Article

Cesarean delivery in Nigeria: prevalence and associated factors—a population-based cross-sectional study

Adewuyi, EO, Auta, Asa, Khanal, V, Tapshak, S and Zhao, Y

Available at http://clok.uclan.ac.uk/29028/

Adewuyi, EO, Auta, Asa ORCID: 0000-0001-6515-5802, Khanal, V, Tapshak, S and Zhao, Y (2019) Cesarean delivery in Nigeria: prevalence and associated factors—a population-based cross-sectional study. BMJ Open, 9.

It is advisable to refer to the publisher’s version if you intend to cite from the work.
http://dx.doi.org/10.1136/bmjopen-2018-027273

For more information about UCLan’s research in this area go to http://www.uclan.ac.uk/researchgroups/ and search for <name of research Group>.

For information about Research generally at UCLan please go to http://www.uclan.ac.uk/research/

All outputs in CLoK are protected by Intellectual Property Rights law, including Copyright law. Copyright, IPR and Moral Rights for the works on this site are retained by the individual authors and/or other copyright owners. Terms and conditions for use of this material are defined in the http://clok.uclan.ac.uk/policies/
Cesarean delivery in Nigeria: prevalence and associated factors—a population-based cross-sectional study

Emmanuel O Adewuyi, Asa Auta, Vishnu Khanal, Samson J Tapshak, Yun Zhao

ABSTRACT

Objective To investigate the prevalence and factors associated with caesarean delivery in Nigeria.

Design This is a secondary analysis of the nationally representative 2013 Nigeria Demographic and Health Survey (NDHS) data. We carried out frequency tabulation, \( \chi^2 \) test, simple logistic regression and multivariable binary logistic regression analyses to achieve the study objective.

Setting Nigeria.

Participants A total of 3171 most recent live deliveries for women aged 15–49 years (mother–child pair) in the 5 years preceding the 2013 NDHS was included in this study.

Outcome measure Caesarean mode of delivery.

Results The prevalence of caesarean section (CS) was 2.1% (95% CI 1.8 to 2.3) in Nigeria. At the region level, the South-West had the highest prevalence of 4.7%. Factors associated with increased odds of CS were urban residence (adjusted OR (AOR): 1.51, 95% CI 1.15 to 1.97), maternal age ≥35 years (AOR: 2.12, 95% CI 1.08 to 4.11), large birth size (AOR: 1.39, 95% CI 1.10 to 1.74) and multiple births (AOR: 4.96, 95% CI 2.84 to 8.62).

Conclusions The prevalence of CS was low, indicating unmet needs in the use of caesarean delivery in Nigeria. Rural–urban, regional and socioeconomic differences were observed, suggesting inequitable access to the obstetric surgery. Intervention efforts need to prioritise women living in rural areas, the North-East and the North-West regions, as well as women of the Islamic faith.

BACKGROUND

Caesarean section (CS) is a life-saving obstetric surgery, which may be necessitated (sometimes the only feasible option) in high-risk pregnancies such as those with multiple/large fetuses, breech presentations, obstructed labour, as well as in women with transmissible infections such as HIV/AIDS. The adequate population-based prevalence for this essential obstetric intervention remains a subject of strong contentions, worldwide, revealing a lack of consensus. However, evidence suggests that a population-based CS prevalence ≤5% indicates unmet needs (lack of access to women in need of it), while prevalence >15% may show no additional benefit for mothers and babies.

In 1985, the WHO recommended CS rates—as a percentage of live births—between 10% and 15% as the optimal range, with a declaration that “there is no justification for caesarean section rates in any region to be higher than 10%–15%.” This position has been contested given the data on which the recommendation was based were limited and drawn primarily from northern European countries. In a more recent position statement, the WHO maintains that population-based CS rates >10% are not associated with a reduction in maternal and neonatal mortality rates. Nonetheless, the world health body emphasises the need of CS service provision to every woman in need of it regardless of the prevailing population-based
Caesarean delivery is over-utilised in many middle-income to high-income countries. For instance, the rate is as high as 25.9% in China, 32.3% in Australia/New Zealand and 45.9% in Brazil. It has been argued that many of the caesarean deliveries in these countries were in excess, medically unjustifiable and thus unnecessary. However, in several low-income countries, where over 60% of the world’s births occur, the population-based prevalence of CS is low—for example, 3.0% in West Africa. This low prevalence may reflect poor availability of accessibility to comprehensive essential obstetric care services (EOC) in the countries/region. Comprehensive EOC refers to a package of clinical services for managing pregnancy/childbirth-related complications of which CS is a critical component.

Available evidence pertaining to the population-based prevalence of CS in Nigeria reveals a threshold, that is, far below the 10% recommended by the WHO. Moreover, there has been no significant increase in the population-based CS rates for several years in the country. For instance, in 2008, merely 2% of births were delivered through CS in Nigeria, and the rate remained unchanged in 2013. This prevalence is substantially lower than for many African countries including Ghana (12.80% in 2014), Lesotho (9.70% in 2014) and Uganda (5.22% in 2011). The considerably low population-based prevalence of CS in Nigeria suggests unmet needs which may contribute to poor maternal and neonatal outcomes in the country. Consistent with this premise, Nigeria currently accounts for the highest absolute number of maternal mortality and the second highest number of neonatal mortality in the world. Hence, the importance of investigating factors associated with the utilisation of this life-saving obstetric surgery in the country.

Some studies have been conducted on CS utilisation in Nigeria including a survey which examined the views of pregnant women and found that a high proportion of the study participants were averse to caesarean delivery. A significant association between CS and parity, maternal weight, child’s birth weight and previous CS were reported in another study. However, studies to date are institutional-based and limited by small sample sizes. Nationally representative studies on this crucial subject are necessary in the country. The present study, thus, assesses the prevalence and factors associated with CS utilisation in Nigeria. Findings will provide evidence-informed knowledge for decision-making on the provision and utilisation of caesarean delivery in Nigeria.

METHODS

Data source

The data analysed in this study were sourced from the 2013 Nigeria Demographic and Health Survey (NDHS), a nationally representative cross-sectional survey implemented in Nigeria by the National Population Commission. The data are available online at https://www.dhsprogram.com/data/available-datasets.cfm. The 2013 survey is the latest in the series of NDHS in Nigeria (at the time of this study), and its implementation was supported by many international partners, including technical assistance from the inner city fund through the Measure Demographic and Health Survey programme. A stratified three-stage cluster sampling was used in the design of the survey with a total of 904 clusters and 40,320 representative households selected for interviews. Interviewer-administered structured questionnaires were used for data collection from women aged 15–49 years who had resided in the selected households for at least a night before the survey.

Sample size

Of the total number of representative households selected for the survey (40,320), only 38,904 were occupied at field work time of which 38,522 were interviewed successfully giving a household response rate of 99%. At the individual level, a total of 39,902 women aged 15–49 years were eligible for the survey, 38,948 of whom were interviewed yielding an eligible women’s response rate of 97.6%. The number of the most recent live deliveries within 5 years preceding the 2013 NDHS was 31,828. Of this, a total of 31,171 mother–child pair had complete information on the mode of delivery and those were included in the present study. We restricted our samples to the most recent live births to reduce possible chances of recall bias. Also, all births, both singleton and multiple, were included to enable us to assess the relationship between CS and ‘birth types’. Whether singleton or multiple births, each of the most recent live deliveries contributed only one case (observation) for analysis. A comprehensive report on the sampling procedure and settings for 2013 NDHS has previously been published.

Variables

Dependent variable

CS was the main outcome of interest in this study. All caesarean deliveries were assessed as, due to non-availability of information in the 2013 NDHS, it was not possible to segregate data on the types of CS. To be used in the multiple binary logistic regression analysis, the responses to the question on the mode of delivery collected in the 2013 NDHS were coded ‘0’ for non-CS and ‘1’ for CS. This outcome variable was assessed against all the explanatory variables.
Independent (explanatory) variables

Explanatory variables were selected according to the objective of this study, and the review of published studies with consideration for the availability/completeness of information in the 2013 NDHS. The variables were grouped into four—socioeconomic, biodemographic, health-seeking/support and sociocultural factors. Socioeconomic factors comprised of wealth index, a proxy for socioeconomic status, which was categorized as poor=poorest and poorer, middle=middle and rich=richer and richest. Other socioeconomic factors assessed included maternal and husband/partner’s education level (none, primary and secondary/higher), as well as maternal and husband/partner’s working status (working and not working).

Biodemographic factors consisted of residence (rural and urban), maternal age (<20, 20–34 and ≥ 35 years), preceding birth interval (<24 and ≥24 months), types of birth (single and multiple), birth size—a proxy for birth weight (large, average and small) and birth order (1, 2–3 and ≥4). Birth size represents the perception of mothers on the size of their babies at birth as captured in the 2013 NDHS. In line with practice in previous studies, the variable was used as a substitute for birth weight in the present study given that substantial information on birth weight was missing in the NDHS data. This substitutionary use is, however, justifiable as evidence indicates that mean birth weight values are closely related to birth size estimates.

Other biodemographic factors were maternal marital status (never married nor cohabited, formerly married/cohabited (divorced, widowed, separated), currently married/cohabiting), religion (Christianity, Islam, traditional/other), maternal body mass index (obese, overweight, normal and underweight—according to the WHO international classification) and region of residence (North-Central, North-East, North-West, South-South and South-West). Health-seeking/support factors were antenatal visit (none, 1–3 and ≥4), health insurance coverage (yes, no), place of delivery (private facility, public facility and home) and distance to a health facility (‘not a big problem’ and ‘a big problem’). We assess female genital cutting (yes, no) as a sociocultural factor.

Data analysis

Frequency tabulation and χ² test were used to summarise the sample characteristics and describe the prevalence of caesarean delivery. To examine the unadjusted association between caesarean delivery and all the explanatory variables, we conducted a simple logistic regression analysis. Factors associated with caesarean delivery were identified using multivariable logistic regression analysis. Variables were selected for inclusion in the multivariable logistic regression model if they satisfied the criterion of p<0.05 in the simple logistic regression analysis. A stepwise backward elimination method was used in obtaining the parsimonious model. Significant factors in the final multivariable logistic regression model were reported using adjusted odds ratio (AOR) along with their 95% CI and p values.

All statistical analyses were carried out using SPSS V.21, and missing data were excluded. To adjust for the sampling weights and the multistage cluster design of the 2013 NDHS, all analyses were performed using the complex sample statistics of SPSS. This statistical method incorporates the sample design and selection probability into data analysis, thereby providing more statistically reliable estimates.

Patient and public involvement

This study was carried out using existing, completely anonymised data. Being a secondary data analysis, there was no involvement of patients in the study. The design and execution of the survey itself (NDHS 2013) involved data collection from respondents and relevant stakeholders (government and non-government organisations) participated in the implementation of the survey.

RESULTS

Sample characteristics

Table 1 describes the characteristics of the study participants as well as the prevalence of caesarean delivery in Nigeria. A total of 31 171 deliveries (mother–child pair) in the 5 years before the 2013 NDHS was included in this study. Almost two-thirds of the deliveries occurred in rural areas, and one-third occurred in the North-West region. The South-East region had the lowest proportion of deliveries (~9%). Close to 50% of deliveries were to women in poor wealth index category. The proportion of women with female genital cutting was 32%. Access to health insurance coverage was considerably low (1.5%). Notably, nearly half of all the deliveries occurred in women who had no education and only approximately half of the women achieved the recommended antenatal attendance of at least four times. The vast majority (95.8%) were married or at least cohabiting with a partner; and, ~70% of them were working. Public health facilities (22.6%) had a greater proportion of deliveries than private facilities (12.9%), nonetheless, most of the deliveries (64.5%) occurred at home.

Prevalence of caesarean delivery

Out of the total number of deliveries, 639 were through CS, representing a prevalence of 2.1% (95% CI 1.8 to 2.3) (table 1). The highest prevalence of caesarean delivery was observed among women who had access to health insurance (10%), followed by those who delivered in private health facilities (7.2%), women who were obese (6.9%) and those who had multiple births (6.4%). CS prevalence was comparatively higher in women who had acquired at least a secondary level of education (4.8%), and in rich households (4.5%). Women in Christian religion (4.1%) or residing in the South-West region (4.7%) or who had attended at least four antenatal care sessions...
Table 1  Sample characteristics and prevalence of caesarean delivery in Nigeria, NDHS 2013

| Factors                          | n (%)† | Prevalence of CS % (95% CI) | P value |
|----------------------------------|--------|-----------------------------|---------|
| Mode of delivery                 |        |                             | <0.001**|
| Caesarean section                | 659    | 2.1 (1.8 to 2.3)            |         |
| Vaginal delivery                 | 30512  | 97.9 (97.7 to 98.2)         |         |
| Socioeconomic factors            |        |                             | <0.001**|
| Maternal education level         |        |                             |         |
| Secondary/higher                | 10109  | 4.8 (4.2 to 5.6)            |         |
| Primary                          | 6364   | 1.6 (1.3 to 2.1)            |         |
| None                             | 14698  | 0.5 (0.3 to 0.6)            |         |
| Maternal working status          |        |                             | < 0.001**|
| Working                          | 21474  | 2.3 (2.0 to 2.6)            |         |
| Not working                      | 9562   | 1.4 (1.1 to 1.8)            |         |
| Husband/partner education level  |        |                             | <0.001**|
| Secondary/higher                | 12778  | 4.0 (3.4 to 4.6)            |         |
| Primary                          | 5936   | 1.2 (0.9 to 1.7)            |         |
| None                             | 11565  | 0.4 (0.3 to 0.6)            |         |
| Husband/partner working status   |        |                             | 0.527    |
| Not working                      | 271    | 2.7 (1.1 to 6.9)            |         |
| Working                          | 30116  | 2.0 (1.8 to 2.3)            |         |
| Wealth index                     |        |                             | <0.001**|
| Rich                             | 10548  | 4.5 (3.9 to 5.2)            |         |
| Middle                           | 6215   | 1.3 (1.0 to 1.7)            |         |
| Poor                             | 14408  | 0.6 (0.5 to 0.8)            |         |
| Bio-demographic factors          |        |                             | 0.213    |
| Maternal marital status          |        |                             |         |
| Never married nor cohabited      | 599    | 3.1 (1.8 to 5.0)            | 0.213    |
| Formerly married/cohabited       | 880    | 2.7 (1.5 to 4.6)            |         |
| Currently married/cohabiting     | 29692  | 2.0 (1.8 to 2.3)            |         |
| Maternal age                     |        |                             | <0.001**|
| 35 or more years                 | 8114   | 2.8 (2.3 to 3.4)            |         |
| 20–34 years                      | 21537  | 1.8 (1.6 to 2.1)            |         |
| <20 years                        | 1520   | 1.5 (0.9 to 2.3)            |         |
| Maternal religion                |        |                             | <0.001**|
| Christianity                     | 12469  | 4.1 (3.5 to 4.7)            |         |
| Traditional/other               | 470    | 1.4 (0.4 to 4.6)            |         |
| Islam                            | 18232  | 0.9 (0.7 to 1.1)            |         |
| Birth order                      |        |                             | < 0.001**|
| 1                                | 6014   | 3.6 (3.1 to 4.2)            |         |
| 2-3                              | 9944   | 2.2 (1.8 to 2.7)            |         |
| 4 or more                        | 15213  | 1.3 (1.1 to 1.6)            |         |
| Birth size                       |        |                             | <0.001**|
| Large                            | 13441  | 2.6 (2.2 to 3.1)            |         |
| Average                          | 12573  | 1.8 (1.5 to 2.1)            |         |
| Small                            | 4556   | 1.3 (1.0 to 1.2)            |         |
| Birth interval (preceding)       |        |                             | 0.156    |
| <24 months                       | 5777   | 1.4 (1.0 to 1.9)            |         |
| 24 or more months                | 19309  | 1.7 (1.5 to 2.0)            |         |
| Birth type                       |        |                             | <0.001**|
| Multiple                         | 1092   | 6.4 (4.2 to 9.5)            |         |
| Single                           | 30079  | 1.9 (1.7 to 2.2)            |         |
| Region of residence              |        |                             | <0.001**|

Continued
(3.9%) or living in urban areas (4%) had a comparatively higher prevalence of caesarean delivery. Conversely, the lowest prevalence of caesarean delivery was observed among women professing Islam (0.6%), or in poor households (0.6%), or whose husband had no education (0.4%) or did not attend antenatal care at all (0.4%) or were not educated (0.5%). Women residing in rural areas (figure 1), as well as the North-West and North-East regions (figure 2), had a substantially lower prevalence of CS at 1%, 0.6% and 0.9%, respectively. Significantly lower prevalence of CS was recorded among women who had genital cutting (1.6%) compared with their counterparts who did not (2.3%, p=0.011).

### Table 1

| Factors                        | n (%)† | Prevalence of CS (% (95% CI)) | P value |
|--------------------------------|--------|-------------------------------|---------|
| North-Central                  | 4576 (13.7) | 2.3 (1.8 to 3.1) |         |
| North-East                     | 6493 (17.6) | 0.9 (0.7 to 1.3) |         |
| North-West                     | 9838 (37.2) | 0.6 (0.4 to 0.9) |         |
| South-East                     | 2794 (9.0)  | 3.9 (3.1 to 4.8) |         |
| South-South                    | 3720 (9.2)  | 4.1 (2.8 to 5.9) |         |
| South-West                     | 3750 (13.3) | 4.7 (3.8 to 5.7) |         |
| Maternal body mass index (BMI) |         | <0.001**                     |         |
| Obese (>30.0)                  | 2469 (8.0)  | 6.9 (5.4 to 8.7)       |         |
| Overweight (25.0–29.9)         | 5627 (17.6) | 3.4 (2.8 to 4.2)       |         |
| Underweight (<18.5)           | 2654 (8.3)  | 0.7 (0.4 to 1.1)       |         |
| Normal weight (18.5–24.9)      | 20421 (66.2) | 1.3 (1.1 to 1.5)     |         |
| Rural – urban residence        |         | <0.001**                     |         |
| Rural                          | 21009 (65.4) | 1.0 (0.8 to 1.2) |         |
| Urban                          | 10162 (34.6) | 4.0 (3.4 to 4.7) |         |
| Health-seeking/support factors |         | <0.001**                     |         |
| Antenatal visit                |         | <0.001**                     |         |
| None                           | 2476 (12.5)  | 1.2 (0.8 to 1.8) |         |
| 1–3                            | 10397 (52.2) | 3.9 (3.5 to 4.4) |         |
| 4 or more                      |         |                               |         |
| Health insurance               |         | <0.001**                     |         |
| Yes                            | 532 (1.5)  | 10.0 (7.2 to 13.6) |         |
| No                             | 30520 (98.5) | 1.9 (1.7 to 2.2) |         |
| Place of delivery              |         | <0.001**                     |         |
| Private health facility        | 3774 (12.9)  | 7.2 (6.1 to 8.4) |         |
| Public health facility         | 7427 (22.6)  | 5.1 (4.4 to 5.9) |         |
| Home                           | 19619 (64.5) | 0.0               |         |
| Distance to health facility    |         | <0.001**                     |         |
| Not a big problem              | 21054 (68.0) | 2.6 (2.3 to 3.0) |         |
| A big problem                  | 9994 (32.0)  | 0.9 (0.7 to 1.2) |         |
| Socio-ccultural factor         |         | 0.011*                      |         |
| Female genital cutting         |         |                               |         |
| Yes                            | 6015 (32.0)  | 1.6 (1.3 to 2.1) |         |
| No                             | 12716 (68.0) | 2.3 (2.0 to 2.7) |         |

*Significant at 5% level, **significant at 1% level, n=sample size (unweighted).
†Weighted percentage for the multistage sampling probability.
NDHS, Nigeria Demographic and Health Survey.

Factors associated with caesarean delivery in Nigeria

Table 2 presents the results of both the unadjusted and the adjusted associations between caesarean delivery and independent variables. Based on the outcome of the multivariable analysis, women whose husbands had obtained at least a secondary education had approximately two times increased odds of delivering their babies through a CS compared with those whose husband had no education (adjusted OR (AOR): 2.07, 95% CI 1.29 to 3.33). Similarly, the odds of CS were over twofold higher for maternal age ≥35 years compared with maternal age <20 years (AOR: 2.12, 95% CI 1.08 to 4.11). Approximately twofold increased odds of CS were recorded among women professing Christianity...
Figure 1  Prevalence of caesarean section by rural–urban residence in Nigeria.

Figure 2  Prevalence of caesarean section by region of residence in Nigeria.
Table 2  Factors associated with caesarean delivery in Nigeria, 2013 NDHS

| Factors                        | Unadjusted OR | Adjusted OR |
|--------------------------------|---------------|-------------|
|                                | OR 95% CI     | P value     | OR 95% CI     | P value     |
| Socio economic factors         |               |             |               |             |
| Maternal education level       |               |             |               |             |
| Secondary/higher              | 10.82         | 7.63 to 15.33 | < 0.001 * *  | 2.07         | 1.29 to 3.33 | 0.002 **     |
| Primary                        | 3.52          | 2.383 to 5.23 | < 0.001 * *  | 1.08         | 0.62 to 1.83 | 0.781        |
| None                           | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Maternal working status        |               |             |               |             |
| Working                        | 1.65          | 1.25 to 2.19 | < 0.001 **   |              |              |             |
| Not working                    | 1.00 (Reference) |            |             |              | (Reference)  |             |
| Husband/partner education level|               |             |               |             |
| Secondary/higher              | 9.34          | 6.19 to 14.05 | < 0.001 **   | 2.07         | 1.29 to 3.33 | 0.002 **     |
| Primary                        | 2.80          | 1.71 to 4.54 | < 0.001 **   | 1.08         | 0.62 to 1.83 | 0.781        |
| None                           | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Husband/partner working status |               |             |               |             |
| Not working                    | 1.37          | 0.52 to 3.61 | 0.529        |              |              |             |
| Working                        | 1.00 (Reference) |            |             |              | (Reference)  |             |
| Wealth index                   |               |             |               |             |
| Rich                           | 7.65          | 5.67 to 10.36 | < 0.001 **   |              |              |             |
| Middle                         | 2.12          | 1.46 to 3.10 | < 0.001 **   |              |              |             |
| Poor                           | 1.00 (Reference) |            |             |              | (Reference)  |             |
| Bio demographic factors        |               |             |               |             |
| Maternal marital status        |               |             |               |             |
| Never married nor cohabited    | 1.52          | 0.88 to 2.62 | 0.120        |              |              |             |
| Formerly married/cohabited     | 1.34          | 0.75 to 2.35 | 0.308        |              |              |             |
| Currently married/cohabiting   | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Maternal age                   |               |             | < 0.001 **   | < 0.001 **   |
| 35 or more years               | 1.91          | 1.14 to 3.25 | 0.15*        | 2.12         | 1.08 to 4.11 | 0.026*       |
| 20–34 years                    | 1.24          | 0.75 to 2.05 | 0.372        | 1.07         | 0.62 to 1.89 | 0.778        |
| <20 years                      | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Maternal religion              |               |             | < 0.001 **   | < 0.001 **   |
| Christianity                   | 4.65          | 3.56 to 6.04 | < 0.001 **   | 2.06         | 1.58 to 2.68 | < 0.001 **   |
| Traditional/other              | 1.51          | 0.41 to 5.47 | 0.520        | 2.07         | 0.55 to 7.91 | 0.281        |
| Islam                          | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Birth order                    |               |             | < 0.001 **   | < 0.001 **   |
| 1                              | 2.81          | 2.21 to 3.62 | < 0.001 **   | 3.86         | 2.66 to 5.56 | < 0.001 **   |
| 2–3                            | 1.71          | 1.30 to 2.23 | < 0.001 **   | 1.85         | 1.31 to 2.60 | 0.001 **     |
| 4 or more                      | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Birth interval (preceding)     |               |             | 0.157        |              |              |             |
| <24 months                     | 0.77          | 0.56 to 1.10 | 0.157        |              |              |             |
| 24 or more months              | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Birth size                     |               |             | < 0.001 **   |              |              | 0.013*       |
| Large                          | 1.48          | 1.22 to 1.84 | < 0.001 **   | 1.39         | 1.10 to 1.74 | 0.006**      |
| Small                          | 0.73          | 0.51 to 1.05 | 0.105        | 1.07         | 0.69 to 1.66 | 0.726        |
| Average                        | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Birth type                     |               |             | < 0.001 **   | < 0.001 **   |
| Multiple                       | 3.51          | 2.21 to 5.56 | < 0.001 **   | 4.96         | 2.84 to 8.62 | < 0.001 **   |
| Single                         | 1.00 (Reference) |            |             | 1.00         | (Reference)  |             |
| Region of residence            |               |             |             |             |

Continued
compared with those in Islam (AOR: 2.06, 95% CI 1.58 to 2.68). Compared with the ‘birth order ≥4’, the odds of CS for ‘birth order 1’ and ‘birth order 2–3’ were 3.9 times (AOR: 3.86, 95% CI 2.66 to 5.56) and 1.9 times (AOR: 1.85, 95% CI 1.31 to 2.60) higher, respectively. Large birth size was associated with 39% increased odds of CS compared with average birth size (AOR: 1.39, 95% CI 1.10 to 1.74).

Other factors that were significantly associated with increased odds of caesarean delivery were multiple births (nearly fivefold higher than single births; AOR: 4.96, 95% CI 2.84 to 8.62), maternal overweight/obesity (overweight: AOR: 1.75, 95% CI 1.31 to 2.37; obesity: AOR: 3.16, 95% CI 2.30 to 4.32) and urban residence (51% higher than residence in rural areas; AOR: 1.51, 95% CI 1.15 to 1.97). Women who attended at least four antenatal care had 2.8 times increased odds of utilising CS compared with their counterparts who attended no antenatal care (AOR: 2.84, 95% CI 1.56 to 5.17). Furthermore, women with access to health insurance coverage had over twofold increased odds of CS than those without health insurance coverage (AOR: 2.01, 95% CI 1.37 to 2.95).

**DISCUSSION**

We determined the national prevalence of CS to be 2.1% in Nigeria which indicates under-utilisation of the service in the country. Factors associated with low prevalence and
decreased odds of CS include residence in rural areas, lack of antenatal attendance, affiliation with Islamic religion, lack of health insurance coverage, lack of husband/partner’s formal education and birth order ≥4. Maternal age ≥35 years, large birth size, multiple births and maternal overweight/obesity were similarly associated with higher prevalence and increased odds of CS. Previous studies have reported a much higher prevalence than the 2.1%, ranging from 11.3% in the North-West to 18.8% in the South-East and 40.1% in the South-West regions in Nigeria.32 33 However, all these studies were institutional-based; and, do not give a true reflection of the prevalence of CS at the population level in Nigeria. Health facilities, particularly, tertiary and regional healthcare centres in Nigeria, where some of the studies were conducted, receive a greater proportion of high-risk patients and would more likely perform a greater number of caesarean deliveries.

A range of factors may explain the low prevalence of CS found in the present study. First, is limited access to and availability of obstetric care services in Nigeria. The WHO’s guideline recommends at least five EOC facilities per 500 000 people, one of which should be capable of providing comprehensive EOC services, and, these need to be evenly spread in the population.5 This level of facility and service coverage has yet to be realised in Nigeria.32 33 Available evidence indicates that facilities and expertise for EOC are inadequate and/or sparsely distributed in the country.32-34 Access to facilities could be poor, coverage low and the needed manpower for anaesthesia and caesarean delivery may be lacking/insufficient in many facilities.35 Second, is the challenge of low acceptance of CS among women in Nigeria, blameable on fear of death, concern about complications, the negative perception of CS as an abnormal mode of delivery and the high cost of the surgery in the country.19

Following the multivariable analysis, the odds of caesarean delivery were 50% higher in urban compared with rural residence, and this may be due to the urban advantage in access to obstetric care services in Nigeria.34 Caesarean delivery is one of the nine life-saving signals that constitute comprehensive EOC,5 36 and studies agree on the poorer coverage/availability of services in rural Nigeria.32 33 For example, in Abia state, South-East Nigeria, only ~19% of the health facilities surveyed met the requirements for EOC services and 77% of those were sited in urban centres.34 A similar finding has been reported in other parts of the country.32 33 Findings in a nationwide study further indicate that EOC services are inadequate in rural Nigeria.35 Promoting equitable access to quality and accessible obstetric services including CS should indeed be the focus of future interventions and women in rural Nigeria need to be especially prioritised.

Previous studies have shown disparities in the use of CS between the poor and the rich3 38 and, factors related to financial capability and access to health insurance were strongly associated with increased use of CS in this study. For instance, women with health insurance coverage had the highest prevalence of CS—10%. Also, compared with their counterparts with no health insurance coverage, women who enjoyed the facility were twice as likely to utilise caesarean delivery following adjustment for other factors/confounders. Similarly, the odds of a CS were twofold higher among women whose husband had at least a secondary school education—a possible indication of a higher socioeconomic status. These results compare well with previous findings.18 39 Considering that the cost of CS is rather high,4 and may not be within the reach of an average Nigerian family, it is likely that financial constraints contributed to the low utilisation of CS in this country. The results of our χ² and simple logistic regression analysis lend credence to this argument indicating that women in rich households had a much greater prevalence and increased odds of utilising CS compared with their counterparts in poor households.

However, wealth index did not attain statistical significance in our multivariable analysis. A follow-up analysis showed that the effect of the variable waned and disappeared following adjustment for antenatal visits and health insurance. This finding suggests that antenatal attendance and health insurance coverage may modulate the effects of socioeconomic status in respect of CS utilisation in Nigeria. Similar to the present finding, previous studies have shown that access to health insurance coverage increased the odds of healthcare facility delivery and antenatal care services utilisation in Nigeria.25 40 Hence, interventions targeted at enhanced coverage of the insurance may prove an important entry point for improved utilisation of CS and other maternal healthcare services, particularly, among the poor and underprivileged women in Nigeria.

The strong association found between antenatal attendance of at least four times and increased prevalence/odds of CS may be explained by the unique opportunity that antenatal care services offer in identifying clients with high-risk pregnancy for appropriate obstetric intervention.18 25 Antenatal services provide the best avenue for counselling and awareness creation thereby empowering pregnant women to make informed decisions in matters of their health, including, when necessary, the utilisation of CS.18 25 While the present finding underscores the relevance of antenatal care attendance to the uptake of CS, antenatal care is equally under-utilised at 46.5% in Nigeria, 61.1% in rural Nigeria and 22.4% in urban Nigeria.36 Intervention efforts aimed at improving CS utilisation, therefore, need to further prioritise antenatal care attendance among pregnant women in the country.25

Other factors, including maternal age ≥35 years, multiple births and maternal overweight/obesity, were associated with increased odds of CS and the findings are consistent with previous studies.20 41 The named factors are known risks for adverse pregnancy outcomes,20 41 and pregnant women in any of the categories are more likely to undergo a life-saving CS. The findings of a significant increase in the odds of CS among women with low parity
and those whose babies were perceived as being large have been reported in studies.\textsuperscript{20,42} Cephalopelvic disproportion commonly associated with fetal macrosomia may explain the finding in respect of large birth size.\textsuperscript{43}

Corroborating the reports of previous studies in respect of maternal healthcare services utilisation,\textsuperscript{25,40,44,45} our study reveals over four-fold higher prevalence and more than twofold increased odds of CS among Christian women compared with their Muslim counterparts. Several factors may contribute to this finding. First, preference for female healthcare providers is common among Muslim women, and, where it cannot be guaranteed, may result in low utilisation of healthcare services.\textsuperscript{25,44,45} Second, religious belief/obligation which discourages women from undue exposure of their bodies has been suggested in explaining low use of maternal healthcare services among Muslim women,\textsuperscript{44} and this may be relevant to the present finding. Another important factor, perhaps, borders on maternal autonomy, women empowerment and gender inequality as several Muslim women often need to take permission from their husbands and/or religious leaders before making health-related decisions.\textsuperscript{25,44,45}

In the Nigerian context, the present result may also relate to differences in geographic location and education level between Christian and Muslim women. For example, our descriptive statistics and simple logistic regression analysis show a significantly lower prevalence and decreased odds of a CS in northern Nigeria, where Islam is predominant and many states are educationally less-developed, compared with the southern regions.\textsuperscript{10} Notably, our follow-up analysis—cross-tabulation of maternal education level and religion (data not shown in table)—reveals that Muslim women accounted for 90.4\% of the respondents with no education compared in table)—reveals that Muslim women accounted for 90.4\% of the respondents with no education compared with 7.7\% among Christian women (p<0.001). In contrast, 71.9\% of women who had acquired secondary/higher education were Christians compared with 27.4\% among Muslim women (p<0.001).

These results suggest a possible contribution of disparities in educational attainment in the observed CS utilisation difference between Christian and Muslim women in Nigeria. In support of this position, lack of maternal and husband/partner’s education was significantly and overwhelmingly associated with low prevalence and decreased unadjusted odds of a CS. Granted that maternal education did not attain significant status in the multivariable analysis, husband/partner’s education retained its significance, underpinning its importance in the present context. Education does not only contribute to an improved socioeconomic status, it enhances skills, knowledge and confidence for appropriate healthcare services utilisation.\textsuperscript{46} Hence, when a need arises, better-educated husbands would more readily appreciate and support their wives for a life-saving caesarean delivery use.

There is consistent evidence that vaginal delivery is associated with many complications in women with FGC, which may result in an increased risk of a CS.\textsuperscript{47} Our study, however, shows that FGC was not associated with an increased prevalence or unadjusted odds of CS. A similar finding has been reported.\textsuperscript{48} Given the low CS prevalence in the present study, limited access to the obstetric surgery in Nigeria may have contributed to our findings for FGC highlighting issues related to the supply side of services.

The national representativeness of the 2013 NDHS means our findings are generalisable to all women of reproductive age in Nigeria. Low missing data, use of complex sample and high response rates are additional strengths of this study. To the best of our knowledge, the is the first population-based study to examine factors associated with CS utilisation using nationally representative data in Nigeria. Nonetheless, our findings need to be interpreted taking into consideration a few limitations. First, the data utilised were self-reported, collected retrospectively, and so liable to recall bias. Restricting our analysis to the most recent live deliveries, however, reduces the chances of this limitation. Second, given the cross-sectional design of the data analysed, causal relationships between our outcome and explanatory variables could not be ascertained. Lastly, the 2013 NDHS data are at least 3 years old and may not reflect the current state of things in Nigeria. Nevertheless, the data remain the most recent edition in the series of NDHS available at the time of this study and our findings provides a suitable comparison for future studies on this subject.

**CONCLUSIONS**

We found a considerably low prevalence of caesarean delivery in Nigeria. Rural residence, Islamic religion, lack of antenatal visit, lack of health insurance coverage, lack of husband/partner’s education and birth order ≥4 were significantly associated with lower prevalence and decreased odds of caesarean delivery. While there is justification for keeping CS rates as low as possible, this study highlights the critical need for increased provision and better utilisation of life-saving CS in Nigeria. The present prevalence suggests unmet needs which are a known risk for higher maternal and newborn mortalities. Our study reveals the need to address geographic, and socioeconomic factors associated with the low prevalence of CS in Nigeria.

A faith-based approach, as well as interventions, focused on women empowerment/maternal autonomy may prove beneficial in improving the uptake of CS, particularly, among women with Islamic affiliation in Nigeria. Improved availability and access to obstetric care services need to be further pursued by meeting the WHO’s recommendations on EOC in all the regions in Nigeria. This will entail increasing the number of comprehensive EOC facilities and promoting even distribution of same, improving staff strength and enhancing their skills as well as equipping and upgrading the existing facilities in Nigeria.

Considering that CS is costly in Nigeria, delivery services need to be made freely available or at the very least, substantially subsidised to address the challenge of
inequitable access between the rich and the poor in the country. Based on our findings, the provision of universal health insurance coverage is an important, and practical intervention in this respect. On the other hand, caesarean deliveries associated with maternal overweight and obesity are rather avoidable/preventable. A short-term to long-term intervention efforts would be to implement health promotion programmes targeted at preventing/reducing maternal overweight/obesity—known risk for CS and several chronic diseases. Future disaggregated studies are recommended for a better insight into the within-country variations in access to- and utilisation of CS in Nigeria. Also, future population-based studies need to explore the contribution of fear and cultural practices to the utilisation/non-utilisation of CS in Nigeria.

Author affiliations
1Statistical and Genomic Epidemiology Laboratory, Institute of Health and Biomedical Innovation, School of Biomedical Sciences, Faculty of Health, Queensland University of Technology, Brisbane, Queensland, Australia
2Pharmacy Department, 2 Division Hospital, Ibadan, Oyo State, Nigeria
3School of Pharmacy and Biomedical Sciences, University of Central Lancashire, Preston, UK
4Nepal Development Society, Bharatpur, Nepal
5Department of Obstetrics and Gynaecology, Chivir Specialist Hospital, and Urology Centre Ltd, Abuja, Nigeria
6Department of Epidemiology and Biostatistics, School of Public Health, Curtin University, Perth, Western Australia, Australia

Acknowledgements We gratefully acknowledge the DHS/ICF International, USA, for providing the NDHS dataset for this study. Also, we appreciate Adefemi Kazeem and Mary Adewuyi for their invaluable contribution in proofreading the original manuscript of this paper.

Contributors EOA designed the study, analysed the data and drafted the manuscript. YZ and VK contributed to the analysis and interpretation of findings. All authors contributed to the critical revision of the manuscript and agreed on the final draft.

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.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethical approval for the conduct of the 2013 NDHS was provided by the Nigerian National Health Research Ethics Committee. Participants provided written informed consent by themselves, and those who were younger than 18 years at the time of the survey had consent provided on their behalf by parents/guardians. The present study was based on a secondary analysis of the completely anonymised data from the survey; hence, no additional ethical clearance was required. Permission to use the data was obtained from the Measure DHS/ICF International, USA.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data analysed in this study are publicly and freely available on the repository of the DHS programme at https://www.dhsprogram.com/data/available-datasets.cfm. Access and permission to use the data are freely granted following online request on the DHS programme’s website (www.dhsprogram.com).

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/.

REFERENCES
1. WHO. WHO Statement on Caesarean Section Rates. Geneva: World Health Organization. Geneva 2015.
2. Gibbons L, Belizan JM, Lauer JA, et al. Inequities in the use of cesarean section deliveries in the world. Am J Obstet Gynecol 2012;206(4):310-9.
3. Baron YM. Does the 10–15% caesarean section rate threshold established by the WHO in 1985 still apply for modern obstetrics in developed countries? Eur J Obstet Gynecol Reprod Biol 2016;206:e81.
4. Gibbons L, Belizan JM, Lauer JA, et al. The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage. World health report 2010;30:1–31.
5. WHO. UNFPA, UNICEF, AMDD: Monitoring emergency obstetric care: a handbook, Geneva 2009.
6. WHO. Appropriate technology for birth. Lancet 1985;2:436–7.
7. Betran AF, Torloni MR, Zhang JJ, et al. WHO Statement on Caesarean Section Rates. BJOG 2016;123:667–70.
8. Keag OE, Norman JE, Stock SJ. Long-term risks and benefits associated with first and subsequent pregnancies: Systematic review and meta-analysis. PLoS Med 2018;15:e1002494.
9. Betran AP, Ye J, Moller AB, et al. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. PLoS One 2016;11:e0148343.
10. National Population Commission (NPC) [Nigeria] and ICF International. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria and Rockville, Maryland, USA: NPC and ICF International, 2014.
11. National Population Commission (NPC) [Nigeria] and ICF International. Nigeria Demographic and Health Survey 2008. Abuja, Nigeria and Rockville, Maryland, USA: NPC and ICF International, 2009.
12. Ghana Statistical Service (GSS) GHSS, and ICF Macro. Ghana Demographic and Health Survey 2014. Accra, Ghana: GSS, GHSS, and ICF Macro, 2015.
13. Cavallaro FL, Cresswell JA, França GV, et al. Trends in caesarean delivery by country and wealth quintile: cross-sectional surveys in southern Asia and sub-Saharan Africa. Bull World Health Organ 2013;91(12):914–22.
14. Uganda Bureau of Statistics (UBOS) and ICF International Inc. Uganda Demographic and Health Survey Kampaia, Uganda: UBOS and Calvertor. Maryland: ICF International Inc, 2011.
15. WHO, UNICEF, UNFPA, et al. United Nations Population Division. Trends in maternal mortality, 1990 to 2015. 2015;32:1–55.
16. Adewuyi EO, Zhao Y. Determinants of neonatal mortality in rural and urban Nigeria: Evidence from a population-based national survey. Pediatr Int 2017;59:190–200.
17. Adewuyi EO, Zhao Y, Lamichhane R. Risk factors for infant mortality in rural and urban Nigeria: evidence from the national household survey. Scand J Public Health 2017;45(5):543–54.
18. Chigbu CO, Ilobachi GC. The burden of caesarean section refusal in a developing country setting. BJOG 2007;114:1281–5.
19. Sunday-Adeoye I, Kalu CA. Pregnant Nigerian women’s view of caesarean section. Niger J Clin Pract 2011;14:276–9.
20. Akinola Ol, Fabamwo AO, Tayo AO, et al. Caesarean section—an appraisal of some predictive factors in Lagos Nigeria. BMC Pregnancy Childbirth 2014;14:217.
21. van Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. PLoS Med 2007;4:e269.
22. Nilsen C, Østbye T, Dalviet AK, et al. Trends in and socio-demographic factors associated with caesarean section at a Tanzanian referral hospital, 2000 to 2013. Int J Equity Health 2014;13:87.
23. Neuman M, Alcock G, Azad K, et al. Prevalence and determinants of caesarean section in private and public health facilities in underserved South Asian communities: cross-sectional analysis of data from Bangladesh, India and Nepal. BMJ Open 2014;4:e005982.
24. Adewuyi EO, Zhao Y, Khanal V, et al. Rural-urban differences on the rates and factors associated with early initiation of breastfeeding in Nigeria: further analysis of the Nigeria demographic and health survey, 2013. Int Breastfeed J 2017;12:51.
25. Adewuyi EO, Aula A, Khanal V, et al. Prevalence and factors associated with utilization of antenatal care services in Nigeria: A comparative study of rural and urban residences based on the 2013 Nigeria demographic and health survey. PLoS One 2018;13:e0197524.

Adewuyi EO, et al. BMJ Open 2019;9:e027273. doi:10.1136/bmjopen-2018-027273
26. Khanal V, Adhikari M, Sauer K, et al. Factors associated with the introduction of prelacteal feeds in Nepal: findings from the Nepal Demographic and Health Survey 2011. *Int Breastfeed J* 2013;8:9.

27. Titaley CR, Dibley MJ, Roberts CL, et al. Iron and folic acid supplements and reduced early neonatal deaths in Indonesia. *Bull World Health Organ* 2010;88:500–8.

28. Lim JU, Lee JH, Kim JS, et al. Comparison of World Health Organization and Asia-Pacific body mass index classifications in COPD patients. *Int J Chron Obstruct Pulmon Dis* 2017;12:2465–75.

29. West BT. Statistical and methodological issues in the analysis of complex sample survey data: practical guidance for trauma researchers. *J Trauma Stress* 2008;21:440–7.

30. Daniel CN, Singh S. Caesar caesarean delivery: An experience from a tertiary institution in north western Nigeria. *Niger J Clin Pract* 2016;19:18–24.

31. Obiechina N, Ezeama C, Ugboaja J. A five-year review of Caesarean section in Nnamdi Azikiwe University Teaching Hospital, Nnewi Anambra State, Nigeria(1st Jan 2002–31st Dec 2006). *Trop J Med Res* 2008;12.

32. Ijadunolal KT, Fatusi AO, Orji EO, et al. Unavailability of essential obstetric care services in a local government area of south-west Nigeria. *J Health Popul Nutr* 2007;25:94–100.

33. Abegunde D, Kobo IA, Sambisa W, et al. Availability, utilization, and quality of emergency obstetric care services in Bauchi State, Nigeria. *Int J Gynaecol Obstet* 2015;128:251–5.

34. Okoli U, Abdullahi MJ, Pate MA, et al. Prenatal care and basic emergency obstetric care services provided at primary healthcare facilities in rural Nigeria. *Int J Gynaecol Obstet* 2012;117:61–5.

35. Boatin AA, Schlotheuber A, Betran AP, et al. Within country inequalities in caesarean section rates in China between 1988 and 2008. *Bull World Health Organ* 2012;90(1):30–9.

36. Malloy MH. Impact of cesarean section on intermediate and late preterm births: United States, 2000-2003. *Birth* 2009;36:26–33.

37. Brabin L, Verhoeff F, Brabin BJ. Maternal height, birthweight and cephalo pelvic disproportion in urban Nigeria and rural Malawi. *Acta Obstet Gynecol Scand* 2002;81:502–7.

38. Chavkin U, Wainstock T, Sheiner E, et al. Perinatal outcome of pregnancies complicated with extreme birth weights at term. *J Matern Fetal Neonatal Med* 2019;32:198–202.

39. Solanke BL, Oladosu OA, Akinlo A, et al. Religion as a Social Determinant of Maternal Health Care Service Utilisation in Nigeria. *Etude Popul Afr* 2015;29:1868–81.

40. Hahn RA, Truman BI. Education Improves Public Health and Promotes Health Equity. *Int J Health Serv* 2015;45:657–78.

41. Berg RC, Underland V, Odgaard-Jensen J, et al. Effects of female genital cutting on physical health outcomes: a systematic review and meta-analysis. *BMJ Open* 2014;4:e006316.

42. Wagner N. Female genital cutting and long-term health consequences—nationally representative estimates across 13 countries. *J Develop Stud* 2015;51:226–46.