

BMJ Open Multivariate decomposition of trends, inequalities and predictors of skilled birth attendants utilisation in Nigeria (1990–2018): a cross-sectional analysis of change drivers

Adeniyi Francis Fagbamigbe ¹, Oyewole Kazeem Oyedele ^{1,2}

To cite: Fagbamigbe AF, Oyedele OK. Multivariate decomposition of trends, inequalities and predictors of skilled birth attendants utilisation in Nigeria (1990–2018): a cross-sectional analysis of change drivers. *BMJ Open* 2022;**12**:e051791. doi:10.1136/bmjopen-2021-051791

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-051791>).

Received 02 April 2021
Accepted 14 March 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Department of Epidemiology and Medical Statistics, University of Ibadan, Ibadan, Nigeria

²International Research Center of Excellence, Institute of Human Virology Nigeria, Abuja, Federal Capital Territory, Nigeria

Correspondence to

Oyewole Kazeem Oyedele; mrokoyedele@gmail.com

ABSTRACT

Objectives Literature has assessed skilled birth attendants (SBAs) utilisation, but little is known about what contributes to the changes in SBA use. Multivariate decomposition analysis was thus applied in this study to examine; levels, trends, inequalities and drivers of changes in SBA utilisation.

Design and setting A cross-sectional analysis of five-waves of NDHS-data (1990, 2003, 2008, 2013, and 2018), collected through similar multistage sampling across the 36 states and the federal-capital-territory of Nigeria.

Participants Women of reproductive age (15–49 years), and with at least one birth in the last 5 years preceding each of the surveys.

Main outcome measure SBA use is the response variable while explanatory variables were classified into; Demographics, Health, Economic and Corporal factors.

Methods Chi-square test for trends of proportions across the ordered survey years assessed trends in SBA use. MDA that quantifies and partition predictors effect into endowment and coefficient components evaluated contributors to changes in SBA use. Statistical analysis was carried out at a 95% confidence interval in Stata 16.

Results SBA use increased with significant ($p < 0.05$) linear trends by 12% between 2003 and 2018. The decomposition analysis showed that differences in characteristics (endowment) accounted for 11.5% of the changes while the remaining 88.5% were due to differences in effects (coefficient). SBA utilisation rises by 61% when respondents decided on her health compared to when such decisions were made by the spouse. Utilisation of SBA, however, fell by 88% among women who reside in the states with high rural populations percentage.

Conclusions SBA use remained low in Nigeria, and slowly increase at the rate of <1% yearly. Women health decision-making power contributed most to positive changes. Residing in states with high rural populations has a negative impact on SBA use. Maternal health programmes that strengthen women's health autonomy and capacity building in rural communities should be encouraged.

Strengths and limitations of this study

- The study might have suffered from recall bias, which is associated with cross-sectional studies.
- Our findings are limited to association and do not infer causality. Therefore, caution must be exercised while interpreting the results.
- The study strength can, however, be drawn from the largeness of the study sample size based on five-waves of the survey that allow us to achieve fair and reliable estimates.
- The use of sampling weights and year-women weight to accommodate differentials in women population across the survey years enhanced the accuracy of our estimates and their generalisation thereof.
- The application of multivariate decomposition analysis that quantifies the contribution of individual predictors in this study is also a strength. Though non-linear multivariate decomposition estimate is generally biased by identification problem but the normalisation option in the multivariate decomposition analysis reduced such bias.

INTRODUCTION

Consistent and effective utilisation of skilled birth attendants (SBAs) before, during and after delivery remained a viable approach to timely management of pregnancy complications, reduced pregnancy, and childbirth-related deaths, and optimal pregnancy outcomes.^{1–4} However, many pregnant women in sub-Saharan African (SSA) countries including Nigeria do not use this preventive intervention technique to curb the high burden of maternal and newborn mortality and morbidity.^{3,4} The contributions of unskilled births attendants to maternal deaths in Africa has been reported.^{3–7}

While developed countries; such as Sweden, Norway, Netherlands and Denmark have rapidly reduced their maternal mortality by increasing the use of SBA, developing nations including South-Sudan, Chad, Sierra Leone and Nigeria, are struggling to ensure that all pregnant women use SBA.⁸ Whereas, the use of SBA is one of the formidable strategies to achieve the United Nations Sustainable Development Goal (SDG)-3.⁹ South Sudan, Chad, Sierra Leone and Nigeria are the topmost four low/middle-income countries most affected by maternal mortality in 2017 with an estimated high maternal mortality ratio (MMR) of 1150, 1140, 1140 and 917 deaths per 100 000 live births, respectively.⁸ Nonetheless, the most recent national survey in Nigeria reported a lower MMR of 512 (95% CI 447 to 578) per 100 000 live births.¹⁰

In Nigeria, SBA coverage has remained below the global average and fluctuates periodically across the geopolitical zones and states despite the recent increase in turn-up at antenatal care (ANC) services.¹⁰ According to the reports from Nigerian Demographic and Health Survey (NDHS), 67% of women aged 15–49 years received ANC in 2018 (6% increase from 2013) while SBAs utilisation increased only slightly from 39% in 2013 to 43% in 2018 while that of traditional birth attendants decreased by only 2% during the same period.^{10 11} For instance, health facility delivery was 32%, 33%, 35%, 36% and 39% of all births in 1990, 2003, 2008, 2013 and 2018 respectively, and pregnancy-related mortality ratio (PRMR) was 545/100,000 for 2001–2008, 576/100,000 for 2006–2013 and 556/100 000 for 2011–2018 while MMR was 512/100 000 live births in 2018.^{10 11}

However, as shown in these statistics, an increase in ANC uptake alone is insufficient to improve the use of SBA owing to drop out from the maternal continuum of care before delivery. This has been reported to be high in Nigeria and driven by low or lack of formal education, poverty and socioeconomic status.¹² Also, as high as one-third of ANC clients in 28 African countries including Nigeria usually drop out from the skilled maternal care continuum and in turn fail to reduce pregnancy and child-related mortality.¹³ Recent statistics however showed an insignificant difference in the reported PRMR in 2013 and 2018 while child (including neonatal) mortality has increased by 2% from 37/1000 live births in 2013 to 39/1000 live births in 2018, thus explaining why 80% of currently married women have the potential for a high-risk birth in Nigeria.^{10 11}

There has been a haphazard rise and fall in the use of SBA in Nigeria with the reported 6% insignificant difference between 1990 and 2013.⁴ While it remains unclear whether the 12% difference in SBA use between 1990 and 2018 is statistically significant, it took nearly three decades to achieve such little increase. This, therefore, implies that at this rate, SBA utilisation will only increase by about 4% by 2030 which will undermine the attainment of the UN SDG-3 target of reducing world MMR to less than 70 per 100 000 live births.^{9 14} This signals the need

to expand efforts/strategies geared towards increasing SBA use in Nigeria by doubling skilled health personnel to childbirth ratio and strengthening healthcare delivery services. If adopted and adequately implemented, this approach could reduce MMR by half as experienced in Egypt between 1983 and 2000.¹⁵

Literature on the determinants of SBA utilisation has identified several factors classified into sociocultural—maternal age, education, marital status, ethnicity; perceived benefit—ANC adequacy, SBA history; economic and physical accessibility-related factors—employment, household social economy, healthcare mobility.^{16–18} Fagbamigbe *et al* identified sociocultural, maternal education and urban residence as strong determinants of SBA use in Nigeria.⁴ Olakunde *et al* also reported maternal age alongside household wealth quintile, geopolitical zone, parity and ANC as influential factors of SBA utilisation among adolescent girls in Nigeria.⁷ Maternal/partner education, household wealth/socioeconomic status, parity and ANC attendance were also major determinants of SBA use in southern and northern Ghana.^{19 20} Whereas, education, urban residence, wealth status, ANC visits, age at first birth and previous pregnancy complications were significantly associated with the use of skilled birth delivery in Ethiopia.^{21 22} These factors have also been linked to the determinants of ANC utilisation and predictors of infant and child survival.^{23–26}

Although studies abound on SBA use and its associated factors in Nigeria^{4 7 14 19 21 22 27} only a few have assessed trends, inequalities, and the predictors of the changes. We are not aware of any study on the changes in SBA use and the drivers of these changes at both the national and subnational levels in Nigeria. Fagbamigbe *et al* had ascertained the dearth of studies on the comparison of SBA use across states and regions of Nigeria⁴. Thus, the current study was designed to assess the trends in SBA use in Nigeria between 1990 and 2018 and also evaluate the factors that contributed to the changes across the periods using the multivariate decomposition analysis (MDA) technique. We sought to provide answers to the questions; were there any significant changes in the level of SBA use in Nigeria between 1990 and 2018? How significant are the changes in the level of SBA use over this period? What are the factors contributing to the changes in SBA use over this period? This study provided evidence-based information that could aid strategic maternal health programming in Nigeria.

METHODOLOGY

Study design, data and area

The study is a secondary analysis of data extracted from the five successive NDHS conducted in 1990, 2003, 2008, 2013, and 2018. The NDHS is a cross-sectional population-based nationally representative survey, routinely collected across all states and the Federal Capital Territory (FCT) of Nigeria. The sampling design is similar across the surveys. The survey usually uses stratified and multistage



Figure 1 Map of Nigeria showing the 36 states and the federal capital territory, by the geopolitical zones.

sampling techniques that accommodate household clusters (primary sampling unit) of respondents providing information on their demographic status and reproductive health behaviours of women aged 15–49 years. Nigeria is divided into six geopolitical zones called regions and each region is subdivided into states and FCT. As of 1990, Nigeria has 21 states. These were then divided and grouped into 30 states and the FCT in 1991. Additional 6 states were created in 1996, which resulted in the present number of 36 states as shown in [figure 1](#).

Sampling procedures

Similar two-stage cluster sampling was used in each of the five-waves of the survey. The 36 states and FCT were subdivided into local government areas (LGAs) whereby rural and urban LGAs were separated. Enumeration areas were selected from the LGAs at the first stage and households were then selected at the second stage where all women aged 15–49 years in the selected households were interviewed. In-depth information on the NDHS sampling methodology where 8781, 7620, 33385, 38 984 and 41 821 women participated in 1990, 2003, 2008, 2013 and 2018 surveys respectively have been documented. [10 11 28](#)

Patient and public involvement

No patient was involved. We applied the strobe reporting guidelines. [29](#)

Outcome and explanatory variables

Utilisation of SBA during the last childbirth within 5 years preceding each survey was the outcome variable and was measured as whether birth was assisted by skilled provider or not. [4 14 30](#) Skilled delivery services are rendered by doctors, nurses, midwives and auxiliary nurses/midwives. Independent/explanatory variables that includes; maternal age, education, ANC visit, parity,

socioeconomic status and place of residence that are consistently associated with SBA use in Nigeria and SSA were studied. [4 7 19–22 31–33](#) Other set of independent factors associated with the use of SBA and captured in each survey year of the DHS were included. [10 11 28](#) To ensure uniformity in all the survey data used, independent variables were classified in this study as; demographic/societal, women health, economic and corporal factors based on extensive literature search and review. [5 16 17 31 34](#) We further adopted the extended behavioural-ecological framework for healthcare access and navigation in selecting and classifying independents variables. [35](#) The independent variables and the respective classification are as follows.

1. Demographic, cultural and societal factors: maternal age (15–24, 25–34, 35–49 years), highest educational level (no education, primary, secondary+) Husband/partner's educational level (no education, primary, secondary+), sex of household head (male, female), marital status (never married, currently married or living with a sexual partner, formerly married), tribe/ethnic group (Hausa/Fulani, Yoruba, Igbo, others), religion (Islam, Christianity, others), region (north-central, northeast, northwest, south-east, south-south, southwest), place of residence (urban, rural).
2. Women health benefit/SBA purpose: wanted last child (wanted then, wanted later, wanted no more), number of ANC visits during pregnancy (none, less than the recommended 4, 4+visits), covered by health insurance (no, yes), birth order (1, 2, 3, 4 and 5+), birth interval (first birth, ≤ 36 months, 36+ months).
3. Economic class: employment status (employed, unemployed), paternal employment status (employed, unemployed), wealth index (poorest, poorer, middle, richer, richest), media access (no, yes), community poverty level (low, high) community unemployment (low, high), community media access (low, high), community social economy disadvantage (least disadvantage, less disadvantage, disadvantage, more disadvantage, most disadvantage).
4. Corporal convenience: distance to health facility (no problem, big problem), person who usually decides on respondent's healthcare (respondent alone, both, spouse alone), getting permission to go for medical help for self (no problem, big problem), years lived at place of residence/mobility (5+years, ≤ 5 years), state rural population percentage (low, high), community illiteracy level (low, high).

Statistical analysis

Simple descriptive statistics reporting frequency and percentages of women utilising SBA viz-a-viz independent characteristics were presented in [tables 1 and 2](#). Bivariate association was examined for each category of nominal/ordinal independent variables and SBA use was examined across the periods between 1990 and 2018 '(1990–2003, 2003–2008, 2008–2013 and 2013–2018) and longer periods of 2003–2018 and 1990–2018' using the χ^2 test for trends of proportions, with the survey years being an

Table 1 Distribution of mothers' background characteristics

Characteristics	1990 (%)	2003 (%)	2008 (%)	2013 (%)	2018 (%)	Total (%)	Sample (n)
Respondent's current age							
15–24	28.7	28.8	26.3	25.8	24.9	25.9	17 809
25–34	48.0	46.7	46.5	46.7	47.0	46.8	32 249
35–49	23.3	24.6	27.2	27.5	28.1	27.3	18 621
Highest educational level							
No education	63.9	49.9	49.1	46.9	44.3	47.7	32 297
Primary	23.3	24.2	22.5	20.0	15.5	19.2	13 772
Secondary+	12.8	25.9	28.4	33.0	40.1	33.2	22 610
Husband/partner's educational level							
No education	55.2	39.9	41.3	38.9	36.1	39.6	25 387
Primary	24.7	24.3	20.8	18.8	14.3	18.1	12 400
Secondary+	20.1	35.8	37.8	42.3	49.6	42.3	27 543
Place of residence							
Urban	31.6	34.7	26.6	33.0	34.7	31.9	22 416
Rural	68.4	65.3	73.4	67.0	65.3	68.1	46 263
Employment status							
Employed	64.5	63.6	64.7	69.2	68.2	66.9	45 967
Unemployed	35.5	36.4	35.3	30.8	31.8	33.1	22 494
Paternal employment status							
Employed	98.8	99.6	98.8	98.5	96.8	97.9	64 853
Unemployed	1.2	0.4	1.2	1.5	3.2	2.1	1287
Sex of household head							
Male	93.3	90.6	89.8	88.9	89.5	89.8	61 489
Female	6.7	9.4	10.2	11.1	10.5	10.2	7190
Marital status							
Never married	0.8	2.6	2.5	2.6	2.8	2.5	1750
Living with sexual partner	95.9	93.4	94.5	94.3	93.7	94.2	64 626
Formerly married	3.3	4.1	3.0	3.1	3.5	3.3	2302
Media access							
No	na	39.3	46.4	54.0	59.7	53.8	33 234
Yes	na	60.7	53.6	46.0	40.3	46.2	30 270
Wealth index							

Continued

Table 1 Continued

Characteristics	1990 (%)	2003 (%)	2008 (%)	2013 (%)	2018 (%)	Total (%)	Sample (n)
Poorest	22.6	22.7	26.4	22.7	23.6	24.1	16 030
Poorer	22.6	21.5	23.4	23.0	22.7	22.9	15 548
Middle	13.9	20.3	19.6	19.9	21.0	19.9	13 581
Richer	18.0	18.8	17.0	18.6	18.1	17.9	12 517
Richest	22.8	16.7	13.8	15.8	14.5	15.2	11 003
No of ANC visits during pregnancy							
None (0)	39.4	33.9	39.1	34.5	25.0	31.9	21 957
Inadequate (less than 4)	10.9	14.4	10.9	12.6	17.5	14.2	9280
Adequate (four or more)	49.7	51.6	49.9	53.0	57.6	53.9	37 075
Religion							
Islam	58.8	60.4	55.2	58.9	58.4	57.7	38 983
Christianity	37.3	37.9	42.3	39.6	40.8	40.7	28 456
Others	3.9	1.7	2.5	1.4	0.8	1.6	1237
Tribe/ethnic group							
Hausa/Fulani	na	40.0	36.6	40.5	40.5	39.3	24 525
Yoruba	na	10.9	11.9	11.6	10.6	11.2	7373
Igbo	na	11.6	10.1	9.8	12.9	11.4	7206
Others	na	37.6	41.4	38.1	36.0	38.1	24 683
A person who usually decides on respondent's healthcare							
Respondent	na	13.8	7.6	5.2	8.9	8.1	4704
Both	na	10.6	33.5	31.1	31.7	31.2	18 494
Spouse alone	na	75.6	58.9	63.7	59.3	60.7	36 542
Getting medical help for self: distance to a health facility							
No problem	na	73.9	59.4	67.5	69.7	66.4	42 557
Big problem	na	26.1	40.6	32.5	30.3	33.6	21 063
Getting medical help for self: getting permission to go							
No problem	na	89.5	84.4	88.3	87.7	86.9	55 313
Big problem	na	10.5	15.6	11.7	12.3	13.1	8283
Wanted the last-child							
Wanted then	87.4	84.8	89.6	90.3	87.8	88.6	60 331
Wanted later	9.7	9.6	5.6	7.6	8.8	7.8	5554
Wanted no more	2.9	5.6	4.8	2.1	3.5	3.7	2534

Continued

Table 1 Continued

Characteristics	1990 (%)	2003 (%)	2008 (%)	2013 (%)	2018 (%)	Total (%)	Sample (n)
Years lived in a place of residence/mobility							
More than 5 years	88.9	79.5	74.2	83.8	80.7	na	38 854
0–4 years	11.1	20.5	25.8	16.2	19.3	na	9626
Covered by health insurance							
No	na	Na	98.7	98.3	97.8	98.2	58 746
Yes	na	Na	1.3	1.7	2.2	1.8	1103
Birth order							
1	16.4	19.2	17.0	17.7	17.0	17.2	11 940
2	15.9	15.2	16.3	16.1	17.3	16.6	11 347
3	14.3	13.8	15.0	14.7	15.2	14.9	10 225
4	12.9	12.6	13.2	13.1	13.4	13.2	9040
5	40.4	39.2	38.6	38.4	37.1	38.1	26 127
Birth interval							
First birth	16.5	19.3	17.0	17.8	17.0	17.2	11 940
<36 months	49.7	46.8	47.6	46.8	47.9	47.7	32 630
36+ months	33.8	33.9	35.4	35.4	35.1	35.1	23 986
States rural population percentage							
Low	34.1	27.0	27.3	26.7	28.3	28.1	19 856
High	65.9	73.0	72.7	73.3	71.7	71.9	48 823
Community poverty level							
Low	58.4	44.9	43.5	38.8	62.0	52.0	33 830
High	41.6	55.1	56.5	61.2	38.0	48.0	34 849
Community illiteracy level							
Low	30.8	46.2	45.2	38.9	67.2	53.0	33 901
High	69.2	53.8	54.8	61.1	32.8	47.0	34 778
Community unemployment							
Low	34.6	20.3	40.6	42.2	72.1	53.6	33 914
High	65.4	79.7	59.4	57.8	27.9	46.4	34 765
Community media access							
Low	91.2	45.9	42.6	34.9	57.7	51.4	33 750
High	8.8	54.1	57.4	65.1	42.3	48.6	34 929
Community socioeconomic status disadvantage							

Continued

Table 1 Continued

Characteristics	1990 (%)	2003 (%)	2008 (%)	2013 (%)	2018 (%)	Total (%)	Sample (n)
Least disadvantage	29.0	2.0	13.6	15.3	28.9	21.2	13 752
Less disadvantage	27.2	15.5	19.5	19.0	21.1	20.5	13 733
Disadvantage	16.0	33.8	22.5	17.6	18.5	20.0	13 758
More disadvantage	15.7	29.7	22.5	20.3	16.3	19.2	13 716
Most disadvantage	12.1	18.9	21.9	28.0	15.2	19.2	13 720
Region							
North Central	15.6	16.5	18.5	14.8	17.4	17.2	11 658
North East	11.5	23.2	22.0	20.3	20.8	20.5	13 832
North West	35.5	30.9	26.8	32.4	29.4	29.6	19 979
South East	10.1	8.1	8.2	8.1	10.9	9.5	6 481
South-South	8.1	10.1	11.8	11.9	9.9	10.6	7 637
South West	19.2	11.4	12.7	12.6	11.6	12.6	9 092
Total	3106	3761	17 920	20 100	21 792	666,79	66 679

na, not available.

ordinal exposure variable.³⁶ The χ^2 analysis of trend and Rao-Scot χ^2 ,^{37 38} were used to determine if there are any significant changes or not at alpha (α)=0.05. We found no difference between the conclusions from the χ^2 for trend and the Rao-Scot χ^2 . MDA was employed to decompose changes in SBA use between 2003 and 2018. The MDA presents an opportunity to decompose what contributes to changes over two time points or among two mutually exclusive groups. We excluded 1990 from the MDA and considered 2003–2018, to allow full comparison across the current 36 states in Nigeria. In the MDA, respondents' SBA use is the response variable with outcomes in 2003 as one 'group' and 2018 as another 'group' while predictor effects were partitioned into differences in characteristics or endowment and differences in the effects or coefficients in the regression decomposition.³⁹ This is to identify the root of the changes in the utilisation of SBA in the last one and half decades (2003–2018) and evaluate how SBA use responds to changes in women characteristics. Data management and analysis were conducted using Stata V.16.0. Survey design was considered in the analysis due to sample disproportionality and was managed by probability weights. Hence, we applied the sample weight (SW) using the weighting factors included in the NDHS data and adjusted for the complex survey design (that incorporate the sample weighting, clustering, and stratification) through the 'svy' analysis on Stata to account for unequal population sizes. Test of statistical significance was carried out at 5% level of significance (95% confidence level) in all the statistical analysis. We computed and applied the year-women weight (YWW) to the analysis to reflect the differences in population sizes of the women in each survey year. The YWW is the product of SW (provided in the NDHS data) and year-specific weight (YSW). We computed the YSW as the number of sampled women aged 15–49 years divided by the population of women aged 15–49 years for each year as earlier reported.⁴⁰ We controlled for multicollinearity using the 'colin' command in Stata and the variance inflation factor (VIF) was evaluated. The mean VIF was 1.97.

The MDA

MDA technique is useful in decomposing changes or group differences in statistics such as; mean, proportion, and count in linear, logit and count multivariate models into characteristic and coefficient functions, respectively.⁴¹ The approach is an improvement of the Oaxaca-Blinder decomposition.^{42 43} It has been extended to non-linear models including logit and probit models.^{44 45} The main purpose of MDA is to determine explanatory variables attributed to changing composition or effects, especially in trends spanning overtime to explain the root cause of those changes.^{46–48} In this study, the options offered in multivariate decomposition were applied to construct a normalised decomposition towards limiting the bias associated with the choice of reference categories (the identification problem). MDA automatically determine the high-outcome group (SBA used) and reference

Table 2 Trends and prevalence of SBA use by background characteristics of mothers

Characteristics	1990	2003	2008	2013	2018	All	1990–2003	2003–2008	2008–2013	2013–2018	1990–2018	2003–2018	Trend test (χ^2 , p value)*
Respondent's current age													
15–24	28.7	31.8	27.3	29.9	34.8	30.7	10.8	-14.2	9.5	16.4	21.3	9.4	4.2; 0.040
25–34	33.9	40.5	38.0	39.4	45.4	40.6	19.5	-6.2	3.7	15.2	33.9	12.1	62.4; 0.000
35–49	32.2	40.1	33.5	38.3	44.1	38.7	24.5	-16.5	14.3	15.1	37.0	10.0	39.1; 0.000
Highest educational level													
No education	15.9	14.6	11.1	11.5	14.5	12.8	-8.2	-24.0	3.6	26.1	-8.8	-0.7	22.4; 0.000
Primary	50.4	45.7	39.3	39.7	45.4	42.4	-9.3	-14.0	1.0	14.4	-9.9	-0.7	55.1; 0.000
Secondary+	79.4	75.5	69.1	70.5	72.0	71.3	-4.9	-8.5	2.0	2.1	-9.3	-4.6	3.6; 0.056
Husband/partner's education level													
No education	12.4	14.4	10.4	10.0	12.0	11.1	16.1	-27.8	-3.8	20.0	-3.2	-16.7	20.1; 0.000
Primary	48.9	38.5	37.4	37.9	43.5	40.3	-21.3	-2.9	1.3	14.8	-11.0	13.0	32.5; 0.000
Secondary+	63.1	61.2	57.7	60.1	63.3	60.9	-3.0	-5.7	4.2	5.3	0.3	3.4	8.6; 0.003
Rural/place of residence													
Urban	59.8	58.4	60.7	65.2	65.3	63.4	-2.3	3.9	7.4	0.2	9.2	11.8	53.2; 0.000
Rural	19.2	26.9	24.2	22.6	30.2	25.4	40.1	-10.0	-6.6	33.6	57.3	12.3	39.9; 0.000
Employment status													
Employed	38.7	42.7	39.1	40.6	47.7	42.5	10.3	-8.4	3.8	17.5	23.3	11.7	53.6; 0.000
Unemployed	20.0	29.3	24.6	27.8	31.1	27.5	46.5	-16.0	13.0	11.9	55.5	6.1	27.0; 0.000
Paternal employment status													
Employed	31.5	37.0	33.9	36.1	42.2	37.1	17.5	-8.4	6.5	16.9	34.0	14.1	78.1; 0.000
Unemployed	59.7	42.9	26.1	54.5	29.3	36.3	-16.3	-42.3	108.8	-46.2	-45.7	-35.2	78.2; 0.000
Sex of household head													
Male	30.6	35.7	32.6	34.4	40.6	35.7	16.7	-8.7	5.5	18.0	32.7	13.7	90.7; 0.000
Female	52.6	58.8	45.8	54.5	58.1	53.6	11.8	-22.1	19.0	6.6	10.5	-1.2	2.0; 0.157
Marital status													
Never married	63.4	68.9	40.4	46.6	54.1	49.4	9.3	-41.7	15.3	16.1	-14.7	-21.9	5.4; 0.020
Currently married	31.4	36.8	33.6	36.2	41.8	37.0	17.2	-8.7	7.7	15.5	33.1	13.6	103.9; 0.000
Formerly	41.4	43.5	38.0	43.1	49.8	44.0	5.1	-12.6	13.4	15.5	20.3	14.5	6.1; 0.013
Media access													
No	na	23.2	16.9	20.2	28.5	22.7	Na	-27.2	19.5	41.1	na	22.8	183.7; 0.000
Yes	na	47.6	48.6	56.1	63.1	55.1	Na	2.1	15.4	12.5	na	32.6	23.6; 0.000
Wealth index													
Poorest	11.1	13.4	7.8	5.5	11.4	8.8	20.7	-41.8	-29.5	107.3	2.7	-14.9	11.6; 0.001
Poorer	14.8	23.1	17.2	16.5	24.2	19.3	56.1	-25.5	-4.1	46.7	63.5	4.8	7.2; 0.007

Continued

Table 2 Continued

Characteristics	1990	2003	2008	2013	2018	All	1990-2003	2003-2008	2008-2013	2013-2018	1990-2018	2003-2018	Trend test (χ^2 , p value)*
Middle	22.5	32.5	34.2	38.1	47.1	39.1	45.1	5.2	11.4	23.6	110.3	44.9	169.1; 0.000
Richer	39.3	51.2	58.5	59.0	66.1	59.3	30.3	14.3	0.9	12.0	68.2	29.1	191.9; 0.000
Richest	70.0	81.5	81.9	82.6	84.9	81.6	16.4	0.5	0.9	2.8	21.3	4.2	72.7; 0.000
No of antenatal visits during pregnancy													
None	2.1	4.0	4.0	4.1	7.4	4.7	90.5	0.0	2.5	80.5	252.4	85.0	1.07; 0.300
Inadequate	27.8	28.9	29.2	26.0	28.6	28.0	4.0	1.0	-11.0	10.0	2.9	-1.0	0.1; 0.833
Adequate	57.6	62.6	58.6	60.3	61.8	60.3	8.7	-6.4	2.9	2.5	7.3	-1.3	7.6; 0.006
Religion													
Islam	17.5	22.5	19.7	21.4	26.0	22.3	28.6	-12.4	8.6	21.5	48.6	15.6	60.2; 0.000
Christian	56.5	63.4	53.4	59.8	66.2	60.0	12.2	-15.8	12.0	10.7	17.2	4.4	19.5; 0.000
Others	18.5	19.2	18.1	24.3	25.2	20.8	3.8	-5.7	34.3	3.7	36.2	31.3	1.5; 0.225
Tribe													
Hausa/Fulani	na	13.1	9.7	12.5	17.9	13.7	Na	-26.0	28.9	43.2	na	36.6	61.1; 0.000
Yoruba	na	77.5	74.7	81.4	82.0	79.4	Na	-3.6	9.0	0.7	na	5.8	7.3; 0.007
Igbo	na	75.8	71.3	79.3	82.3	78.3	Na	-5.9	11.2	3.8	na	8.6	41.5; 0.000
Others	na	41.3	34.6	37.8	43.9	39.0	Na	-16.2	9.2	16.1	na	6.3	0.8; 0.372
A person who usually decides on respondent's healthcare													
Respondent	na	57.4	53.2	62.9	57.0	57.3	Na	-7.3	18.2	-9.4	na	-0.7	1.5; 0.218
Both	na	61.1	46.6	55.3	59.3	54.2	Na	-23.7	18.7	7.2	na	-2.9	10.4; 0.001
Spouse alone	na	30.1	23.7	24.6	30.2	26.6	Na	-21.3	3.8	22.8	na	0.3	1.2; 0.268
Getting medical help for self: distance to a health facility													
No problem	na	44.7	41.1	44.9	47.9	45.0	Na	-8.1	9.2	6.7	na	7.2	40.0; 0.000
Big problem	na	18.7	23.6	19.6	29.8	24.1	Na	26.2	-16.9	52.0	na	59.4	11.9; 0.001
Getting medical help for self: getting permission to go													
No_problem	na	41.2	36.8	39.5	44.5	40.6	Na	-10.7	7.3	12.7	na	8.0	27.7; 0.000
Big_problem	na	9.8	18.8	15.6	27.4	20.2	Na	91.8	-17.0	75.6	na	179.6	38.9; 0.000
Wanted the last-child													
Wanted then	30.8	35.3	32.9	35.1	40.5	35.9	14.6	-6.8	6.7	15.4	31.5	14.7	87.0; 0.000
Wanted later	37.8	48.4	42.5	50.6	56.5	49.9	28.0	-12.2	19.1	11.7	49.5	16.7	65.9; 0.000
Wanted no more	49.8	59.2	47.0	58.2	55.9	53.1	18.9	-20.6	23.8	-4.0	12.2	-5.6	9.0; 0.003
Family mobility													
No	29.0	34.6	28.3	na	38.4	33.6	19.3	-18.2	-100.0	na	32.4	11.0	134.3; 0.000
Yes	56.2	50.6	50.2	na	63.0	55.4	-10.0	-0.8	-100.0	na	12.1	24.5	7.01; 0.008

Continued

Table 2 Continued

Characteristics	1990	2003	2008	2013	2018	All	1990–2003	2003–2008	2008–2013	2013–2018	1990–2018	2003–2018	Trend test (χ^2 , p value)*
Has health insurance													
No	na	na	33.2	35.8	41.6	37.1	Na	na	7.8	16.2	na	na	287.6; 0.000
Yes	na	na	87.6	85.5	76.7	82.0	Na	na	-2.4	-10.3	na	na	15.6; 0.000
Birth order													
1	37.9	48.7	41.9	46.2	52.4	46.6	28.5	-14.0	10.3	13.4	38.3	7.6	24.6; 0.000
2	32.3	41.2	40.3	42.8	48.6	43.3	27.6	-2.2	6.2	13.6	50.5	18.0	59.6; 0.000
3	28.6	38.7	38.3	40.3	48.8	41.7	35.3	-1.0	5.2	21.1	70.6	26.1	74.2; 0.000
4	31.7	39.1	35.8	39.0	44.1	39.3	23.3	-8.4	8.9	13.1	39.1	12.8	22.6; 0.000
5	30.8	30.6	25.4	27.4	31.7	28.6	-0.6	-17.0	7.9	15.7	2.9	3.6	1.17; 0.279
Preceding birth interval													
First birth	37.9	48.7	41.9	46.2	52.4	46.6	28.5	-14.0	10.3	13.4	38.3	7.6	24.6; 0.000
<36 months	32.2	32.8	32.1	33.1	38.8	34.6	1.9	-2.1	3.1	17.2	20.5	18.3	33.2; 0.000
36+ months	28.6	38.8	32.4	36.3	42.2	36.7	35.7	-16.5	12.0	16.3	47.6	8.8	48.1; 0.000
% rural proportion													
Low rural prop	na	71.5	69.5	74.5	75.6	73.3	Na	-2.8	7.2	1.5	na	5.7	19.6; 0.000
High rural prop	na	25.5	20.6	22.9	29.3	24.6	Na	-19.2	11.2	27.9	na	14.9	18.8; 0.000
Community poverty rate													
Low	40.3	28.3	34.6	48.6	47.6	43.3	-29.8	22.3	40.5	-2.1	18.1	68.2	241.4; 0.000
High	20.5	45.7	33.4	29.1	34.0	32.0	122.9	-26.9	-12.9	16.8	65.9	-25.6	28.9; 0.000
Community illiteracy rate													
Low	44.0	28.3	32.6	52.0	45.8	43.1	-35.7	15.2	59.5	-11.9	4.1	61.8	103.8; 0.000
High	26.7	46.1	35.1	26.9	35.6	32.2	72.7	-23.9	-23.4	32.3	33.3	-22.8	132.8; 0.000
Community unemployment rate													
Low	39.6	34.5	36.6	35.7	40.3	38.2	-12.9	6.1	-2.5	12.9	1.8	16.8	39.0; 0.000
High	28.0	38.8	32.1	37.3	47.9	36.9	38.6	-17.3	16.2	28.4	71.1	23.5	20.5; 0.000
Community media access													
High	na	29.0	32.5	51.5	46.7	43.1	Na	12.1	58.5	-9.3	na	61.0	169.2; 0.000
Low	na	45.5	35.0	28.7	36.5	33.6	Na	-23.1	-18.0	27.2	na	-19.8	293.5; 0.000
Community Disadvantage													
Least	65.7	55.7	67.9	79.9	72.2	72.4	-14.5	20.8	17.7	-9.6	9.9	28.5	6.2; 0.013
2	27.5	52.5	54.2	58.3	39.7	48.0	90.9	3.2	7.6	-31.9	44.4	-24.4	9.1; 0.003
3	10.4	36.8	30.8	40.0	28.8	32.2	253.8	-16.3	29.9	-28.0	176.9	-21.7	22.4; 0.000
4	17.9	37.5	20.4	20.9	30.5	24.5	109.5	-45.6	2.5	45.9	70.4	-18.7	55.3; 0.000
Most	8.7	26.4	12.0	7.7	19.1	12.6	203.4	-54.5	-35.8	148.1	119.5	-27.7	201.9; 0.000

Continued

Table 2 Continued

Characteristics	1990	2003	2008	2013	2018	All	1990–2003	2003–2008	2008–2013	2013–2018	1990–2018	2003–2018	Trend test (χ^2 , p value)*
Region													
North Central	36.9	47.1	40.0	51.1	53.2	47.5	27.6	-15.1	27.8	4.1	44.2	13.0	32.6; 0.000
North East	14.8	19.6	15.6	18.2	22.6	18.9	32.4	-20.4	16.7	24.2	52.7	15.3	8.2; 0.004
North West	5.7	15.6	9.2	12.1	16.7	12.6	173.7	-41.0	31.5	38.0	193.0	7.1	50.5; 0.000
South East	54.5	75.4	68.1	78.5	80.7	74.6	38.3	-9.7	15.3	2.8	48.1	7.0	134.3; 0.000
South-South	41.7	59.6	48.6	46.1	54.2	49.5	42.9	-18.5	-5.1	17.6	30.0	-9.1	1.4; 0.242
South West	71.6	76.6	73.8	76.5	81.1	76.5	7.0	-3.7	3.7	6.0	13.3	5.9	14.9; 0.000
Total	32.0	37.9	33.9	36.6	42.4	37.5	18.4	-10.6	8.0	15.8	32.5	11.9	39.43; 0.000

All percentages calculated as [(b-a)/a * 100].

*Trend test of proportions across the survey year. na, not available; SBA, skilled birth attendants.

the low-outcome group (SBA not used) in the analysis of group variables (dummy) which was set for ANOVA normalisation, such that the coefficients of the multivariate (logistic) regression for all the level of the categories approximately sum to zero.³⁹ The decomposition or standardisation of the difference in the first moment (1. e proportion using SBA) was based on logit model and is thus a function of a linear combination of the predictors and the regression (logistic) coefficients and can be in general, additively decomposed into:

$$Y = F(X\beta) \quad (1)$$

$$Y_P - Y_{1-P} = F(X_P\beta_P) - F(X_{1-P}\beta_{1-P}) \quad (2)$$

$$Y_P - Y_{1-P} \equiv \{F(X_P\beta_P) - F(X_{1-P}\beta_P)\} + \{F(X_{1-P}\beta_P) - F(X_{1-P}\beta_{1-P})\} \quad (3)$$

Where Y is the n x 1 vector of the dependent variable $0 \leq p \leq 1$, X is the n x k matrices of the independent variables and β is the k x 1 vector of the regression coefficients in (1). The difference in the proportion of respondents using and not using SBA was decomposed in (2). In (3) the component $\{F(X_P\beta_P) - F(X_{1-P}\beta_P)\}$ refers to the differential attributable to differences in characteristics or endowment (explained component) while $\{F(X_{1-P}\beta_P) - F(X_{1-P}\beta_{1-P})\}$ refers to the differential attributable to differences in coefficients or effects (unexplained component). Y_P denotes the proportion of mothers who used SBA (comparison group) while subscript denotes the proportion of mothers who did not utilise SBA (reference group).

RESULTS

Characteristics of the studied women population

Table 1 shows the distribution of the sampled women. Nearly half (46.8%) of the respondents were aged 25–34 years. Around two-thirds of women have no education in the 1990 survey and it reduced to 44.3% in the 2018 survey. The proportion of partners without formal education decreased from 55.2% to 36.1% from the 1990 to 2018 surveys respectively. In all, about two-thirds (68.1%) of respondents reside in rural areas. Similarly, two-thirds (66.9%) of respondents were employed at the time of all the surveys. Most (94.2%) of respondents lives with a sexual partner over the five-survey period and the highest decline was between 1990 (95.9%) and 2003 (93.4%). Two-fifths (60.7%) of women have access to media in the 2003 survey but it declined to 40.3% in 2018. Also, most (47.7%) of respondents have less than 36 months' birth interval. Low or high community poverty, illiteracy level, unemployment and media assessment were different among women.

Trends and bivariate analysis of SBA utilisation in Nigeria

Table 2 shows the prevalence, percentage change, and significance in the trend in SBA use by maternal characteristics over the study periods. The overall weighted prevalence of SBA use in 1990, 2003, 2008, 2013 and 2018 were 32.0%, 37.9%, 33.9%, 36.6% and 42.4%, respectively. The

use of SBA increased by 18.4% between 1990 and 2003, decreased by 10.6% between 2003 and 2008, increased again by 8.0% between 2008 and 2013, and further by 15.8% between 2013 and 2018. In all, SBA use increased by 33% between 1990 and 2018 compared with only 12% between 2003 and 2018. These changes were significant over the studied period. Trends in SBA use were significant with all women characteristics considered.

Major significant changes were observed across maternal characteristics such as; respondent age, partner's educational level, place of residence, mobility and birth interval, marital and socioeconomic status among other factors presented in [table 2](#). There is a significant trend in SBA use over the intervals in all the geopolitical zone except in the south-south. Similarly, there was a significant trend in SBA use when both respondent and spouse decide on respondent healthcare and insignificant when either respondent or spouse decides alone. Also, there are significant trends in SBA use when mother's ANC visits are adequate.

Subnational analysis of SBA use across states

[Table 3](#) shows the prevalence and trend of SBA use in the states of Nigeria. Overall, the highest SBA use was in Osun (90.2%), Imo (87.3%) and Abia (84.1%) while the lowest use of SBA was in Kebbi (6.0%), Zamfara (6.5%) and Sokoto (6.6%). Between 2003 and 2018, SBA use reduced by 39.8% in Yobe, 34.4% in Niger, and 33.7% in Borno but increased by 2188.9% in Jigawa, 627.3% in Zamfara, and 3148% in Sokoto. There was no appreciable change in Lagos, Kebbi, Abia and Imo over the period.

Multivariate decomposition of SBA used from 2003 to 2018

The decomposition of the change in SBA utilisation between 2003 and 2018 revealed that 11.5% of the overall percentage change can be attributed to differences in characteristics effects (explained/endowment component) while the remaining 88.5% is due to differences in coefficient effects (unexplained/coefficient component). In general, increase in SBA use from 2003 to 2018 is more attributed to the difference in characteristics effect (behavioural changes) than the changes in compositional factors among women respondents. However, the most significant contributions to change in SBA utilisation based on the compositional factors, was observed in who decides on women healthcare utilisation. Compared with the utilisation when spouses alone made the decisions, there was a 61.3% increment in SBA utilisation between 2003 and 2018 when such decisions were made by the respondents alone. Also, residing in the states with a high rural population percentage contributed 88% to changes in the utilisation of SBA as shown in [table 4](#). Women and partners' educational levels however contributed significant change to SBA use through primary and secondary/tertiary attainment respectively. While the SBA use was reduced by the educational attainment of the respondents, it nonetheless increased with higher educational attainment among the spouses. Though at a

low proportion, maternal age and religion also contributed significantly to the positive change in SBA use.

Based on the coefficient effect, a significant impact on the observed positive change in SBA use was also observed when household heads are males. Factors including partner's education and distance to healthcare providers also showed a significant effect on the positive change in SBA use ([table 4](#)).

State-level decomposition analysis

In all, there were significant increments in SBA use between 2003 and 2018 in FCT, Jigawa, Sokoto, Zamfara, Ekiti, Ogun, Benue, Ondo, Enugu, Nasarawa and Bauchi states. There was a significant decrease in SBA use between 2003 and 2018 in Yobe, Borno and Niger states. Other states had insignificant changes over the period. Due to insufficient sample sizes, FCT, Jigawa, Sokoto and Zamfara states with a significant increase in SBA utilisation were excluded from the state-level decomposition analysis.

Decomposition analysis of factors associated with increase in SBA use among states

As shown in [figure 2](#), the contributors to the increased changes in SBA use are mostly household wealth index, neighbourhood SES disadvantage, tribe, decision-takers on women healthcare utilisation and women educational attainment. The household wealth index contributed mostly to the increment recorded between 2003 and 2018 in SBA use with 93% in Ogun and 55% in Enugu, 27% in Ondo and 16% in Nasarawa. This was followed by neighbourhood SES disadvantage which contributed 58% to the increments in Ogun, 38% in Ondo, 27% in Benue and 25% in Ekiti.

Decomposition analysis of factors associated with decreased in SBA use among states

The decomposition analysis of the factors contributing to the reduction in SBA use between 2003 and 2018 is shown in [figure 3](#). In Yobe, differences in household wealth index contributed mostly (79%) to the changes in SBA use followed by whether or not the pregnancy was wanted as of the time of its conception (14%). Having problem with distance to healthcare centres was the greatest contributor to the reduction in SBA use during the period (29.2%), followed by the place of residence (19%), having a problem getting permission to go to healthcare (17%) in Niger and the person who decide healthcare utilisation (13%) while ANC use (54%) and media access (17%) were the greatest contributors to the differences in SBA use in Borno.

DISCUSSION

The integral focus of this study is to evaluate levels, trends and identify factors that drive the changes in SBA use over the years. We applied MDA to assess the contributions of the key factors to the changes in SBAs utilisation over time.

Table 3 Prevalence of SBA use by the states of residence of the participants

State of residence	Trend test (χ^2 , p value)													
	1990	2003	2008	2013	2018	All	1990–2003	2003–2008	2008–2013	2013–2018	1990–2018	2003–2018	2003–2018	2003–2018
Abia	na	94.0	73.5	78.8	94.4	84.1	na	-21.8	7.2	19.8	na	na	0.4	19.51, p<0.001
Adamawa	22.9	31.6	14.7	33.2	38.3	28.7	38.0	-53.5	125.9	15.4	67.2	67.2	21.2	1.11,0.302
Akwa Ibom	45.6	48.5	39.4	42.6	37.3	40.8	6.4	-18.8	8.1	-12.4	-18.2	-18.2	-23.1	1.71,0.196
Anambra	41.0	96.1	92.8	91.1	89.8	80.9	134.4	-3.4	-1.8	-1.4	119.0	119.0	-6.6	1.05,0.305
Bauchi	5.7	11.3	12.9	15.9	23.2	16.4	98.2	14.2	23.3	45.9	307.0	307.0	105.3	22.31,p<0.001
Bayelsa	na	23.3	17.3	21.5	24.3	21.1	na	-25.8	24.3	13.0	na	na	4.3	0.88,0.347
Benue	45.7	55.3	48.5	58.6	65.5	56.0	21.0	-12.3	20.8	11.8	43.3	43.3	18.4	3.02,0.083
Borno	15.1	33.2	15.0	21.4	22.0	19.9	119.9	-54.8	42.7	2.8	45.7	45.7	-33.7	29.76,p<0.001
Cross River	19.7	45.5	39.7	36.6	51.3	40.8	131.0	-12.7	-7.8	40.2	160.4	160.4	12.7	2.54,0.110
Delta	na	72.2	58.1	58.0	61.0	59.8	na	-19.5	-0.2	5.2	na	na	-15.5	4.99,0.025
Ebonyi	na	36.5	42.4	55.9	46.6	47.7	na	16.2	31.8	-16.6	na	na	27.7	1.01,0.314
Edo	62.9	69.3	77.8	76.9	88.5	78.1	10.2	12.3	-1.2	15.1	40.7	40.7	27.7	0.66, 0.414
Ekiti	na	67.2	79.3	80.8	80.6	79.8	na	18.0	1.9	-0.2	na	na	19.9	5.34,0.021
Enugu	na	81.0	55.5	84.5	92.0	79.8	na	-31.5	52.3	8.9	na	na	13.6	38.18,0.000
FCT-Abuja	83.3	27.6	64.2	64.3	69.7	65.8	-66.9	132.6	0.2	8.4	-16.3	-16.3	152.5	21.75,0.000
Gombe	na	22.7	15.5	16.0	17.3	16.6	na	-31.7	3.2	8.1	na	na	-23.8	1.24,0.264
Imo	66.9	93.2	92.3	93.3	93.6	87.3	39.3	-1.0	1.1	0.3	39.9	39.9	0.4	0.31,0.576
Jigawa	na	0.9	5.0	9.5	20.6	11.7	na	455.6	90.0	116.8	na	na	2188.9	48.56,0.000
Kaduna	15.4	24.4	21.7	31.5	26.5	25.1	58.4	-11.1	45.2	-15.9	72.1	72.1	8.6	0.31,0.572
Kano	5.2	26.6	14.5	16.3	21.1	16.6	411.5	-45.5	12.4	29.4	305.8	305.8	-20.7	2.33,0.126
Katsina	3.5	19.2	5.1	7.6	19.6	10.9	448.6	-73.4	49.0	157.9	460.0	460.0	2.1	0.59,0.439
Kebbi	na	3.8	6.3	8.5	3.8	6.0	Na	65.8	34.9	-55.3	na	na	0.0	0.02,0.881
Kogi	na	77.1	64.2	71.0	70.0	69.0	Na	-16.7	10.6	-1.4	na	na	-9.2	0.99,0.318
Kwara	53.1	72.1	48.1	73.7	58.8	60.6	35.8	-33.3	53.2	-20.2	10.7	10.7	-18.4	0.63,0.426
Lagos	73.9	81.1	80.2	82.6	79.9	79.2	9.7	-1.1	3.0	-3.3	8.1	8.1	-1.5	0.04,0.484
Nasarawa	na	27.7	31.4	45.0	57.1	44.5	na	13.4	43.3	26.9	na	na	106.1	25.68,0.000
Niger	27.7	36.0	17.0	25.0	23.6	22.9	30.0	-52.8	47.1	-5.6	-14.8	-14.8	-34.4	7.74,0.005
Ogun	72.0	61.4	65.5	86.2	77.3	75.4	-14.7	6.7	31.6	-10.3	7.4	7.4	25.9	17.52,0.000
Ondo	57.2	68.0	50.5	55.7	82.2	62.7	18.9	-25.7	10.3	47.6	43.7	43.7	20.9	1.03,0.309
Osun	na	86.5	88.9	88.9	93.2	90.2	na	2.8	0.0	4.8	na	na	7.7	0.74,0.388
Oyo	72.0	77.7	73.9	67.8	75.5	72.5	7.9	-4.9	-8.3	11.4	4.9	4.9	-2.8	0.86,0.352
Plateau	19.2	42.9	27.9	40.0	44.2	35.3	123.4	-35.0	43.4	10.5	130.2	130.2	3.0	6.11,0.013

Continued

Table 3 Continued

State of residence	1990	2003	2008	2013	2018	All	1990–2003	2003–2008	2008–2013	2013–2018	1990–2018	2003–2018	Trend test (χ^2 , p value)	
													2003–2018	2003–2018
Rivers	28.7	63.4	61.5	51.7	67.4	58.0	120.9	-3.0	-15.9	30.4	134.8	6.3	0.53,0.463	
Sokoto	0.7	2.7	5.7	6.2	11.2	6.6	285.7	111.1	8.8	80.6	1500.0	314.8	1.47,0.225	
Taraba	na	19.8	25.4	15.0	25.0	21.4	na	28.3	-40.9	66.7	na	26.3	0.75,0.386	
Yobe	na	22.6	10.2	12.2	13.6	12.6	na	-54.9	19.6	11.5	na	-39.8	4.01,0.045	
Zamfara	na	1.1	5.7	6.4	8.0	6.5	na	418.2	12.3	25.0	na	627.3	4.07,0.043	
Total	32.0	37.9	33.9	36.6	42.4	37.5	18.4	-10.6	8.0	15.8	32.5	11.9	39.43,0.000	

FCT, Federal Capital Territory; na, not available; SBA, skilled birth attendants.

Two-fifths of women used SBA in the last three decades in Nigeria. We found that SBA use has increased generally by 33% between 1990 and 2018, but the increase was not steady during the earlier part of the interval. However, a percentage increase of 12% in SBA use was observed between 2003 and 2018. It is worth noting that a 16% increase in SBA use was recorded in the last 5 years of the interval studied compared with only 6% upward trends between 2003 and 2013 reported in a previous study in Nigeria.⁴ The increase can be credited to various capacity-building programmes and government involvement in healthcare funding as well as the support of non-governmental organisation that have hitherto strengthened the community healthcare system and enhanced women empowerment schemes.^{9 49} Nonetheless, the overall 12% increase in SBA use between 2003 and 2018 translated to less than 1% increment every year. At this rate, efforts modelled towards the realisation of SDG will be weakened and Nigeria may not achieve the SDG goal on health for all.

The factors contributing to SBA use over the studied period include demographic/cultural/societal factors, perceived health benefits, corporal convenience, and economic factors. Nonetheless, trends in SBA use were insignificant among women from female-headed households but significant in male-headed households. This was in agreement with the findings of a study in northern Nigeria²⁷ but in consonance with another study in southern Nigeria.¹⁴

Similarly, trends in SBA use were insignificant at higher birth orders but significant for lower birth orders. Trends in SBA use was also significant among women with adequate ANC visit and when both respondent and spouse decide on the woman's healthcare. The relationship between women's ANC and SBA utilisation has been documented.⁷ Whereas, an insignificant trend was found when women's ANC visit is inadequate and when a spouse decides on healthcare alone. All regions other than south-south, other tribes apart from Hausa/Fulani, Igbo and Yoruba and other religions apart from Islam and Christianity did not have significant linear trends in SBA changes.

We employed the MDA to determine the contribution of individual women characteristics marked in the bivariate analysis of changes in the SBA use. Over 1/10th, (11.5%) of the changes in SBA use was due to characteristics component while nearly 9/10th (88.5%) of those changes in SBA use were attributed to coefficient effect component, which implies that policies that strengthens SBA use in addition to quality childbirth services could ultimately increase SBA use by nearly nine times more than relying on the basic existing healthcare system function. The major compositional contributor to changes in SBA utilisation was among the women who make decisions about respondents' healthcare utilisation as it contributed a substantial 61% to increment in SBA use between 2003 and 2018. This is a signal that pregnant women are in the best position to decide on their

Table 4 Decomposition of change in utilisation of SBA in Nigeria from 2003 to 2018

Characteristics	Difference due to characteristics (E)			Difference due to coefficients (C)		
	Coefficient	P value	Per cent	coefficient	P value	Per cent
Respondent's age						
15–24	Ref					
25–34	0.0000	0.037	0.1	–0.0003	0.969	–0.6
35–49	0.0006	0.008	1.3	–0.0031	0.495	–7.0
Highest educational level						
No education	Ref					
Primary	–0.0027	0.000	–6.2	–0.0015	0.641	–3.4
Secondary+	0.0097	0.000	21.9	–0.0057	0.156	–13.1
Husband/partner's education level						
No education	Ref					
Primary	–0.0027	0.004	–6.0	0.0089	0.024	20.2
Secondary+	0.0059	0.000	13.3	0.0083	0.134	18.8
Employment status						
Employed	–0.0001	0.655	–0.1	0.0080	0.624	18.2
Sex of household head						
Male	0.0000	0.525		0.0125	0.518	28.3
Media access						
No	–0.0058	0.000	–13.1	–0.0082	0.087	–18.6
Wealth index						
Poorest	–0.0014	0.000	–3.2	–0.0028	0.610	–6.3
Poorer	–0.0026	0.000	–5.9	–0.0064	0.153	–14.6
Middle	–0.0003	0.000	–0.7	–0.0002	0.958	–0.5
Richer	0.0005	0.000	1.1	–0.0010	0.765	–2.2
Richest	Ref					
No of ANC visits during pregnancy						
None (0)	Ref					
Inadequate (less than 4)	0.0050	0.000	11.5	–0.0038	0.138	–8.7
Adequate (four or more)	0.0127	0.000	28.9	–0.0127	0.126	–28.8
Religion						
Islam	Ref					
Christianity	0.0004	0.000	0.9	–0.0131	0.027	–29.7
Others	0.0006	0.042	1.4	0.0004	0.656	0.8
Tribe/Ethnic group						
Hausa/Fulani	Ref					
Yoruba	–0.0002	0.000	–0.4	–0.0010	0.691	–2.3
Igbo	0.0010	0.000	2.2	–0.0075	0.020	–17.2
Others	–0.0013	0.000	–2.9	–0.0053	0.347	–12.1
A person who usually decides on respondent's healthcare						
Spouse alone	Ref					
Both	–0.0023	0.166	–5.1	0.0007	0.756	1.5
Respondent alone	0.0008	0.538	1.8	0.0270	0.029	61.3
Distance to HC is a big problem						
Yes	–0.0006	0.023	–1.3	0.0112	0.004	25.4
Getting permission to go to HC is a big problem						

Continued



Table 4 Continued

Characteristics	Difference due to characteristics (E)			Difference due to coefficients (C)		
	Coefficient	P value	Per cent	coefficient	P value	Per cent
Yes	-0.0002	0.139	-0.4	-0.0003	0.910	-0.7
Wanted the last-child						
Wanted then	Ref					
Wanted later	0.0002	0.298	0.4	-0.0016	0.336	-3.6
Wanted no more	-0.0001	0.468	-0.2	-0.0007	0.528	-1.5
Family mobility						
Mobile (<5 years)	-0.0017	0.000	-3.9	0.0042	0.149	9.5
Birth Interval						
First birth	Ref					
<36 months	-0.0006	0.000	-1.3	0.0109	0.185	24.7
36+ months	0.0001	0.001	0.2	0.0048	0.466	10.9
Place of residence						
Rural	-0.0001	0.002	-0.3	0.0004	0.962	0.9
States rural population percentage						
Low	Ref					
High	0.0009	0.000	2.0	-0.0388	0.002	-88.1
Community socioeconomic status disadvantage						
Least disadvantage	-0.0105	0.000	-23.9	0.0007	0.425	1.5
Less disadvantage	0.0002	0.481	0.4	-0.0019	0.637	-4.4
Disadvantage	0.0005	0.639	1.2	-0.0026	0.619	-5.9
More disadvantage	-0.0008	0.080	-1.9	0.0063	0.111	14.3
Most disadvantage	Ref					
Constant				0.0534	0.244	121.3
E	0.0051	0.138	11.5	0.0390	0.000	88.5
R	-0.0529	0.000				

ANC, antenatal care; HC, healthcare; SBA, skilled birth attendants.

healthcare utilisation. Whether distance to healthcare was a big problem for the respondents or not also contributed to the explained changes in SBA use. Women's use of SBAs was not motivated by long-distance healthcare facilities. On the contrary, the closeness of health facilities, especially, the facilities with SBA have increased SBA use over the studied periods. This finding corroborates the outcomes of earlier studies which reported that long distances prevent the use of SBA in Ogun state Nigeria and healthcare distance is a determinant of SBA use in northern Ghana.^{14 20} This positive development could be attributed to an upsurge in the number of health facilities in Nigeria over the years. The increase in the number of health facilities could have reduced distances travelled to access skill delivery services. Unsurprisingly, residing in states with high rural population proportion however contributed a huge decrease to SBA use. This is due to poor household social-economic class, low patronage/lack of healthcare centres, low educational level and preference for use of traditional births attendants among

other factors associated with barriers to use of SBA among rural community dwellers.^{19 27 43}

Spouses with at least primary education contributed to change in SBA use, respondents, and spouses' educational level however both contributed significantly to changes in SBA use. Adequacy of ANC visits contributed to a positive significant change in SBA use. This is a pointer to the fact that, for SBA use, pregnant women must be enrolled and kept in the continuum of care. Even though at low proportion, religion and family mobility contributed to change in SBA use respectively. Tribe and birth order contributed both positively and negatively to the significant change in SBA use. Impact of education, ANC visit, ethnicity, and religion has also been reported as an important set of contributors to SBA use.^{4 19-22}

We further decomposed the characteristics that contribute to SBA use at the state level. The highest SBA use was found among the Southern states with at least 4 of every 5 women using an SBA during the most recent childbirth in Osun, Imo, and Abia compared with barely

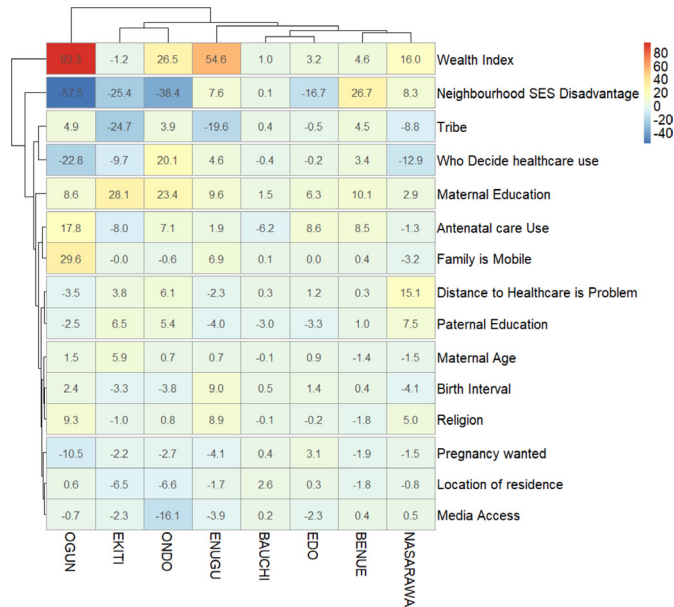


Figure 2 A decomposition analysis of factors associated with increase in SBA utilisation from 2003 to 2018 by states in Nigeria. SBA, skilled birth attendants; SES, socioeconomic status.

one SBA user in every 5 women in Kebbi, Zamfara and Sokoto. We found significant increments in SBA use in FCT, Jigawa, Sokoto, Zamfara, Ekiti, Edo, Ogun, Benue, Ondo, Enugu, Nasarawa and Bauchi states. On trends, SBA use reduced by 40% in Yobe, 34% in both Niger and Borno between 2003 and 2018. However, the greatest increment during the same period was in the north, with Jigawa recording over 2000%, Zamfara over 600% and over 300% increase in Sokoto. There was a significant decrease in SBA use between 2003 and 2018 in Yobe,

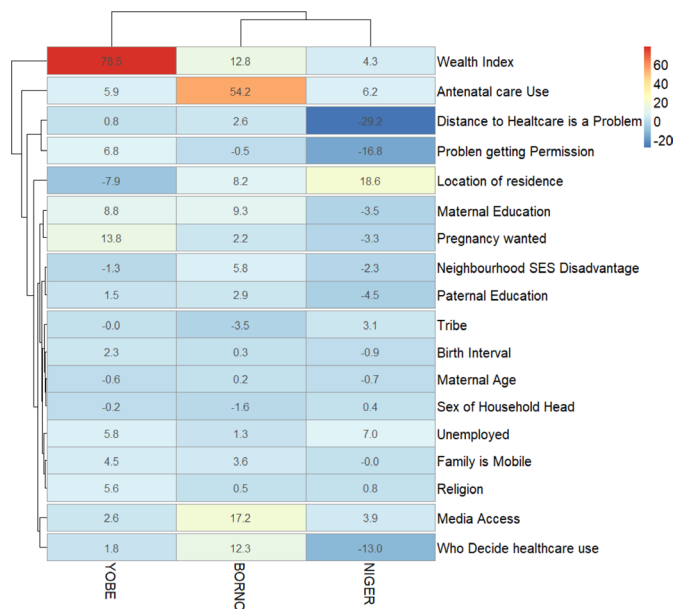


Figure 3 A decomposition analysis of factors associated with decrease in SBA utilisation from 2003 to 2018 by states in Nigeria. SBA, skilled birth attendants; SES, socioeconomic status.

Borno and Niger states. There are needs for the states with negative changes to benchmark what is been done right in the state with high prevalence, and high increase in SBA use.

Household wealth index contributed most to the rise in SBA use in Ogun, Enugu, Ondo, and Nasarawa states. Differences in community socioeconomic status disadvantage also contributed to an increase in SBA use in Ogun, Ondo, Benue and Ekiti. Fall in SBA use was however stimulated by long-distance to healthcare in Niger, tribe/ethnicity in Borno, and place of residence in Yobe states. The effect of household wealth status differences observed in our study is in agreement with the outcome of the study on the practice of SBAs in Bangladesh.⁵⁰

CONCLUSIONS

With only a 12% increment over 15 years, progress made in SBA use in Nigeria is both low and slow. Overall, nine in a tenth of the changes in SBA was due to the coefficient's component. Women's sociodemographic, health, economic and corporal factors are significantly associated with an increase and decrease in SBA use over the studied period. Women's ability to decide on their healthcare utilisation alone contributed mostly to an increase in SBA use while residing in states with a high rural population decreased SBA use most. Women/partners' education and ANC adequacy contributed to a rise in SBA use while tribe, place of residence and distance to healthcare contributed to a fall in SBA use in northern states. Household wealth however contributed to an increase in SBA use in some states.

Recommendations

Based on our findings, we recommend the implementation of interventions that could increase the use of SBAs. Our findings suggested that a multisectoral approach will yield the desired change as there are urgent needs to accelerate SBA progress towards 100% utilisation. Moreover, the northern sub nationals where poor SBA persists, need to emulate southern states on what works and what doesn't work. Maternal health programmers should rekindle their commitment towards eliminating barriers to SBA use and adopt interventions focusing on strengthening the capacity of women in healthcare autonomy and education. There is also a need for healthcare capacity development to increase access to trained and qualified SBAs and other professional health workers especially in rural communities. Further study on contextual analysis of respondents and spouse decision making regarding the use of SBA is essential to the development of interventional strategies.

Acknowledgements The authors thank the ICF for granting access to the dataset. [Dataset] 44. 1990-2018 data from; National Population Commission (NPC) [Nigeria] and ICF International, DHS Data Repository dhsprogram.com "Nigeria Demographic and Health Survey 2018," Abuja, Nigeria, And Rockville, Maryland, USA, 2019.

Contributors AFF conceptualised the study, designed the study, AFF and OKO analysed the data, provided the visualisations and wrote the results. OKO

searched for the literatures. All authors contributed to the literature review, data interpretation, writing of the manuscript and abstract. All authors read, scrutinised and approved the final version of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Map disclaimer The inclusion of any map (including the depiction of any boundaries therein), or of any geographic or locational reference, does not imply the expression of any opinion whatsoever on the part of BMJ concerning the legal status of any country, territory, jurisdiction or area or of its authorities. Any such expression remains solely that of the relevant source and is not endorsed by BMJ. Maps are provided without any warranty of any kind, either express or implied.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by ICF Institutional Review Board with ref Number FWA000008450 and ID number 144644. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data are available on reasonable request. The anonymised data are available in the public domain. The data supporting this article is available on request at www.dhsprogram.com. Extra data are available by emailing Bridgette Wellington (thedhsprogram@gmail.com) the Data Archivist.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Adeniyi Francis Fagbamigbe <http://orcid.org/0000-0001-9184-8258>

Oyewole Kazeem Oyedele <http://orcid.org/0000-0003-4275-8111>

REFERENCES

- Tey N-P, Lai S-li. Correlates of and barriers to the utilization of health services for delivery in South Asia and sub-Saharan Africa. *ScientificWorldJournal* 2013;2013:1–11.
- WHO. Who recommendation on antenatal care for a positive pregnancy experience 2016.
- Afulani PA, Moyer C. Explaining disparities in use of skilled birth attendants in developing countries: a new conceptual framework. *Ann Glob Health* 2016;82:375.
- Fagbamigbe AF, Hurricane-Ike EO, Yusuf OB, *et al.* Trends and drivers of skilled birth attendant use in Nigeria (1990-2013): policy implications for child and maternal health. *Int J Womens Health* 2017;9:843–53.
- Fapohunda B, Orobato N. Factors influencing the selection of delivery with no one present in northern Nigeria: implications for policy and programs. *Int J Womens Health* 2014;6:171–83.
- Austin A, Fapohunda B, Langer A, *et al.* Trends in delivery with no one present in Nigeria between 2003 and 2013. *Int J Womens Health* 2015;7:345–56.
- Olakunde BO, Adeyinka DA, Mavegam BO, *et al.* Factors associated with skilled attendants at birth among married adolescent girls in Nigeria: evidence from the multiple indicator cluster survey, 2016/2017. *Int Health* 2019;11:545–50.
- WHO. Trends in maternal mortality 2000 to 2017: estimates by who, UNICEF, UNFPA, world bank group and the United nations population division: Executive summary, 2019. Available: <https://apps.who.int/iris/handle/10665/327596>
- United Nations. *Sustainable development goals (SDG)*. Washington, DC, 2015.
- National Population Commission(NPC)[Nigeria] and ICF International. *Nigeria Demographic and Health Survey 2018* 2019.
- National Population Commission(NPC)[Nigeria] and ICF International. *Nigeria Demographic Health Survey, 2013* Abuja, 2014.
- Akinyemi JO, Afolabi RF, Awolude OA. Patterns and determinants of dropout from maternity care continuum in Nigeria. *BMC Pregnancy Childbirth* 2016;16:282.
- Chukwuma A, Wosu AC, Mbachu C, *et al.* Quality of antenatal care predicts retention in skilled birth attendance: a multilevel analysis of 28 African countries. *BMC Pregnancy Childbirth* 2017;17:152.
- Olowokere AE, Oyedele AT, Komolafe AO, *et al.* Birth preparedness, utilization of skilled birth attendants and delivery outcomes among pregnant women in Ogun state, Nigeria. *Eur J Midwifery* 2020;4:22.
- Graham WJ, Hussein J. Universal reporting of maternal mortality: an achievable goal? *International Journal of Gynecology & Obstetrics* 2006;94:234–42.
- Gabrysch S, Campbell OMR. Still too far to walk: literature review of the determinants of delivery service use. *BMC Pregnancy Childbirth* 2009;9:34.
- Kyei NNA, Campbell OMR, Gabrysch S. The influence of distance and level of service provision on antenatal care use in rural Zambia. *PLoS One* 2012;7:e46475.
- Fapohunda BM, Orobato NG. When women deliver with no one present in Nigeria: who, what, where and so what? *PLoS One* 2013;8:e69569.
- Manyeh AK, Akpakli DE, Kukula V, *et al.* Socio-Demographic determinants of skilled birth attendant at delivery in rural southern Ghana. *BMC Res Notes* 2017;10:268.
- Dickson KS, Amu H. Determinants of skilled birth attendance in the Northern parts of Ghana. *Adv Public Health* 2017;2017:1–8.
- Yaya S, Bishwajit G, Ekholuenetale M, *et al.* Factors associated with maternal utilization of health facilities for delivery in Ethiopia. *Int Health* 2018;10:310–7.
- Negero MG, Mitike YB, Worku AG, *et al.* Skilled delivery service utilization and its association with the establishment of women's health development Army in Yeky district, South West Ethiopia: a multilevel analysis. *BMC Res Notes* 2018;11:83.
- Fagbamigbe AF, Idemudia ES. Barriers to antenatal care use in Nigeria: evidences from non-users and implications for maternal health programming. *BMC Pregnancy Childbirth* 2015;15:1–10.
- Fagbamigbe AF, Idemudia ES. Wealth and antenatal care utilization in Nigeria: policy implications. *Health Care Women Int* 2017;38:17–37.
- Fagbamigbe AF, Olaseinde O, Sethlare V. Sub-national analysis and determinants of numbers of antenatal care contacts in Nigeria: assessing the compliance with the who recommended standard guidelines. *BMC Pregnancy Childbirth* 2021;21:1–20.
- Oyedele OK, Fagbamigbe AF, Ayeni O. Modelling time-to-discontinuation of exclusive breastfeeding: analysis of infants and under-2 survival in Nigeria. *Etude la Popul. Africaine* 2020;34.
- Adeiwemimo AW, Msuya SE, Olaniyan CT, *et al.* Utilisation of skilled birth attendance in northern Nigeria: a cross-sectional survey. *Midwifery* 2014;30:e7–13.
- National Population Commission(NPC)[Nigeria] & ICF International. Nigeria Demographic and Health Survey. In: *DHS measure macro, New York and Nigeria population Commission*. Abuja, Nigeria, 2008.
- von Elm E, Altman DG, Egger M, *et al.* The strengthening of reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med* 2007;4:e296–7.
- Idowu A, Olowookere SA, Abiola OO, *et al.* Determinants of skilled care utilization among pregnant women residents in an urban community in Kwara state, northcentral Nigeria. *Ethiop J Health Sci* 2017;27:291–8.
- Adedokun ST, Uthman OA. Women who have not utilized health service for delivery in Nigeria: who are they and where do they live? *BMC Pregnancy Childbirth* 2019;19:1–14.
- Shivalli S, Kaup S. Comment on "The Prevalence of Skilled Birth Attendant Utilization and Its Correlates in North West Ethiopia". *Biomed Res Int* 2015;2015:1–2.
- Ameayek EK, Dickson KS. Skilled birth attendance in Sierra Leone, niger, and Mali: analysis of demographic and health surveys. *BMC Public Health* 2020;20:1–10.
- Fagbamigbe AF, Bello S, Salawu MM, *et al.* Trend and decomposition analysis of risk factors of childbirths with no one present in Nigeria, 1990–2018. *BMJ Open* 2021;11:e054328–2018.
- Ryvicker M. A conceptual framework for examining healthcare access and navigation: a behavioral-ecological perspective. *Soc Theory Health* 2018;16:224–40.
- Koletsis D, Pandis N. The chi-square test for trend. *Am J Orthod Dentofacial Orthop* 2016;150:1066–7.
- Rao JNK, Thomas DR. Analysis of categorical response data from complex surveys: an appraisal and update. *Anal. Surv. Data* 2003;1989:85–108.

- 38 Skinner CJ, Skinner C. Analysis of categorical data for complex surveys article (accepted version) (Refereed) analysis of categorical data for complex surveys 2018.
- 39 Powers DA, Yoshioka H, Yun M-S. mvdcmp: multivariate decomposition for nonlinear response models. *Stata J* 2011;11:556–76.
- 40 UN Department of Economics and Social Affairs. World Population Prospects - Population Division - United Nations. *The International Journal of Logistics Management* 2015;9:1–13 <https://esa.un.org/unpd/wpp/>
- 41 Powers DA, Yoshioka H, Yun M-S. Mvdcmp: multivariate decomposition for nonlinear response models. *Stata J* 2011;11:556–76.
- 42 Blinder AS. Wage discrimination: reduced form and structural estimates. *J Hum Resour* 1973;8:436–55.
- 43 Oaxaca R. Male-Female wage differentials in urban labor markets. *Int Econ Rev* 1973;14:14:693–709.
- 44 Pritchett J, Yun M-S. The in-hospital mortality rates of slaves and freemen: evidence from Touro Infirmary, new Orleans, Louisiana, 1855–1860. *Explor Econ Hist* 2009;46:241–52.
- 45 Bowblis JR, Yun M-S. Racial and ethnic disparities in the use of drug therapy. *Soc Sci Res* 2010;39:674–84.
- 46 Pillai V, Teboh C. A decade of contraceptive use in Cameroon: influences of structural changes. *Open Access J. Contracept* 2010;2:5–11.
- 47 Worku AG, Tessema GA, Zeleke AA. Trends of modern contraceptive use among young married women based on the 2000, 2005, and 2011 Ethiopian demographic and health surveys: a multivariate decomposition analysis. *PLoS One* 2015;10:e0116525–14.
- 48 Muhoza DN, Rutayisire PC, Umubyeyi A. Measuring the success of family planning initiatives in Rwanda: a multivariate decomposition analysis. *J Popul Res* 2016;33:361–77.
- 49 NPHCDA. Minimum standards for primary health care in Nigeria. *Production of department of planning, research and statistics*, Port-Harcourt Crescent, Garki II, Abuja, 2012.
- 50 Kibria GMA, Burrowes V, Choudhury A, *et al*. A comparison of practices, distributions and determinants of birth attendance in two divisions with highest and lowest skilled delivery attendance in Bangladesh. *BMC Pregnancy Childbirth* 2018;18:122.