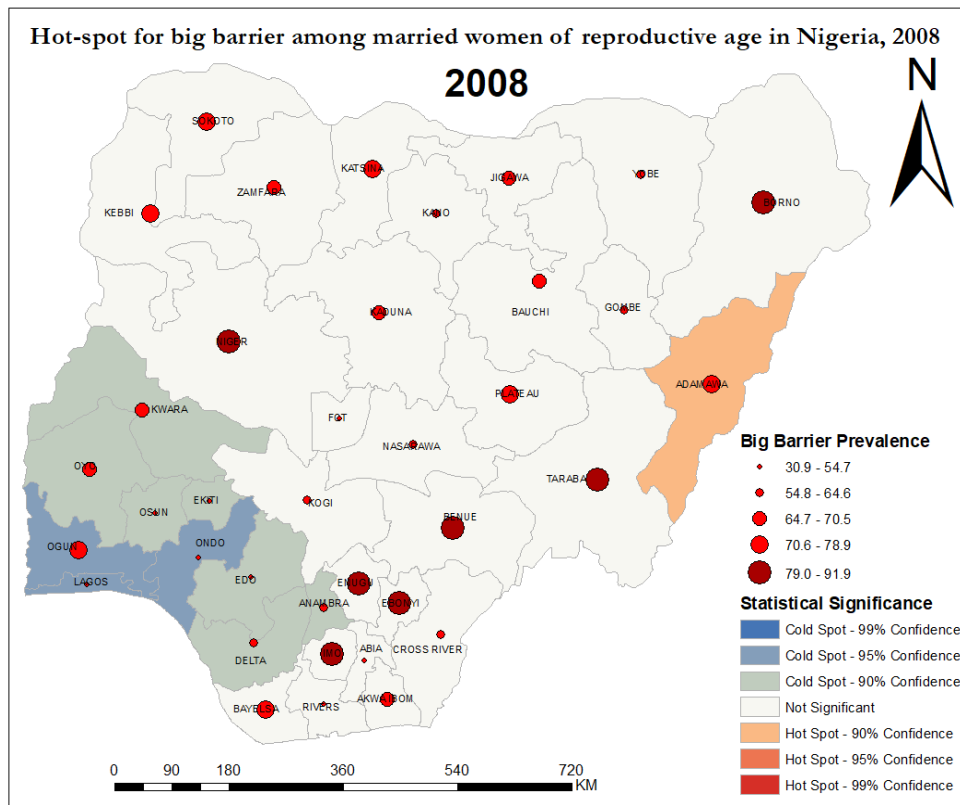


Figure 1b: Hot-spot for big barrier in Nigeria -2008

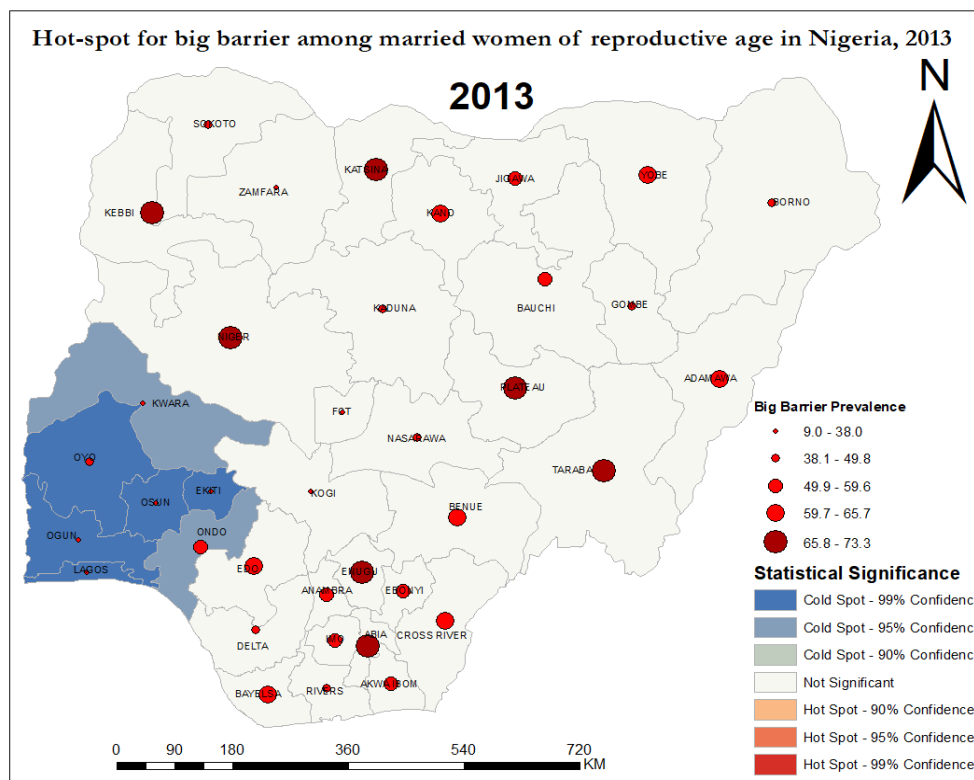


Figure 1c: Hot-spot for big barrier in Nigeria -2013

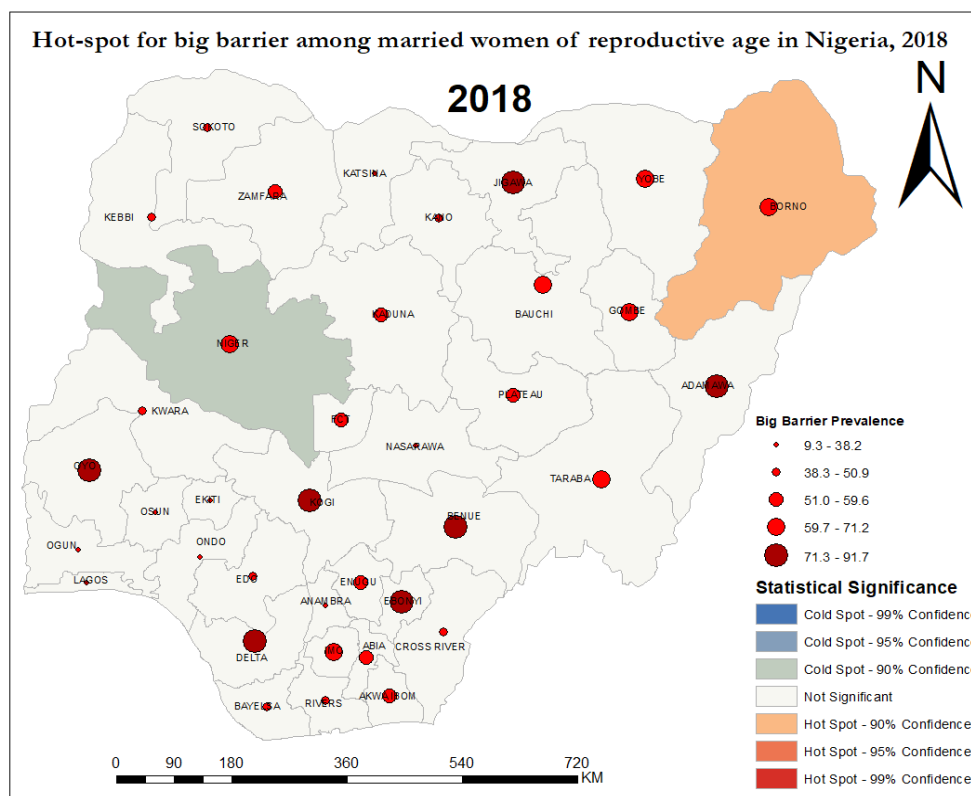


Figure 1d: Hot-spot for big barrier in Nigeria -2018

Table 5 presents the results of the Wagstaff decomposition method showing the concentration index which measures the relative inequality with respect to big barriers to healthcare access. The overall estimated index was -0.3172 which implies that the inequality in relation to having big barriers in accessing healthcare was more accounted for among the poor unless a 23.63% is accounted for among the rich to attain equality. Maternal age 15-24 years and 45-49 years categories have a pro-poor concentration index, meaning that the access barrier is more concentrated among the poor population within that age range, while the access barrier is more concentrated among the rich population within the age category 25-44 years. An experience of big barriers to healthcare access was more concentrated among the poor population with no formal education and among the poor whose partners had no formal and primary education. The data further show that experiencing a big barrier to healthcare access for women who were not exposed to media was more concentrated among the poor ( $C_i = -0.3571$ ), needing a redistributed 26.78% to the rich population to balance the inequality. Also, the Islamic religion has a pro-poor concentration index ( $C_i = -0.1637$ ) therefore, balancing the inequality will require 12.28% shifted to the rich population. Experiences of big barriers for women with one (0.0503) and no (0.0985) under-five children are more concentrated among the rich, therefore, 3.78% and 7.39% respectively on healthcare access barriers will have to be redistributed to the poor population to balance the inequality. In the rural residence, experiencing big barriers is more concentrated among the poor ( $C_i = -0.2355$ ) unless 17.66% is redistributed to the rich population to attain equality. Regardless of statistical significance, factors that contributed the most to income inequality in healthcare access include maternal education (36.7%), partner education (41.1%), place of residence (35.5%), and media exposure (9.5%).



**Table 5:** Decomposition analysis of factors influencing big barrier from 2003 to 2018

Background Characteristics	Concentration Index	Elasticity	Absolute Contribution	% Contribution
<b>Age</b>				0.8
15-19	-0.2768*	0.0000	0.0000	
20-24	-0.0747*	-0.0002	0.0000	
25-29	0.0332*	-0.0054	-0.0002	
30-34	0.0609*	-0.0049	-0.0003	
35-39	0.0724*	-0.0023	-0.0002	
40-44	0.0277*	-0.0042	-0.0001	
45-49	-0.0007	-0.0035	0.0000	
<b>Highest Educational Level</b>				36.7
No education	-0.3313*	0.1689	-0.0559	
Primary	0.0559*	0.0524	0.0029	
Secondary	0.3767*	0.0400	0.0151	
Higher	0.5734*	0.0000	0.0000	
<b>Partner's Educational Level</b>				41.1
No education	-0.3721*	0.0000	0.0000	
Primary	-0.0068*	-0.0208	0.0001	
Secondary	0.2645*	-0.0683	-0.0181	
Higher	0.4547*	-0.0539	-0.0245	
<b>Occupation</b>				0.1
Not working	-0.1298	0.0087	-0.0011	
Working	0.0579	0.0000	0.0000	
<b>Religion</b>				-13.2
Christian	0.2434	0.0000	0.0000	
Islam	-0.1637*	-0.0832	0.0136	
Others	-0.2325	0.0002	0.0000	
<b>Media Exposure</b>				9.5
Not Exposed	-0.3571*	0.0275	-0.0098	
Exposed	0.1686	0.0000	0.0000	
<b>Number of Under-5 Children</b>				1.7
None	0.0985*	0.0000	0.0000	
One	0.0503*	0.0125	0.0006	
Two	-0.0290	0.0177	-0.0005	
Three and above	-0.1489	0.0130	-0.0019	
<b>Has Final Say on Own Health Care</b>				-2.4
Woman alone	0.2266	0.0000	0.0000	
Husband alone	-0.1455	0.0046	-0.0007	
Woman and Husband	0.2019	0.0159	0.0032	
Others	-0.1163	0.0003	0.0000	
<b>Place of Residence</b>				35.5
Urban	0.4158*	-0.0882	-0.0367	
Rural	-0.2355*	0.0000	0.0000	
<b>Region</b>				-10.7
North central	-0.0063*	-0.0157	0.0001	
North east	-0.2827*	-0.0238	0.0067	
North west	-0.2531	-0.1052	0.0266	
South east	0.3198*	0.0000	0.0000	
South south	0.3258*	-0.0167	-0.0055	
South west	0.4236*	-0.0397	-0.0168	

*\*Significant at 5%; Wagstaff Index = -0.3151*

#### 4. Discussion

Access to health facilities is one of the challenges facing individuals in most low-income countries and women of reproductive age are mostly affected (2). In Nigeria, health care access is poor due to myriad of problems aside from the known three delays – the decision to go to the facility at the family level, transportation, and at the health facility (45). However, the zonal diversities in culture, religion, education, and other socioeconomic characteristics define health care access across the regions in Nigeria (46). In the face of the limited research that addressed barriers to health care access in Nigeria, this study, examined factors influencing health care access among women of reproductive age in each of its six geopolitical zones. We also used the Wagstaff concentration index decomposition to ascertain whether a pro-rich or pro-poor inequality exists as a barrier to healthcare access among women in Nigeria. The direction and contributions of the factors associated with income inequality in barriers to healthcare access were determined. The trend in the pattern of the hotspot and cold spot areas of barriers to healthcare access was assessed.

There was a pronounced increase in barriers to healthcare access among married women of reproductive age between 2003 and 2008. However, a reduction was seen between 2008 and 2013 but no clear reduction was observed between 2013 and 2018. This decline in the proportion of women who experienced barriers to health care between 2008 and 2018 could be attributed to improved maternal health programs and interventions designed to address the challenges in accessing healthcare over the last decade. These interventions are part of mechanisms to meet up with the benchmark highlighted for universal health coverage in the Millennium Development Goals and the target for SDG 3.1 to reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030. The observed pattern in this study corroborates the outcome of previous studies conducted in Nigeria and some other African countries (23,47) but at variance with the findings from Ethiopia (33).

In this study, a high prevalence of big barriers to healthcare access hovers around some states in the north east, North West, and South South regions. There were no significant hot-spot regions of big barriers in 2003 and 2013 but, there were hotspot clusters of healthcare access barriers in Adamawa and Borno in 2008 and 2018 respectively. In 2018, a decrease in prevalence was discovered in some states that had previously been found to have a high prevalence, while the south west region/states have consistently remained a cold-spot for barrier to health care access in the last 15 years. This finding is in agreement with that of a study conducted in Ethiopia (33). The finding from the south west region is an indication of the level of accessibility to health in the region due to the higher literacy level across the states and closeness of health facilities to individuals in the region compared to other regions in Nigeria (26,48). It is also not impossible that the hotspot and high prevalence areas had fewer healthcare facilities located close to most residential areas (49,50). Societal socioeconomic characteristics and cultural barriers differences between the cold spot and hot spot areas can also be responsible for the variation in healthcare access in the states in Nigeria (33).

Health care access is not free in Nigeria both at the public and private health facilities and predominantly payments for health care services are out-of-pocket. The National Health Insurance Scheme (NHIS) instituted by the Federal Government is still underutilized with less than five percent of the huge population of Nigeria using the service. Consequently, the rich are likely to be at an advantage. This study revealed that barriers to health care access concentrated more among the poor than the rich. However, within the poor sampled, the concentration was found to be more among the youth and uneducated. This outcome is expected because higher income will facilitate an increase in the ability to; pay for health services, take quick decisions on access to health care as well as the capacity for ease of transportation to the health facility. The outcome of the previous studies conducted elsewhere around the world and in Africa are evidence that support the current finding (13,51–54). Socioeconomic factors like maternal educational level, partner educational level, wealth index, media exposure, and place of residence contributed to the barriers to healthcare access concentration index among the poor. This finding aligns with the previous study that examined socioeconomic inequality in the use of maternal health care services in Nigeria (55,56). The poor inability to pay for health services or afford transportation to health centers compared to their rich counterparts (57) can explain our finding.

The common predictors of barriers to health care access over the years were education, religion, media exposure, wealth index, place of residence, and region of residence. These outcomes corroborate the outcome of earlier studies in this research area (58–63). Higher levels of education either maternal or husband, higher wealth quintile, living in urban areas are somewhat related to the lower experience of healthcare access barriers (19,64,65). The role of education in

health care access has been extensively substantiated in the literature. Education improves knowledge of the need to seek health care when the need arises and educated women may be autonomous, especially in the area of making timely decisions on health care and financial ability to access such services (60,66,67). They are likely to be employed and earn better salaries including management of their earnings compared to the uneducated and as such have the higher financial ability to procure drugs and other health needs at the facility. Having more educated husbands or partners will further improve access as this will not only keep the wife informed on the importance of seeking healthcare, but also provides women with better economic and psychosocial support. Experiencing a lower likelihood of barrier to health care access found among urban women compared to rural women is expected (26,68–71). In Nigeria, most private and public health facilities are predominantly found in urban areas. The rural dwellers in most situations access facilities located in the urban areas as the majority of the primary health care centers located in the rural areas are either moribund or dysfunctional and limited in the services they provide. Also, barriers to healthcare access among rural populations have been linked to financial challenges, long distance to health centers (72) and absence of hospital facilities, poor attitude of health care providers (73–76). The pattern observed by wealth quintiles and exposure to media was consistent with the literature (40,56,77–79).

The cross-sectional nature of the survey data used cannot give room for the establishment of causal relationships. There is a possibility that other contextual factors which were not captured during the survey might contribute to the barriers to healthcare access. Other factors that are relevant to barriers to healthcare access, particularly those that relate to the health system and healthcare providers were not included in this study. However, the use of four rounds of nationally representative data from 2003 and 2018 is the strength of this study.

## 5. Conclusions

A declining trend in barriers to healthcare access has been observed between 2003 and 2018 in Nigeria, however, the level is still high but variation across the six geopolitical zones in the country. The common predictors of barriers to health care access over the years were education, religion, media exposure, wealth index, place of residence, and region of residence. Having higher education, higher wealth, living in the urban area, and residence in south west Nigeria were protective against barriers to health care access among women of reproductive age in Nigeria. These factors should be considered while designing strategies or interventions to alleviate barriers to health care access in Nigeria. The disparity in health care access across the geopolitical zones points to the need for qualitative research specific to each region to ascertain the contextual factors responsible for poor access to health care.

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## References

1. Gulliford M, Figueroa-Munoz J, Morgan M, Hughes D, Gibson B, Beech R, et al. What does “access to health care” mean? *J Health Serv Res Policy* [Internet]. 2002;7(3):186–8. Available from: <https://doi.org/10.1258/135581902760082517>
2. Uzochukwu BSC, Ughasoro MD, Etiaba E, Okwuosa C, Envuladu E, Onwujekwe OE. Health care financing in Nigeria: Implications for achieving universal health coverage. *Niger J Clin Pract*. 2015;18(4):437–44.
3. Ruiz RL, Shah MK, Lewis ML, Theall KP. Perceived access to health services and provider information and adverse birth outcomes: findings from LaPRAMS, 2007-2008. *South Med J* [Internet]. 2014 Mar 1 [cited 2022 Aug 31];107(3):137–43. Available from: <https://europepmc.org/article/med/24937329>
4. Omoruyi, G. (2008). Causes of maternal mortality... - Google Scholar [Internet]. [cited 2022 Apr 9]. Available from: [https://scholar.google.com/scholar?hl=en&as\\_sdt=0%2C5&q=Omoruyi%2C+G.+%282008%29.+Causes+of+maternal+mortality+in+Nigeria.+Sunday+Observer%2C+Benin.&btnG=](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Omoruyi%2C+G.+%282008%29.+Causes+of+maternal+mortality+in+Nigeria.+Sunday+Observer%2C+Benin.&btnG=)
5. New WHO and World Bank Group Report Shows that 400 Million Do Not Have Access to Essential Health Services and 6% of Population Tipped into or Pushed Further into Extreme Poverty because of Health Spending [Internet]. [cited 2022 Jul 12]. Available from: <https://www.worldbank.org/en/news/press-release/2015/06/12/new-who-and-world-bank-group-report-shows-that-400-million-do-not-have-access-to-essential-health-services-and-6-of-population-tipped-into-or-pushed-further-into-extreme-poverty-because-of-health-spending>
6. FayehunID O, Ajisola M, Uthman O, Oyeboode O, Oladejo A, Owoaje E, et al. A contextual exploration of healthcare service use in urban slums in Nigeria On behalf of the Improving Health in Slums Collaborative. 2022; Available from: <https://doi.org/10.1371/journal.pone.0264725>
7. Maternal mortality Evidence brief Progress towards achieving the Sustainable Development Goals. [cited 2022 Aug 30]; Available from: <https://www>.
8. Gulland A. Some 400 million people lack access to essential health services. *BMJ* [Internet]. 2015;350(June):h3263. Available from: <http://dx.doi.org/doi:10.1136/bmj.h3263>
9. Olaniyan O, Lawanson AO. Health Expenditure and Health Status in Northern and Southern Nigeria: A Comparative Analysis Using NHA Framework 1. 2010;
10. SEA-HE-190 Distribution: General Social Determinants of Health.
11. Health Care Around the World — Global Issues [Internet]. [cited 2022 Aug 30]. Available from: <https://www.globalissues.org/article/774/health-care-around-the-world>
12. Akwash FBA. Healthcare transformation: Issues, challenges and the way forward. ~ 27 ~ *WWJMRD* [Internet]. 2016 [cited 2022 Aug 30];2(5):27–30. Available from: [www.wwjmr.com](http://www.wwjmr.com)
13. Peters DH, Garg A, Bloom G, Walker DG, Brieger WR, Hafizur Rahman M. Poverty and Access to Health Care in Developing Countries. *Ann N Y Acad Sci* [Internet]. 2008 Jun 1 [cited 2022 Aug 31];1136(1):161–71. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1196/annals.1425.011>
14. Obansa SAJ, Orimisan A. Health care financing in Nigeria: Prospects and challenges. *Mediterr J Soc Sci*. 2013;4(1):221–36.

15. Alawode GO, Adewole DA. Assessment of the design and implementation challenges of the National Health Insurance Scheme in Nigeria: a qualitative study among sub-national level actors, healthcare and insurance providers. [cited 2022 Aug 30]; Available from: <https://doi.org/10.1186/s12889-020-10133-5>
16. WHO Ranks Nigeria Ranks 187 out of 190 in World Health Systems | DNNreports [Internet]. [cited 2022 Aug 30]. Available from: <https://www.dnnafrica.com/ranks-nigeria-ranks-187-190-world-health-systems/>
17. Lozano R, Fullman N, Mumford JE, Knight M, Barthelemy CM, Abbafati C, et al. Measuring universal health coverage based on an index of effective coverage of health services in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2020 Oct 17;396(10258):1250–84.
18. National Population Commission (NPC) [Nigeria] and ICF (2019) Nigeria Demographic and Health Survey 2018. National Population Commission and ICF, Abuja and Rockville. - References - Scientific Research Publishing [Internet]. [cited 2022 Jul 12]. Available from: <https://www.scirp.org/reference/referencespapers.aspx?referenceid=3021942>
19. Okwaraji YB, Webb EL, Edmond KM. Barriers in physical access to maternal health services in rural Ethiopia. *BMC Health Serv Res* [Internet]. 2015 Nov 4 [cited 2022 Jul 12];15(1):1–8. Available from: <https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-015-1161-0>
20. Seidu A-A. Mixed effects analysis of factors associated with barriers to accessing healthcare among women in sub-Saharan Africa: Insights from demographic and health surveys. 2020; Available from: <https://doi.org/10.1371/journal.pone.0241409.t001>
21. Shiferaw S, Spigt M, Godefrooij M, Melkamu Y, Tekie M. Why do women prefer home births in Ethiopia? *BMC Pregnancy Childbirth* [Internet]. 2013 Jan 16 [cited 2022 Aug 30];13(1):1–10. Available from: <https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/1471-2393-13-5>
22. Bohren MA, Hunter EC, Munthe-Kaas HM, Souza JP, Vogel JP, Gülmezoglu AM. Facilitators and barriers to facility-based delivery in low- and middle-income countries: A qualitative evidence synthesis. *Reprod Health* [Internet]. 2014 Sep 19 [cited 2022 Apr 9];11(1):1–17. Available from: <https://reproductive-health-journal.biomedcentral.com/articles/10.1186/1742-4755-11-71>
23. Adedini SA, Odimegwu C, Bamiwuye O, Fadeyibi O, De Wet N. Barriers to accessing health care in Nigeria: implications for child survival. <https://doi.org/103402/gha.v723499> [Internet]. 2014 [cited 2022 Apr 9];7(1):1–10. Available from: <https://www.tandfonline.com/doi/abs/10.3402/gha.v7.23499>
24. Karra M, Fink G, Canning D. Facility distance and child mortality: a multi-country study of health facility access, service utilization, and child health outcomes. *Int J Epidemiol* [Internet]. 2017 Jun 1 [cited 2022 Apr 9];46(3):817–26. Available from: <https://academic.oup.com/ije/article/46/3/817/2617178>
25. Kibuye JA. Disrespect And Abuse Of Women During Pregnancy And The Effects On The Utilization Of Ante Natal Care Services: A Case Of Jaramogi Oginga Odinga Teaching And Referral Hospital In Kisumu County. 2020 [cited 2022 Aug 30]; Available from: <http://erepository.uonbi.ac.ke/handle/11295/153871>
26. Adeyanju O, Tubeuf S, Ensor T. Socio-economic inequalities in access to maternal and child healthcare in Nigeria: changes over time and decomposition analysis. *Health Policy Plan* [Internet]. 2017 Oct 1 [cited 2022 Apr 9];32(8):1111–8. Available from: <https://academic.oup.com/heapol/article/32/8/1111/3829669>
27. Bassegy Rimani H, Sebastian Akpan Senior Lecturer E. Munich Personal RePEc Archive Healthcare Financing and Health outcomes in Nigeria: A State Level Study using Multivariate Analysis Healthcare Financing and Health outcomes in Nigeria: A State Level Study using Multivariate Analysis. *Int J Humanit Soc Sci*. 2012;2(15).

28. Rosero-Bixby L. Spatial access to health care in Costa Rica and its equity: a GIS-based study. *Soc Sci Med.* 2004 Apr 1;58(7):1271–84.
29. Wollum A, Burstein R, Fullman N, Dwyer-Lindgren L, Gakidou E. Benchmarking health system performance across states in Nigeria: A systematic analysis of levels and trends in key maternal and child health interventions and outcomes, 2000–2013. *BMC Med* [Internet]. 2015 Sep 2 [cited 2022 Aug 31];13(1):1–16. Available from: <https://link.springer.com/articles/10.1186/s12916-015-0438-9>
30. Tuana N, Tong R. Family Structure and Feminine Personality. 2018 Feb 6 [cited 2022 Aug 31];199–216. Available from: <https://www.taylorfrancis.com/chapters/edit/10.4324/9780429500527-15/family-structure-feminine-personality-nancy-chodorow>
31. Population Distribution in Nigeria [Internet]. [cited 2022 Aug 31]. Available from: <https://nigerianfinder.com/population-distribution-in-nigeria/>
32. Universal access to reproductive health: accelerated actions to enhance progress on Millennium Development Goal 5 through advancing Target 5B [Internet]. [cited 2022 Jul 12]. Available from: <https://apps.who.int/iris/handle/10665/70546>
33. Tesema GA, Tessema ZT, Tamirat KS. Decomposition and Spatio-temporal analysis of health care access challenges among reproductive age women in Ethiopia, 2005–2016. *BMC Health Serv Res.* 2020 Aug 17;20(1).
34. Barriers to Accessing Surgical Care in Pakistan: Healthcare Barrier Model and Quantitative Systematic Review. *J Surg Res.* 2012 Jul 1;176(1):84–94.
35. Boateng EY, Abaye DA, Boateng EY, Abaye DA. A Review of the Logistic Regression Model with Emphasis on Medical Research. *J Data Anal Inf Process* [Internet]. 2019 Sep 12 [cited 2022 Nov 1];7(4):190–207. Available from: <http://www.scirp.org/journal/PaperInformation.aspx?PaperID=95655>
36. Stoltzfus JC. Logistic regression: A brief primer. *Acad Emerg Med.* 2011;18(10):1099–104.
37. Wagstaff A, Van Doorslaer E, Watanabe N. On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. *J Econom.* 2003 Jan 1;112(1):207–23.
38. NON-LINEAR DECOMPOSITION OF CHANGES IN SEXUAL BEHAVIOUR AMONG YOUTH IN FOUR SUB-SAHARAN AFRICAN COUNTRIES. 2004;
39. Omotoso KO, Koch SF. Assessing changes in social determinants of health inequalities in South Africa: A decomposition analysis. *Int J Equity Health* [Internet]. 2018 Dec 11 [cited 2022 Apr 8];17(1):1–13. Available from: <https://equityhealthj.biomedcentral.com/articles/10.1186/s12939-018-0885-y>
40. Pulok MH, Chirwa GC, Novignon J, Aizawa T, Makate M. Levels of and changes in socioeconomic inequality in delivery care service: A decomposition analysis using Bangladesh Demographic Health Surveys. *PLoS One* [Internet]. 2020 Nov 1 [cited 2022 Apr 8];15(11):e0242325. Available from: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0242325>
41. Safiri S, Kelishadi R, Heshmat R, Rahimi A, Djalalinia S, Ghasemian A, et al. Socioeconomic inequality in oral health behavior in Iranian children and adolescents by the Oaxaca-Blinder decomposition method: the CASPIAN-IV study. 2016;
42. McLafferty S, Grady S. Prenatal Care Need and Access: A GIS Analysis. *J Med Syst* 2004 283 [Internet]. 2004 Jun [cited 2022 Apr 8];28(3):321–33. Available from: <https://link.springer.com/article/10.1023/B:JOMS.0000032848.76032.28>

43. Mahara G, Wang C, Yang K, Chen S, Guo J, Gao Q, et al. The Association between Environmental Factors and Scarlet Fever Incidence in Beijing Region: Using GIS and Spatial Regression Models. *Int J Environ Res Public Heal* 2016, Vol 13, Page 1083 [Internet]. 2016 Nov 4 [cited 2022 Apr 8];13(11):1083. Available from: <https://www.mdpi.com/1660-4601/13/11/1083/htm>
44. Shariati M, Mesgari T, Kasraee M, Jahangiri-rad M. Spatiotemporal analysis and hotspots detection of COVID-19 using geographic information system (March and April, 2020). *J Environ Heal Sci Eng* [Internet]. 2020 Dec 1 [cited 2022 Aug 31];18(2):1499–507. Available from: <https://link.springer.com/article/10.1007/s40201-020-00565-x>
45. Emilio Carrillo J, Carrillo VA, Perez HR, Salas-Lopez D, Natale-Pereira A, Byron AT. Defining and Targeting Health Care Access Barriers. *J Health Care Poor Underserved* [Internet]. 2011 May [cited 2022 Aug 31];22(2):562–75. Available from: <https://muse.jhu.edu/article/430672>
46. Solanke BL, Rahman SA. Multilevel analysis of factors associated with assistance during delivery in rural Nigeria: Implications for reducing rural-urban inequity in skilled care at delivery. *BMC Pregnancy Childbirth* [Internet]. 2018 Nov 8 [cited 2022 Aug 31];18(1):1–15. Available from: <https://link.springer.com/articles/10.1186/s12884-018-2074-9>
47. Universal access to reproductive health.
48. Anselmi L, Lagarde M, Hanson K. Health service availability and health seeking behaviour in resource poor settings: evidence from Mozambique. *Health Econ Rev* [Internet]. 2015 Sep 2 [cited 2022 Aug 31];5(1):1–13. Available from: <https://link.springer.com/articles/10.1186/s13561-015-0062-6>
49. Parvin F, Ali SA, Hashmi SNI, Khatoon A. Accessibility and site suitability for healthcare services using GIS-based hybrid decision-making approach: a study in Murshidabad, India. *Spat Inf Res* [Internet]. 2021 Feb 1 [cited 2022 Aug 31];29(1):1–18. Available from: <https://link.springer.com/article/10.1007/s41324-020-00330-0>
50. Guagliardo MF. Spatial accessibility of primary care: Concepts, methods and challenges. *Int J Health Geogr* [Internet]. 2004 Feb 26 [cited 2022 Aug 31];3(1):1–13. Available from: <https://link.springer.com/articles/10.1186/1476-072X-3-3>
51. Alamneh TS, Teshale AB, Yeshaw Y, Alem AZ, Ayalew HG, Liyew AM, et al. Socioeconomic inequality in barriers for accessing health care among married reproductive aged women in sub-Saharan African countries: a decomposition analysis. *BMC Womens Health* [Internet]. 2022 Dec 1 [cited 2022 Aug 31];22(1):1–10. Available from: <https://link.springer.com/articles/10.1186/s12905-022-01716-y>
52. Ganle JK, Parker M, Fitzpatrick R, Otupiri E. Inequities in accessibility to and utilisation of maternal health services in Ghana after user-fee exemption: a descriptive study. *Int J Equity Heal* 2014 131 [Internet]. 2014 Nov 1 [cited 2022 Aug 31];13(1):1–19. Available from: <https://equityhealth.biomedcentral.com/articles/10.1186/s12939-014-0089-z>
53. Báscolo E, Houghton N, Del Riego A. Leveraging household survey data to measure barriers to health services access in the Americas. *Rev Panam Salud Pública* [Internet]. 2020 [cited 2022 Aug 31];44. Available from: </pmc/articles/PMC7429927/>
54. Houghton N, Bascolo E, Riego A del. Socioeconomic inequalities in access barriers to seeking health services in four Latin American countries. *Rev Panam Salud Pública*. 2020 May 8;44:e11.
55. Obiyan MO, Kumar A. Socioeconomic Inequalities in the Use of Maternal Health Care Services in Nigeria: Trends Between 1990 and 2008. <https://doi.org/10.1177/2158244015614070> [Internet]. 2015 Nov 25 [cited 2022 Jul 12];5(4). Available from: <https://journals.sagepub.com/doi/full/10.1177/2158244015614070>

56. Olayinka A, Olaide L, Opeloyeru S. Inequity in Healthcare Utilization: Analysis of the Nigeria Situation. *Int J Bus Soc Sci* [Internet]. 2016 [cited 2022 Jul 12];7(5). Available from: [www.ijbssnet.com](http://www.ijbssnet.com)
57. Sidze EM, Wekesah FM, Kisia L, Abajobir A. Inequalities in Access and Utilization of Maternal, Newborn and Child Health Services in sub-Saharan Africa: A Special Focus on Urban Settings. *Matern Child Health J* [Internet]. 2022 Feb 1 [cited 2022 Aug 31];26(2):250–79. Available from: <https://link.springer.com/article/10.1007/s10995-021-03250-z>
58. Kalule-Sabiti I, Amoateng AY, Ngake M. The Effect of Socio-demographic Factors on the Utilization of Maternal Health Care Services in Uganda. *African Popul Stud* [Internet]. 2014 Apr 29 [cited 2022 Jul 12];28(1):515–25. Available from: <https://aps.journals.ac.za/pub/article/view/504>
59. Acharya D, Adhikari R, Kreps GL. Does exposure of mass media associate with utilisation of ANC services? A trend analysis from Nepal demographic and health surveys. *Int J Health Plann Manage* [Internet]. 2021 Nov 1 [cited 2022 Jul 12];36(6):2145–61. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1002/hpm.3285>
60. Bintabara D, Nakamura K, Seino K. Improving access to healthcare for women in Tanzania by addressing socioeconomic determinants and health insurance: a population-based cross-sectional survey. *BMJ Open* [Internet]. 2018 Sep 1 [cited 2022 Jul 12];8(9):e023013. Available from: <https://bmjopen.bmj.com/content/8/9/e023013>
61. Woldeamanuel BT. Trends and Factors Associated with Healthcare Utilization for Childhood Diarrhea and Fever in Ethiopia: Further Analysis of the Demographic and Health Surveys from 2000 to 2016. *J Environ Public Health*. 2020;2020.
62. Zamawe COF, Banda M, Dube AN. The impact of a community driven mass media campaign on the utilisation of maternal health care services in rural Malawi. *BMC Pregnancy Childbirth* [Internet]. 2016 Jan 27 [cited 2022 Jul 12];16(1):1–8. Available from: <https://link.springer.com/articles/10.1186/s12884-016-0816-0>
63. Badu E, Gyamfi N, Opoku MP, Mprah WK, Edusei AK. Enablers and barriers in accessing sexual and reproductive health services among visually impaired women in the Ashanti and Brong Ahafo Regions of Ghana. <https://doi.org/10.1080/0968808020181538849> [Internet]. 2018 Nov 8 [cited 2022 Jul 12];26(54):51–60. Available from: <https://www.tandfonline.com/doi/abs/10.1080/09688080.2018.1538849>
64. Loftus J, Allen EM, Call KT, Everson-Rose SA. Rural-Urban Differences in Access to Preventive Health Care Among Publicly Insured Minnesotans. *J Rural Heal* [Internet]. 2018 Feb 1 [cited 2022 Jul 12];34:s48–55. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/jrh.12235>
65. Silal SP, Penn-Kekana L, Harris B, Birch S, McIntyre D. Exploring inequalities in access to and use of maternal health services in South Africa. *BMC Health Serv Res* [Internet]. 2012 May 21 [cited 2022 Jul 12];12(1):1–12. Available from: <https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-12-120>
66. Munguambe K, Boene H, Vidler M, Bique C, Sawchuck D, Firoz T, et al. Barriers and facilitators to health care seeking behaviours in pregnancy in rural communities of southern Mozambique. *Reprod Health* [Internet]. 2016 Jun 8 [cited 2022 Jul 12];13(1):83–97. Available from: <https://link.springer.com/articles/10.1186/s12978-016-0141-0>
67. Ahmad S, Maqbool PA. Health Seeking Behaviour and Health Service Utilization in Lucknow. *SSRN Electron J* [Internet]. 2013 Aug 15 [cited 2022 Aug 31]; Available from: <https://papers.ssrn.com/abstract=2326415>
68. Liu X, Li N, Liu C, Ren X, Liu D, Gao B, et al. Urban–rural disparity in utilization of preventive care services in China. *Medicine (Baltimore)* [Internet]. 2016 [cited 2022 Sep 1];95(37). Available from:



/pmc/articles/PMC5402572/

69. Okoronkwo IL, Onwujekwe OE, Ani FO. The long walk to universal health coverage: Patterns of inequities in the use of primary healthcare services in Enugu, Southeast Nigeria. *BMC Health Serv Res* [Internet]. 2014 Mar 21 [cited 2022 Sep 1];14(1):1–7. Available from: <https://link.springer.com/articles/10.1186/1472-6963-14-132>
70. Stewart K, Li M, Xia Z, Adewole SA, Adeyemo O, Adebamowo C. Modeling spatial access to cervical cancer screening services in Ondo State, Nigeria. *Int J Health Geogr* [Internet]. 2020 Jul 21 [cited 2022 Sep 1];19(1):1–14. Available from: <https://ij-healthgeographics.biomedcentral.com/articles/10.1186/s12942-020-00222-4>
71. Cao Y, Stewart K, Wish E, Artigiani E, Sorg MH. Determining spatial access to opioid use disorder treatment and emergency medical services in New Hampshire. *J Subst Abuse Treat*. 2019 Jun 1;101:55–66.
72. Awoyemi TT, Obayelu OA, Opaluwa HI. Effect of Distance on Utilization of Health Care Services in Rural Kogi State, Nigeria. *Kamla Raj Enterp* [Internet]. 2017 Jul [cited 2022 Jul 12];35(1):1–9. Available from: <https://www.tandfonline.com/doi/abs/10.1080/09709274.2011.11906385>
73. Latunji OO, Akinyemi OO. Factors influencing health-seeking behaviour among civil servants in Ibadan, Nigeria. *Ann Ibadan Postgrad Med* [Internet]. 2018 Jul 17 [cited 2022 Sep 1];16(1):52–60. Available from: <https://www.ajol.info/index.php/aipm/article/view/174662>
74. Disrespect And Abuse Of Women During Pregnancy And The Effects On The Utilization Of Ante Natal Care Services: A Case Of Jaramogi Oginga Odinga Teaching And Referral Hospital In Kisumu County [Internet]. [cited 2022 Apr 9]. Available from: <http://41.204.161.209/handle/11295/153871>
75. Uzochukwu BSC, Onwujekwe OE. Socio-economic differences and health seeking behaviour for the diagnosis and treatment of malaria: A case study of four local government areas operating the Bamako initiative programme in south-east Nigeria. *Int J Equity Health* [Internet]. 2004 Jun 17 [cited 2022 Apr 9];3(1):1–10. Available from: <https://link.springer.com/articles/10.1186/1475-9276-3-6>
76. Afolabi M, Irinoye A, Adegoke A. Health-seeking behaviour and student perception of health care services in a university community in Nigeria. 2013 [cited 2022 Jul 12]; Available from: <https://196.27.128.74/handle/123456789/6997>
77. Bhuiya A. Health for the Rural Masses Insights from Chakaria Editor. 2009 [cited 2022 Sep 1]; Available from: [www.icddrb.org](http://www.icddrb.org)
78. Kim ET, Singh K, Speizer IS, Angeles G, Weiss W. Availability of health facilities and utilization of maternal and newborn postnatal care in rural Malawi. *BMC Pregnancy Childbirth* [Internet]. 2019 Dec 17 [cited 2022 Sep 1];19(1):1–15. Available from: <https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2534-x>
79. Ghosh N, Chakrabarti I, Chakraborty M, Biswas R. Factors Affecting the Healthcare-seeking Behavior of Mothers Regarding their Children in a Rural Community of Darjeeling District, West Bengal. *Int J Med Public Heal*. 2013;3(1):12.