Population Review

Determinants of fertility in Nigeria: An analysis of recent data

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Abstract

Despite the continuous decline in fertility since the 1950s, several African nations, including Nigeria, have continued to experience population growth. Previous research has concentrated on how socioeconomic and fertility-related factors influence fertility outcomes in developing countries. It is crucial to understand the dynamics of fertility in Nigeria, a country with rapid population growth, to lower the total fertility rate (TFR), particularly in regions prone to rapid population expansion, which in turn affects the rate of development. This study sought to examine the factors influencing fertility outcomes in Nigeria. Using zero-inflated Poisson regression models, this study examined recent data from the 2018 Nigeria Demographic and Health Survey (NDHS) to determine the factors with the greatest influence on fertility in the country. The findings indicate that the sociodemographic and economic characteristics of women influence their fertility. In addition, proximate factors such as contraceptive use, marital status, and abortion were also significantly associated with fertility. Recommendations are made to the government, policymakers, and local stakeholders to maintain a national policy for citizens and development that aims to improve the education of young girls and extend their ages at first sex (and, consequently, their ages at first birth) through extended schooling. Finally, greater emphasis should be placed on promoting knowledge of the use of contraceptives.

Keywords: Fertility, DHS, Growth, Contraceptives, Nigeria, Education

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1. Introduction

From the mid-twentieth century onwards, the global population experienced a remarkable increase, surpassing threefold to 8 billion people on 15 November 2022, which was officially dubbed the "Day of 8 billion" by the United Nations. Projections from the United Nations indicate that this figure could increase to approximately 11 billion by the year 2100 (United Nations Economic and Social Affairs, 2022). The capacity for reproduction, which enables the bearing of human offspring following the attainment of sexual maturity, constitutes a fundamental aspect of population development. The World Health Organization (2020) defines fertility as the incidence of childbearing within a population, characterized by the inherent ability to conceive and the successful realization of childbirth. Between 1954 and 2019, the significant surge in global population growth necessitated the initiation of the first and subsequent conferences focused on the human population and development. The discussions took place in various locations to examine the ongoing relative transformations in human development as influenced by urbanization, aging, migration, and fertility. In 1960, the global total fertility rate (TFR) was 5, representing the anticipated number of children a woman would bear by the end of her reproductive years (50 years), if she experienced all existing age-specific fertility rates. Nevertheless, in the final quarter of the 20th century, there was a notable decrease in fertility rates across all countries. In 1980, the global TFR per woman was 3.7. This figure decreased to 2.7 at the onset of the 21st century and further decreased to 2.3 by the year 2020 (Garenne, 2008; World Bank, 2024).

Sub-Saharan Africa (SSA) remains the most underdeveloped region globally, as indicated by a wide array of conventional indicators used to assess socioeconomic progress. Although low-income nations in Latin America and Asia have experienced advancements in living conditions, low-income countries in Africa faced setbacks in the 1970s, as population growth exceeded the slight rise in economic output (Bongaarts et al., 1984). Globally, SSA stands out as the sole region where women typically bear an average of five to six children over their lifetimes. Consequently, numerous SSA nations have persistently regarded population management as a significant concern. In this context, SSA maintains a notably high fertility rate, notwithstanding a plethora of initiatives, programs, and policies designed to substantially and effectively diminish poverty and the global birthrate (Odimegwu et al, 2015).

Nigeria has the distinction of having the largest population in SSA and ranks sixth globally, showcasing a total fertility rate that, despite a gradual decline, remains significantly high. Despite the decline in Nigeria's TFR, the pace of this transition has been relatively slow when paired with the pressing developmental challenges posed by its substantial population (Odusina, 2017; Odimegwu et al, 2015). The country has been experiencing a gradual yet consistent decrease in the total fertility rate. The decline in the TFR has been notable, decreasing from a peak of 5.8 births per woman in 2010 to the current figure of 5.2 births per woman, with most of the high fertility occurring before a woman's 50th year. Despite the decrease in the TFR, the yearly population growth rate increased from 2% in 1960 to approximately 2.5% in 2021 (World Bank, 2021).

Fertility is a key determinant of population growth and change, as well as an essential measure of a country's development. Studies have shown that fertility rates across countries in SSA are

influenced by various factors that can be categorized to include both sex-related issues and socioeconomic determinants (Bongaarts,1978, 2002, 2003; Odu et al., 2005; Odusina, 2017; Odimegwu & Zerai, 1996; Odimegwu et al., 2015; Adebowale, 2019). While proximate determinants refer to those factors that have a direct influence on fertility, approximate or independent determinants are sociodemographic and economic factors that can influence people's attitudes toward fertility issues. Bongaarts (1978) proposed that eight proximate determinants drive fertility, which he further divided into three main categories: exposure factors, deliberate marital fertility control factors, and natural marital fertility factors. These variables had a direct effect on fertility. In the absence of deliberate interventions, their influence reduces fertility from the projected level of fertility or "natural fertility," which is the TFR. According to Bongaarts's mathematical methodology and research, changes in four important factors—marriage, contraception, lactation, and abortion—are the main drivers of increasing fertility in developing countries (Bongaarts, 1978). This has been reflected in the case of Nigeria, which is part of the developing world category, as the extant literature suggests.

In contrast to previous research that utilized older Nigeria Demographic and Health Survey (NDHS) datasets from 1990, 2003, 2008, and 2013 (Odu et al., 2005; Odusina, 2017; Bankole & Audam, 2011; Odimegwu, 1996; Odimegwu et al., 2015), this study contributes to the existing body of knowledge by examining contemporaneous fertility trends. It draws upon the most recent (2018) Nigerian Demographic and Health Survey to assert that various sociodemographic and economic factors—including sex, age, marital status, wealth status, level of education, and place and region of residence—significantly influence fertility outcomes. Furthermore, it posits that these factors interact with proximate determinants such as exposure to sexual activities, contraceptive methods, and abortion. Comprehending the interplay of sociodemographic and economic factors, in conjunction with the direct determinants of fertility, is crucial for understanding the intricacies of contemporary fertility challenges, programs, initiatives, and development strategies in Nigeria.

2. Literature review

2.1 Trend of fertility growth in the SSA region: Nigeria

Several studies have attempted to explain the increasing fertility trend in Africa. One such example is that of Alaba, Olubusoye, & Olaomi (2017), who explained that fertility patterns in many developed countries in the late 1990s indicated a significant decline from the conventional six children per woman to two or fewer children at the beginning of the current century (Alaba et al., 2017). Fertility is declining globally but remains stagnant in SSA (Alaba et al., 2017; Schoumaker, 2019).

According to some research, fertility choice is not permanent and fluctuates depending on the conditions (Liefbroer, 2009; Trinitapoli and Yeatman, 2018). In addition, research conducted in SSA has revealed various factors associated with high fertility desire (Ahinkorah et al., 2020; Kodzi et al., 2010; Odusina et al., 2020; Van Lith et al., 2013). These studies indicated a positive relationship between fertility preference and several fertility determinants. Owing to people's belief that children are a gift from God, Ushie et al. (2011) explain that women in SSA are unable

to transform their fertility preferences into actual fertility, resulting in 'overachieved' fertility. The failure of a woman to attain her reproductive objectives may result in either underachieving or overachieving fertility. Underachievement is defined as a woman's desire for fertility to be lower than her actual fertility. When a woman's actual fertility exceeds her desire for fertility, she has overachieved fertility. Attained fertility, however, refers to the condition in which a woman's desired fertility and actual fertility coincide.

It has been determined that fertility preferences are a significant predictor of actual fertility in tandem with the presence of socioeconomic benefits (Bongaarts & Casterline, 2012; Casterline, 2017; Cleland et al., 2020; Mbacké, 2017). An individual's capacity to make 'clever choices' on their sexual and reproductive rights is enhanced by the presence of and access to and utilization of developmental services such as education, employment, contraceptives, and a host of others. The 2030 Agenda for Sustainable Development Goals (SDGs) emphasizes reproductive health and rights, as mentioned in target 6 of SDG 5. According to one report by the United Nations Population Fund (UNFPA), "the way forward is a full realization of reproductive rights for every individual and couple by dismantling all economic, social, and institutional barriers that inhibit free and informed choice" (UNFPA, 2018).

The overall fertility rate in Nigeria, according to the 2018 NDHS, is 5.3 children per woman. The Nigerian Bureau of Statistics (NBS) indicates that the population stood at 174 million (of which, women constituted 49.5 percent and men constituted the remaining 50.5 percent) in 2013, with forecasts suggesting that it will reach 240 million by 2025 and 440 million by 2050 (NBS, 2013). The TFR was 6.8 in 1981, 6.4 in 1991, and 6.1 in 2004, and the current growth rate has remained at 2.4% for the past two years (World Bank, 2024), indicating a continuing population increase (Wusu, 2012). The dominant perspectives among Nigerians concerning reproduction have largely persisted, shaped by cultural convictions that an increased number of children is advantageous for both material and familial benefits. Furthermore, in many communities, a woman's reproductive capacity correlates with the respect she receives, hence influencing the longevity of her clan. Children are perceived as sources of financial support, pride, and security in old age.

Furthermore, historically, population scientists, doctors, and international organizations working in population health have pointed to the negative reality that children under the age of five are at high risk of dying in Africa because of diseases and conflicts that have been prevalent in recent centuries. It was thought that if a woman had a larger number of children and some of them died, others would live, which justifies the high rates of fertility among households (Basu 2002). Consequently, due to enhanced living conditions and contemporary medical interventions, child mortality has been decreasing (Hirschman, 2001). In Nigeria, the mortality rate for children under five years of age is 128 deaths per 1,000 live births (NPC & ICF, 2014).

Researchers such as Davis and Blake (1956), Onoja & Osayemore (2012), and Wusu (2012) have argued that less developed countries such as those in SSA can progress only if population growth is regulated because excessive population increases impede development if there is no equilibrium with the availability of development infrastructure (Caldwell et al., 1992). High birth rates in developing countries with high unemployment rates are at the heart of this problem (Onoja & Osayemore, 2012). However, many people persist in their belief that "God is the giver of children

and has set no limits on family size" in SSA. Moreover, one study noted that some cultures in Africa (Nigeria) place more value on a woman's ability to have children than others do (Adebowale, 2019).

Several studies have shown a relationship between a woman's sociodemographic characteristics (such as age, occupation, income, etc.) and fertility (Shapiro & Gebreselassie, 2008; Bongaarts, 2010; Onoja & Osayomore, 2012) in driving fertility in SSA. Previous research has indicated that there is a correlation between more meta-cognitive processes, such as pride in having children educated within a household, and fertility in traditional household settings in Africa. For example, Becker (1981) argued that it is a source of pride for educated women to educate their children, which increases the cost of childrearing (Becker, 1981), effectively controlling people's desire for children. The globalization trend of faster internet connectivity and communication, where young people in developed and developing countries bidirectionally influence each other's worldview on matters such as fertility, abortion, and autonomy over health-related decisions, may play a significant role in shaping people's perceptions of children in Africa. Rather than following the traditional trend of high fertility backed by cultural constraints, people obtain more education, consumption attitudes, and varying cultural experiences that delay pregnancy while working alongside the more extensive use of contraception by people (Hendi, 2017; Hirschman, 2001).

2.2 Reproductive behavior/socioeconomic model

According to reproductive behavior theory, proximate fertility determinants could explain both high and low fertility outcomes. The model is concerned primarily with changes in fertility preferences or behavior. In general, fertility results are associated with marriage age and timing, early motherhood, shorter birth intervals, out-of-wedlock childbirth, low contraceptive use, and/or lower infertility rates (Davis & Blake, 1956; Bongaarts, 2006, 2008; Garenne, 2008; Shapiro & Gebreselassie, 2008; Garenne, 2008; Mberu & Reed, 2014). The model appears to be beneficial in terms of fertility reduction when certain socioeconomic conditions, such as the school attendance of women in the fertile age bracket (15-49 years), increase since this will postpone marriages, frequent sexual intercourse, and subsequent pregnancies (Shapiro & Gebreselassie, 2008).

In Nigeria, government policies attempt to improve the socioeconomic experience of young women and girls, although cultural hurdles remain a barrier. This study adopts the reproductive behavior model but includes variables from the socioeconomic model of Caldwell (1982), Shapiro & Gebreselassie (2008), and Stecklov (1999), which argues that socioeconomic factors such as education, female labor force participation, urban residence, household wealth, cultural norms (often measured by religion or ethnicity), and overall levels of social development (often measured by region or level of urbanization) influence childbearing behavior and explain fertility levels and differences (Ezeh & Dodoo, 2001; Stecklov, 1999; Bongaarts, 2002; Garenne, 2008). This model has also been adapted based on the recognition that certain factors may have a closer relationship than others in terms of their effect on fertility. Thus, the choice of explanatory variables was guided by the literature on factors explaining fertility across different developing countries worldwide (Alabi et al., 2017; Bongaarts, 1978; Ali, 1985; Mahmoudiani, 2023; Heaton, 2011; Adebowale, 2019; Ushie, 2011; Odu et al., 2005).

3. Materials and methods

3.1 Source of data and sample design

This study employs data sourced from the data files of women in the 2018 Nigeria Demographic and Health Survey (NDHS). The NDHS is a nationally representative survey that provides key demographic and health measures of several development indicators since 1990, and the objective of the survey is to obtain precise estimates of demographic and health indicators, encompassing factors such as fertility, family planning methods, breastfeeding practices, nutritional status of women and children, maternal and child health, childhood and adult mortality, women's empowerment, domestic violence, female genital mutilation, malaria, HIV/AIDS, other sexually transmitted infections (STIs), disability, and other adult health concerns. The 2018 NDHS uses the National Population Commission's 2006 Population and Housing Census of the Federal Republic of Nigeria (NPHC) as its sample frame. The 2018 NDHS sample design offers comprehensive national estimates for 6 geopolitical zones, 36 states, and the Federal Capital Territory (FCT). Additionally, it provides information about residential households, places of residence, and locations of enumeration.

The sample for the 2018 NDHS is a stratified sample selected in two stages. Stratification was achieved by separating each of the 36 states (plus the Federal Capital Territory) into urban and rural areas. In total, 74 sampling strata were identified. The samples were selected independently in every stratum through two-stage selection. Implicit stratifications were achieved at each of the lower administrative levels by sorting the sampling frame before sample selection according to administrative order and by using a probability proportional to size selection at the first sampling stage. In the first stage, 1,400 EAs were selected with a probability proportional to the EA size (NPC & ICF, 2019). EA size is the number of households in the EA. A household listing operation was carried out in all selected EAs, and the resulting lists of households served as the sampling frame for the selection of households in the second stage. In the second stage, a fixed number of 30 households were selected in every cluster via equal probability systematic sampling. A total of 41,821 women aged 15-49 years (with 127,545 children ever born) who were usual members of the selected households or who spent the night before the survey in the selected households were individually interviewed for the 2018 NDHS (NPC & ICF, 2019).

Owing to the nonproportional allocation of the sample to the various states and the potential for differences in response rates, sampling weights are required for any analysis using the 2018 NDHS data to ensure the actual representativeness of the survey results at the national and domain levels. The initial sample size employed in the study consisted of 35,088 women, with each woman's data being given a certain weight. Nevertheless, the dataset for the regression analysis excluded 16 respondents who did not provide information on their age, resulting in a further reduction in the sample size to 35,072 women.

3.2 Variables

Dependent variable. The dependent variable (number of children ever born) is a count variable representing the number of children ever born by a woman aged 15-49 years during the date when

the data were collected. In this study, the count variable will be the number of respondents whose children had ever been born. Total fertility was estimated via the cohort-period technique from answers to the birth-history section of the questionnaire.

Independent (sociodemographic and socioeconomic) variables

The independent variables are the sociodemographic and economic characteristics, which are based on what has been previously discussed in the literature to be associated with fertility. These included variables such as respondent's age, age at first sex, place of residence, education, occupation, religion, wealth status, and ethnicity, among others (Alabi et al., 2017; Odusina, 2017; Odu et al., 2005; Odusina, 2017; Bankole & Audam, 2011; Odimegwu, 1996; Odimegwu et al., 2015; Heaton, 2011; Shapiro & Gebreselassie, 2008).

Age. In this analysis, age is a discrete variable. The women in the reproductive age range were divided into seven groups: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44 and 45–49 years.

Occupation. The respondent's primary form of employment before the survey period is referred to as their "occupation." Asking, "What do you do for a living?" The respondent's employment status was sorted into the following categories: unemployed; working in the professional/clerical sector; working in sales/service; working in agriculture; and working in manual capacity.

Region of residence. Populations were classified as either urban or rural based on their location. Geographical divisions within Nigeria were used to categorize people into different regions: north-central, northeast, northwest, southeast, south, and southwest.

Place of residence. The place of residence was measured as urban or rural.

Educational level. Education refers to the highest level of educational attainment a person has obtained. The level of education was determined by the response to the question. "What is the highest level of education"? The level of education was classified into no education, primary, secondary, and higher.

Religion. This variable captures one's religious leanings or convictions, if any were solicited. The participants were categorized according to their religious beliefs into Christian, Muslim, African traditional religion (ATR), and other groups (which included Hinduism, other Eastern religions, and no religion).

Wealth quintile. In terms of wealth, people were ranked from poorest to richest. This variable comprises the original five categories, which include poorest, poorer, middle, richer, and richest. The wealth quintile is derived from an index calculated via principal component analysis and measured by respondents' household assets, housing materials and access to water and sanitation indicators.

Ethnicity. The ethnicity variable is recoded and measured as Igbo, Fulani/Hausa, Yoruba, Ijaw/Ekoi/Ibibio, and other ethnic groups.
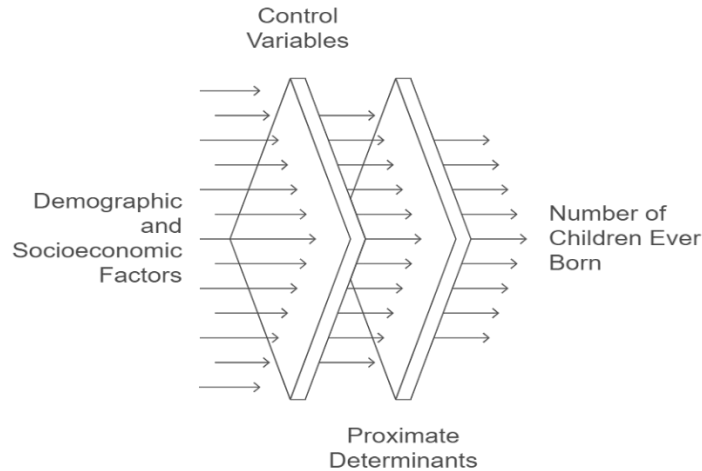
Figure: A diagram to express the relationships among the variables

Proximate and control variables

The proximate variable serves as a causal link between other variables, and it is acted on by the independent variable and [proximate] then acts on the dependent variable to create change. This variable is also referred to as the intervening variable, the mediating variable, or the intermediary variable. For example, consider the relationship between education and children ever born. A level of education does not directly inversely impact a woman's fertility, but it may guarantee knowledge and access to the use of (modern) contraceptives. Contraceptives, in turn, affect the fertility of women, making them a proximate variable. Among other factors, the knowledge and use of contraceptives, abortion, and marital status were selected as the proximate or intervening variables in this study. The model also presents some controlling variables that could also affect the fertility of women. These factors or variables include the culture in which the woman finds herself, the availability of governmental health policies and interventions, the influence of the internet, and, finally, accessibility to health facilities.

Age at first sex. The age at first sex was measured as less than 15 years, 15–24 years, and 25+ years. This variable comprises women who had their first sexual experience within the age categories listed.

Marital Status. Regardless of whether formal rituals have been carried out, a man and a woman are considered married if they report being married in the survey. Questions about whether respondents are never in a union/single, living with partners, married, widowed, divorced, and no longer living together/separated provide useful data. In this case, the marital status variable is measured as a person being single, married, living together, divorced, separated, or widowed.

Contraceptive Use. The research investigates whether a respondent has ever used or never used contraception. It is measured as follows: no method, folkloric/traditional method, and modern method.

Abortion. Abortion is measured as whether a respondent (woman) has ever had a terminated pregnancy, and the possible response is 'yes' or 'no'. This measure of abortion includes spontaneous and induced abortions.

Access to healthcare. The access to healthcare variable refers to whether the respondent indicates accessing healthcare as a major problem or not. The responses to this variable are not a problem, a large problem, or a large problem.

Use of the Internet. The use of the internet refers to the use of the internet by respondents. The question is "Do you use the internet?", and respondents respond with yes or no answers.

3.3 Analyses

Descriptive statistics and Poisson regression models were used to analyse the data. A computer-based software package called the Statistical Package for Social Sciences (SPSS) version 26 was used to perform the analysis. For the descriptive analysis, the study calculated frequency distributions and percentages based on the participants' sociodemographic and socioeconomic background characteristics. At the bivariate level, an ANOVA was carried out to determine the associations between various determinants, including background characteristics, and the dependent variable. Finally, zero-inflated Poisson regression models were fit to the data to determine the relationships and effects of the determinants of fertility and fertility while controlling for other variables, such as internet/media influence and access to healthcare. The zero-inflated model was preferred because of issues of excess zero, which were discovered in the result of a normal Poisson regression. This model is the best fit for the data, as it takes care of true values and assumes that zeros are apparent in the data. The Poisson regression method utilizes three models. The first model included the independent variables and the dependent variable while adjusting for the controls. The second model included the three proximate variables in addition to the control variables and the dependent variable. Finally, the third model regressed the dependent variable against all proximate, independent, and control variables. This was done to determine the degree to which the intervening variables were associated with one another. In this research, a test statistic with a confidence level of 95% is utilized.

4. Results

4.1 Profile of the study population

Table 1 provides an overview of the sociodemographic characteristics of the study participants. The study included a total of 35,088 women aged 15-49 years (with 127,545 children ever born). The table indicates that a greater proportion (19.9%) of the women were 25-29 years old and highlights the usual bell curve where fertility peaks at 25-29 years, whereas 16.8% of the women were between the ages of 20-24 years. A total of 8.4%, 16.9%, and 11.1% of the respondents were aged 15-19, 30-44, and 44-49 years, respectively. Several of the respondents were engaged in sales/services at a percentage of 47, and others were engaged in manual capacity, agriculture, and the professional/clerical sector at percentages of 29.4, 15.6, and 7.8, respectively. The percentage of respondents who reported having had no education was 39.1%, whereas the percentage of respondents who reported having higher education was 11.3%. With respect to ethnic grouping,

most of the respondents were Hausa/Fulani, accounting for 36.5% of the sample, whereas respondents in the "other" category made up 29% of the study sample. Although a greater proportion of the respondents were from rural regions than they were from urban areas, the Northwest region constituted the highest proportion (29.5%), followed by the Northeast and North Central regions, with 15.7% and 14.2%, respectively, while those from the South–South region constituted the lowest proportions (11.9%), indicating the religious differences of respondents, which have higher bases in these places.

Table 1: Descriptive characteristics and bivariate results of the 20018 NDHS for women

VARIABLES	Frequency	Percent (%)	ANOVA test sig.
Age			.000
15-19 years	2953	8.4	
20-24 years	5884	16.8	
25-29 years	6976	19.9	
30-34 years	5942	16.9	
35-39 years	5382	15.4	
40-44 years	4049	11.5	
45-49 years	3886	11.1	
Missing	16	0.04	
Occupation			.000
Working in the agricultural sector	5486	15.6	
Not working/unemployed	56	0.2	
Working in professional/clerical sector	2751	7.8	
Working in sales/service	16488	47	
Working in a manual capacity	10307	29.4	
Education			.000
No education	13720	39.1	
Primary education	5438	15.5	
Secondary education	11965	34.1	
Higher education	3965	11.3	
Ethnicity			.000
Hausa/Fulani	12807	36.5	
Igbo	5228	14.9	
Yoruba	5298	15.1	
Ekoi/Ibibio/Ijaw/Izon	1579	4.5	
Others	10176	29	
Place of residence			.000
Rural	19825	56.5	
Urban	15263	43.5	
Religion			.000
Islam	18772	53.5	
Christianity	16105	45.9	
Traditionalist	141	0.4	
Others	70	0.2	

Wealth Quintile			.000
Poorest	6456	18.4	
Poorer	7052	20.1	
Middle	6877	19.6	
Richer	7298	20.8	
Richest	7404	21.1	
Region			.000
North Central	4980	14.2	
Northeast	5500	15.7	
Northwest	10335	29.5	
Southeast	4035	11.5	
South–South	4167	11.9	
Southwest	6071	17.3	
Age at first sex			.000
Less than 15 years	6724	19.2	
15-24 years	27147	77.4	
25+ years	1218	3.5	
Marital status			.000
Married	28118	80.1	
Never in union/single	3821	10.9	
Living with partner	968	2.8	
Widowed	1058	3	
Divorced	562	1.6	
No longer living together/separated	561	1.6	
Contraceptive			.000
No method	29123	83	
Traditional/folkloric	1579	4.5	
Modern	4386	12.5	
Abortion			.000
No	30211	86.1	
Yes	4877	13.9	
Use of internet			.000
No	29439	83.9	
Yes	5649	16.1	
Access to healthcare			.000
Not a big problem	25719	73.3	
Big problem	9369	26.7	
Total	35088	100	

At the time of the survey, compared with the least (poorest category), respondents in the richest group had the highest proportion of 21.1%, whereas respondents in the richer, middle, and poorer categories had proportions of 20.9%, 19.6%, and 20.1%, respectively. Similarly, 77.4% of the women who had their first sexual experience were 15-24 years old, whereas 3.5% of the women who had their first sexual experience were 25 years and above, as only 10.9% of the respondents had never been married or were single, and 80.1% stated that they were married. Additionally, 83%

of the respondents were not using any kind of contraceptive at the time of the survey, whereas 12.5% and 4.5% were using modern and traditional methods, respectively. For abortion, 86.1% of the respondents stated that they had never experienced an abortion, 13.9% stated otherwise, and 73.3% of the respondents stated that they did not have an issue visiting a health facility. All bivariate analyses of the independent and dependent variables revealed statistical significance.

4.2 Multivariate analysis results

As shown in Table 2, age has a highly statistically significant effect on the number of children born. According to the findings, an increase in age correlates with an increase in fertility. The results show that women in the 15–19 years age group, compared with those in the 45–49 years age group (reference category), expect to have decreased rates in terms of the number of children, with values of 0.07 and 0.09 in models 1 and 3, respectively, while holding the other variables constant. Likewise, women within the 40–44 years age group, compared with their 45–49 years (reference category) counterparts, would also expect to have decreased rates of 0.93 and 0.92, respectively, while holding the other variables constant in models 1 and 3, respectively. Both models confirm that the number of children born to a woman increases with her age. The study verified the hypothesis that age at first birth is directly proportional to the number of children ever born.

Occupation is an important predictor and has been shown to be significantly associated with the number of children born. In the first model, the results show that women who work in a manual capacity compared with those in the agricultural sector (reference category) would be expected to have a decreased rate in the number of children born of 0.92 while holding the other variables constant in the model. On the other hand, women who work in the sales/service sector, compared with those in the agricultural sector (reference category), expect to have a decrease in the number of children by 0.96, while the other variables are held constant in the model. In the third model, the results show that women who work in a manual capacity compared with their agricultural sector counterparts would have a decreased rate in the number of children of 0.94 while holding the other variables constant in the model. Compared with those in the agricultural sector, women who work in the professional/clerical sector become marginally significant in Model 3. They have a decreased rate of 0.97 in the number of children ever born while holding the other variables constant.

The level of education of a woman has a statistically significant effect on the number of children born annually. In Model 1, the results show that compared with women with no formal education (reference category), women who have primary education expect an increase in the number of children of 1.03, while the other variables are held constant in the model. Additionally, women with higher education expect to experience a decrease in their number of children of 0.76, while the other variables are held constant in the model. In Model 3, the results are similar and demonstrate that the higher a woman's level of education is, the lower her fertility. Additionally, educational levels are inversely proportional to the number of children ever born, which means that the first hypothesis holds in the study.

Ethnicity also has a statistically significant association with the number of children ever born. In Model 1, the results show that women from the Hausa/Fulani ethnic group (reference category), compared with women from Igbo, Yoruba, Ekoi/Ibibio/Ijaw/Izon and other ethnic groups, expect to have decreased rates of 0.93, 0.87, 0.89 and 0.93 children, respectively, while the other variables are held constant in the model. On the other hand, in Model 3, the results show a similar pattern, but there are relatively decreased rates for the number of children from Igbo (0.92) and Yoruba (0.86) and relatively decreased rates of 0.92 and 0.94 for Ekoi/Ibibio/Ijaw/Izon and other ethnic groups, respectively.

At the multivariate level, for those who live in urban areas as their place of residence, it appears not to have a statistically significant relationship with the number of children ever born. This may be explained by the fact that as additional variables were fitted into models 1 and 3, controlling for the effects of other variables rendered any spurious results as not significant.

Religion can be said to have a significant relationship with the number of children ever born, whereas Christianity and other beliefs of the respondents appear to have a significant association with the number of children ever born in Model 1; only Christianity maintained a trend in Model 3 when comparing respondents who are Muslims (reference category) while holding other variables constant in the models. In Model 1, the results show that women who are Muslim (reference category) compared with those who are Christians and other belief practitioners expect to have decreased rates in the number of children of 0.84 and 0.87, respectively, while other variables are held constant in the model. Similarly, in Model 3, the results show that women who are Muslim, compared with those who are Christians, expect to have a decrease in the number of children of 0.87, whereas the other variables are held constant in the model.

Table 2: Zero-inflated Poisson regression

VARIABLES	Model 1		Model 2		Model 3	
	IRR (p value)	95% CI	IRR (p value)	95% CI	IRR (p value)	95% CI
Total number of children ever born		[. - .]		[. - .]		[. - .]
Age						
45-49 years (RC)						
15-19 years	0.07 (0.000)	[0.07 - 0.08]			0.09 (0.000)	[0.09 - 0.09]
20-24 years	0.23 (0.000)	[0.22 - 0.24]			0.25 (0.000)	[0.25 - 0.26]
25-29 years	0.44 (0.000)	[0.43 - 0.45]			0.45 (0.000)	[0.44 - 0.46]
30-34 years	0.65 (0.000)	[0.64 - 0.67]			0.65 (0.000)	[0.64 - 0.66]
35-39 years	0.82 (0.000)	[0.81 - 0.83]			0.81 (0.000)	[0.79 - 0.82]
40-44 years	0.93 (0.000)	[0.92 - 0.95]			0.92 (0.000)	[0.92 - 0.93]
Occupation						
Working in the agricultural sector (RC)						
Not working/unemployed	0.96(0.597)	[0.82 - 1.12]			1.01 (0.918)	[0.87 - 1.17]
Working in professional/clerical sector	0.97 (0.112)	[0.95 - 1.01]			0.97 (0.050)	[0.94 - 1.00]
Working in sales/service	0.96 (0.000)	[0.95 - 0.99]			0.97 (0.002)	[0.96 - 0.99]
Working in a manual capacity	0.92 (0.000)	[0.91 - 0.95]			0.94 (0.000)	[0.92 - 0.96]
Education						

Variable	Model 1		Model 2		Model 3	
No education (RC)						
Primary education	1.03 (0.000)	[1.02 - 1.05]			1.03 (0.001)	[1.01 - 1.05]
Secondary education	0.90 (0.000)	[0.88 - 0.92]			0.91 (0.000)	[0.89 - 0.93]
Higher education	0.76 (0.000)	[0.73 - 0.78]			0.77 (0.000)	[0.75 - 0.80]
Ethnicity						
Hausa/Fulani (RC)						
Igbo	0.93 (0.001)	[0.89 - 0.97]			0.92 (0.000)	[0.88 - 0.96]
Yoruba	0.87 (0.000)	[0.84 - 0.90]			0.86 (0.000)	[0.83 - 0.89]
Ekoi/Ibibio/Ijaw/Izon	0.89 (0.000)	[0.85 - 0.93]			0.92 (0.000)	[0.88 - 0.96]
Others	0.93 (0.000)	[0.91 - 0.95]			0.94 (0.000)	[0.92 - 0.96]
Place of residence						
Rural (RC)						
Urban	0.99 (0.135)	[0.98 - 1.00]			1.0 (0.853)	[0.99 - 1.02]
Religion						
Islam (RC)						
Christianity	0.84 (0.000)	[0.83 - 0.86]			0.87 (0.000)	[0.85 - 0.88]
Traditionalist	0.99 (0.742)	[0.91 - 1.07]			1.01 (0.876)	[0.93 - 1.09]
Others	0.87 (0.004)	[0.78 – 0.96]			0.91 (0.058)	[0.83 – 1.00]
Wealth Quintile						
Richest (RC)						
Poorest	1.08 (0.000)	[1.05 - 1.11]			1.14 (0.000)	[1.11 - 1.17]
Poorer	1.08 (0.000)	[1.05 - 1.10]			1.13 (0.000)	[1.10 - 1.16]
Middle	1.07 (0.000)	[1.05 - 1.09]			1.12 (0.000)	[1.09 - 1.15]
Richer	1.04 (0.002)	[1.01 - 1.06]			1.07 (0.000)	[1.05 - 1.09]
Region						
North Central (RC)						
Northeast	1.10 (0.000)	[1.08 - 1.12]			1.11 (0.000)	[1.09 - 1.13]
Northwest	1.17 (0.000)	[1.15 - 1.19]			1.18 (0.000)	[1.15 - 1.20]
Southeast	1.02 (0.286)	[0.98 - 1.06]			1.04 (0.048)	[1.00 - 1.09]
South–South	0.97 (0.022)	[0.94 - 0.99]			1.01 (0.497)	[0.98 - 1.04]
Southwest	0.95 (0.002)	[0.92 - 0.98]			0.96 (0.011)	[0.93 - 0.99]
Age at first sex						
Less than 15 years (RC)						
15-24 years	0.85 (0.000)	[0.84 - 0.87]			0.85 (0.000)	[0.84 - 0.86]
25+ years	0.59 (0.000)	[0.56 - 0.61]			0.59 (0.000)	[0.57 - 0.62]
Marital status						
Married (RC)						
Never in union/single			0.12 (0.000)	[0.11- 0.12]	0.25 (0.000)	[0.24 - 0.26]
Living with partner			0.73 (0.000)	[0.71- 0.76]	0.96 (0.024)	[0.92 - 0.99]
Widowed			1.19 (0.000)	[1.15- 1.22]	0.96 (0.007)	[0.94 - 0.99]
Divorced			0.71 (0.000)	[0.68- 0.75]	0.71 (0.000)	[0.67 - 0.75]
No longer living together/separated.			0.71 (0.000)	[0.67- 0.74]	0.76 (0.000)	[0.73 - 0.80]
Contraceptive						
No method (RC)						
Traditional/folkloric			1.03 (0.060)	[1.00- 1.06]	1.15 (0.000)	[1.12 - 1.19]
Modern			1.06 (0.000)	[1.04- 1.08]	1.14 (0.000)	[1.12 - 1.16]
Abortion						
No (RC)						
Yes			1.06 (0.000)	[1.04- 1.07]	0.94 (0.000)	[0.93 - 0.96]
Use of internet						
No						
Yes	0.73 (0.000)	[0.71 - 0.75]	0.57 (0.000)	[0.55- 0.58]	0.82 (0.000)	[0.80 - 0.84]
Access to healthcare						
Not a big problem (RC)						
Big problem	1.02 (0.007)	[1.00 - 1.03]	1.01 (0.000)	[1.00- 1.02]	1.01 (0.027)	[1.00 - 1.03]
Inflate						
Constant	0.62***	[0.58 - 0.66]	4.42 (0.053)	[4.3 - 4.46]	0.72 (0.000)	[0.68 - 0.77]
Observations	35,072		35,072		35,072	

(RC) – reference category

p<0.05

The wealth quintile has been shown to have a statistically significant relationship with the number of children ever born. In Model 1, the results show that women who are from the richest group (reference category) compared with those who are richer, middle, poorer, and poorest expect to have increased rates in the number of children of 1.04, 1.07, 1.08, and 1.08, respectively, while holding the other variables constant in the model. Similarly, when we take the proximate variables into context in Model 3, we discover that women who are from the richest group (reference category) compared with those who are richer, middle, poorer, and poorest groups continue to have greater rates of children of 1.14, 1.13, 1.12 and 1.07, respectively, while holding the other variables constant in the model. This shows an inverse relationship in the models and is explained by the fact that as a woman's wealth increases, the number of children ever born decreases. In summary, it might be assumed that as wealth increases, respondents are exposed to a higher level of education, knowledge, and access to contraception, among other factors, that are necessary for reducing fertility. However, there are exceptions to this.

The region of residence refers to any of the six geopolitical zones in Nigeria. Based on the results, while other regions in Models 1 and 3 are significantly associated with the number of children ever born, respondents from the Southeast region (Model 1) and South-South region (Model 3) appear not to have a statistically significant association with the number of children ever born. In Model 1, the results show that women who reside in the North Central Region (reference category), compared with those who are in the Northeast and Northwest, expect to have increased rates of children of 1.10 and 1.17 greater, respectively, and women who reside in South–South and Southwest expected to have decreased rates of children of 0.97 and 0.95, respectively, while holding the other variables constant in the model. On the other hand, when we take the variables on the method of contraception, abortion, and marital status into context in Model 3, we discover that women who reside in the North Central Zone of Nigeria (reference category) compared with those who reside in Northeast, Northwest, and Southeast expect to have increased rates in the number of children of 1.11, 1.18 and 1.04, respectively, while holding the other variables constant in the model. The results of the model show that fertility in Northwest and Northeast is relatively high compared with that in other regions in Nigeria. The third hypothesis that women from Northwest will have a greater fertility rate than women from the remaining areas has also been proven to be true.

Additionally, there is a statistically significant correlation between age at first birth and the number of children born. In the first model, the results show that women who have had their first sexual intercourse before they reach age 15 years (reference category) rather than those who had their first intercourse at age 15-24 years would be expected to have a decrease in the number of children by 0.85 while holding the other variables constant in the model. Additionally, in Model 1, women who have had their first sexual intercourse before they reach age 15 years, compared with those who had their first sexual intercourse at age 25+ years, expect to have a decrease in the number of children of 0.59, while the other variables are held constant in the model. The same trend is

experienced in Model 3. Given these findings, it appears that when a woman postpones her initial sexual encounter, the likelihood of becoming a parent diminishes.

Marital status is significantly associated with the number of children born. In the second model, the results show that women who are married (reference category) compared with those who are single, living with partners, no longer living with a partner, or divorced expect to have decreased rates in the number of children of 0.12, 0.73, 0.71 and 0.71, respectively, while holding the other variables constant in the model. On the other hand, in Model 2, compared with those who are widowed, women who are married expect to have an increase in the number of children of 1.19, while the other variables are held constant in the model. In Model 3, if women are married compared with those who are single, living with partners, widowed, divorced and no longer living with partners are expected to decrease the number of children by 0.25, 0.96, 0.96, 0.71 and 0.76, respectively, while the other variables are held constant in the model.

The method of contraception is statistically significant in the model. In Model 2, the results show that women who do not use any method of contraception (reference category) compared with those who use modern methods are expected to increase the rate of the number of children by a factor of 1.03 while holding the other variables constant in the model. A similar pattern of higher fertility is experienced in Model 3. This type of result might assume that women use either traditional or modern methods of contraception after they have given birth to their required number of children.

Abortion has been found to be significantly associated with the number of children ever born. In Model 2, the results show that women who have never experienced abortion (reference category) are expected to have an increased rate in the number of children by a factor of 1.06 compared with women who have never experienced abortion (reference category), while the other variables are held constant in the model. However, in Model 3, we find that there is a decrease of 0.94 when the independent variables of education, wealth quintile, and age at first sex, among others, are included and held constant in the model.

The control variables of use of the internet and access to healthcare have proven to be statistically significantly associated with the number of children born in all three models. In all three models, the use of the internet shows that women who do not use the internet (reference category) compared with those who use the internet are expected to have decreased rates in the number of children by 0.73, 0.57, and 0.82 in Model 1, Model 2 and Model 3, respectively, while holding the other variables constant in the model. This shows that as more variables are fitted into the model, fertility decreases. While access to healthcare has a statistically significant association with the number of children born, there is a similar trajectory as the use of the internet in all three models.

5. Discussion

This study examined the relationships between various selected determinants of fertility and fertility outcomes. It also highlights how independent determinants through proximate determinants influence fertility in Nigeria. In addition, this study evaluates the contributions of controlled independent factors and their level of nexus with fertility. The results of the analysis indicate that there is a significant association between the selected independent and proximate variables and the number of children ever born to a woman in Nigeria. Age has been shown to have a significant association with the number of children born. It was discovered that as women grow older, their fertility becomes greater. This is further confirmed by Ushie (2011) and Akpa & Osayomore (2012), who concluded that as a woman's age increases, so does the number of children because she must have completed her childbearing at the end of her reproductive period.

In addition, education is one of the most significant independent factors in this study, and it has a substantial effect on the number of births. With respect to the sociodemographic features of the respondents, the link between education and fertility is one of the most important determinants influencing fertility in Nigeria. This is corroborated by Bongaarts (2003), Shapiro & Gebreselassie (2008) and Alaba et al. (2017), who concluded that the more education a woman has, the lower her fertility rate is relative to that of uneducated women.

Although occupation is influential for fertility in this study, it was found that respondents (women) who are unemployed and working in the professional sector do not have a significant association with the number of children. This conclusion contrasts with the findings of studies in which several African nations and a few less developed nations demonstrated that the unemployment rate is closely associated with a high fertility rate (Mekonnen & Worku, 2011).

Furthermore, despite its significance, ethnicity has been found to affect the number of children ever born. Makinwa-Adebusoye & Kritz (1997) indicate that fertility rates vary significantly between ethnic groups and appear to be connected to the status of women in each society. For example, couples from ethnic groups with the lowest level of women's status, such as Hausa/Fulani and Kanuri, have a greater degree of dispute on their reproductive intentions than do those from ethnic groups with a higher level of women's status, such as Ibo and Yoruba. The findings are identical to those of Akpa & Ikpotokin (2012) and Adebowale (2019).

Place of residence appeared to be significantly correlated with the number of children ever born at the bivariate level of analysis but not at the multivariable level, which proves otherwise. Ushie (2011) concluded that the association between fertility behavior and place of residence is direct. There is an association between the urban or rural characteristics of a location of residence and fertility. The rate at which urban fertility decreases affects the rate at which the population grows endogenously. As urban fertility decreases to low levels in some emerging economies, including Nigeria, rural-to-urban migration becomes an increasingly important factor in urban growth (Gebreselassie 2011; Lerch, 2019). Changes in rural fertility can be interpreted as a measure of population pressure and, by extension, an indicator of urban migration where migrants are involved in reproduction in their place of domicile (Lerch, 2019).

Religion generally plays a significant role as a predictor of fertility in Nigeria, as confirmed by the Poisson regression analysis. As Mutairu et al. (2013) claimed, religion influences a woman's reproductive behavior because it imposes a set of living standards and is related to a shared set of beliefs, values, and rituals. Odu et al. (2005) and Onoja and Osayomore (2012) reported that, compared with those of Muslims and traditionalists, Christian fertility rates in Nigeria are relatively low.

The wealth quintile is an important predictor of fertility outcomes in Nigeria. Statistically, we can see that women who make up the richest wealth group will have the least number of children, probably because of their exposure to higher levels of education, which inform their knowledge and use of contraception. This is further supported by previous research that concluded that economic and social advancements such as increased income and educational attainment reduce the birth rate (Bongaarts, 2003; Shapiro & Gebreselassie, 2008). An additional economic and social advancement in families with fewer children is to devote fewer resources to raising their children, freeing those resources for other purposes, such as savings and investments.

Moreover, the region of residence influences fertility in this study. Individually, while it was discovered that respondents from the Northwest region have a higher rate of children ever born than do those from the other five regions do, overall, the Northern region has higher fertility than the South region does, as confirmed by Adebowale (2019). Age at first sex showed that women who started their sexual encounter early in life might be prone to having higher birth rates than those who did not. This result is further supported by Bongaarts et al. (1984) and Donkor (2014), who concluded that if a woman begins having sexual relationships at a young age, she will be exposed to the likelihood of becoming pregnant for a long period.

Marital status is a significant proximate determinant of fertility in Nigeria. As a result of its role in reproduction, marriage is often recognized as an important social institution. It is the bedrock of society in both the developed and developing worlds (Bongaarts, 2012; Elleamoh & Dake, 2019). Abortion as a proximate determinant shows that approximately 13% of the respondents have experienced abortion, which influences the models fitted. The fourth hypothesis, which states that women who are married will have higher numbers of children than those who are divorced, has been proven to be true in the present study.

Despite the lack of optimism for contraceptive usage in this analysis, the corresponding model statistics are significant. Only 12.5% of the respondents indicated that they had used modern contraception, whereas 4.5% reported using traditional contraception. Multivariate findings indicate that the methods of contraception do not reduce the number of children. This might be because current users have greater fertility because current users are seeking to limit births after achieving their desired or more than desired fertility. This finding is consistent with the results of Onoja & Osayemore (2012). Women who have low levels of education are mostly not open to using contraceptives. Only 13% of married women in Onoja & Osayemore's research reported using contemporary methods of contraception. An increase in female education can help regulate reproductive age and increase the prevalence of birth control, both of which contribute to a more rapid drop in fertility.

6. Recommendations

First, in addition to current education policies, there must be one that promotes and intensifies women's education to a greater degree. Since 1989, Nigeria has maintained a national policy for women and development that aims to improve the education of young girls. To increase the enrolment of female students, additional incentives, such as work opportunities and scholarships, must be provided. For women to make their own decisions regarding fertility, they must be assisted in becoming monetarily independent and self-reliant. The Ministry of Women's Affairs should work in coordinated efforts with the National Population Commission to streamline key policies to increase the enrollment of both males and females. Additionally, the tasks of communicating these policy areas and organizing workshops on issues related to population health across the country should be actively undertaken by the National Orientation Agency and other stakeholders, such as civil society organizations.

Second, there should be an intensified focus on raising awareness of the importance of using contraceptives. Although relevant policies on family planning and reproductive acts are in force, efforts should be skewed toward areas with greater vulnerability to high birth. This included areas in the northern regions as well as among the Hausas/Fulani. Education and services related to a wide range of methods of contraceptive use should be widely accessible. Focus on raising awareness of the importance of using contraceptives.

Furthermore, additional studies should deepen our understanding of the variations in the different kinds of contraceptives, especially traditional methods, and advocate the safest types appropriate for women and couples. Additionally, qualitative studies could be conducted to add textural depth to the study, as they would include individual explanations for outcomes related to fertility. Governmental efforts should pool resources to encourage the use of contraception in northern efforts should also be made to increase the number of females enrolled in schools.

7. Conclusion

The study was able to achieve all three objectives in identifying the independent and proximate determinants of fertility, and it adequately revealed the relationships they have with the influence of fertility outcomes in Nigeria. The independent and proximate determinants are statistically significant predictors of fertility in Nigeria. There are other control factors (use of the internet and access to healthcare) that also predict fertility. Among the independent factors are age, age at first sex, occupation, level of education, wealth quintile, religion, ethnicity, region of residence, and place of residence. The proximate determinants include marital status, method of contraception, and abortion. The study revealed that all these factors influence fertility in Nigeria.

The findings indicate that most women give birth before the age of 20, increasing fertility. The results revealed an increasing relationship between age and fertility. The number of children born has a statistically significant relationship with a woman's education level. While education and

wealth inversely influence a woman's number of children, key cultural elements (religion, ethnicity, and region of residence) suggest higher births among Muslims, Hausa/Fulani, and northern region dwellers, respectively, which must be investigated further. Finally, contraceptive usage among women in Nigeria is low. For the reproduction rate to continue to decrease, (I maintain a bias that) modern contraception acceptance must increase among young people and middle-aged women whose fertility peaks at the middle-level of the fertility age range.

If family stability and national development are desired in Nigeria, it is crucial for policy initiatives and other government activities to ensure that low-income families and rural communities have access to education and other crucial services, with careful consideration and sensitivity to the public. However, further study can explore the policy relevance of increasing social services such as education on fertility.

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