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Fertility among Northern Nigeria women and associated factors: Negative binomial regression model approach

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Abstract

Objective: The 2020 sustainable development progress report shows that human population growth is a critical barrier to achieving the Sustainable Development Goals (SDG). There are very few studies on determinants of fertility particularly looking at the northern part of Nigeria that has a relatively high fertility level compared with the southern part of the country. This study therefore is aimed at identifying the factors associated with fertility among women in northern Nigeria.

Methods: The data for this study was from the Nigeria Demographic and Health Survey (NDHS) 2018. The number of children ever born by women aged 15 – 49 years and other variables who lived in Northern Nigeria were extracted and analyzed using Negative Binomial Regression, where the level of significance was 0.05.

Results: There were variations in factors associated with fertility among the geopolitical zones in Nigeria. Age of the respondents, sex of household head, wealth index, religion, ethnicity, use of family planning (FP) method, and child death experience were among the factors associated with fertility. Women with no/lower education, early marriage, being Muslim and Hausa/Fulani ethnic background experienced high fertility ($p<0.05$).

Conclusion: Attention to the factors mentioned above and intervention programmes designed to reduce fertility are indispensable. Education of female children should be given extra attention as this will empower them to be more informed. Hence, achieving SDGs will become a reality.

Keywords: Negative Binomial Regression, Northern Nigeria, Number of children ever born, Demographic and Health Survey, Sustainable development Goals, Women

Plain English Summary

The 2020 sustainable development progress report shows that human population growth is a critical barrier to achieving the Sustainable Development Goals (SDG). Limited information about the reasons that made people give birth to many children especially in the northern part of Nigeria compared with the southern part of the country. This study set out to find the factors or reasons that are responsible for giving birth to more children among women in northern Nigeria. We used the Nigeria Demographic and Health Survey

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data. The number of children ever born by women aged 15 – 49 years and other variables who lived in Northern Nigeria were extracted and analyzed using Negative Binomial Regression which is for count data. There were differences in factors associated with fertility among the geopolitical zones in Nigeria. These include the age of the mother, sex of the household head, whether the woman was poor or rich, religion, ethnicity, use of family planning method, and the number of children that died among the women's children influenced fertility. Women with no/lower education, early marriage, being Muslim and Hausa/Fulani ethnic background gave birth to more children. Attention to these factors and different programmes from the Government is particularly important as these will help to reduce the way people are giving birth to more children. Female children should be given education as this will empower them to have more knowledge about their health and lives. In effect, these may facilitate the achievement of Sustainable Development Goals.

Background

Globally, the median fertility was put at 2.3 births per woman from 2010 – 2015, yet fertility remained at high levels of more than 3.5 births per woman in about 55 countries areas. With this rate, the world's population is projected to reach between 6.9 billion and 9.7 billion in 2010 and 2050 respectively (1). The consequences of unchecked population growth would result in excessive use of natural resources, environmental destruction, as well as unsustainable demand for resources like land, food, water and energy (2, 3). Some of the SDGs have direct or indirect effects on lower population growth such as universal access to sexual and reproductive health-care services. These are family planning, information and education, and the integration of reproductive health into national strategies and programmes (4). The SDG goals that relate to child mortality, maternal mortality, causes of death, and reproductive health can be translated directly into future mortality and fertility trends.

The 2020 sustainable development progress report shows that human population growth is a critical barrier to achieving the SDGs and that, strong population policies can fundamentally improve the trajectory toward the achievement of the goals. According to Robin Maynard, a better world with security and opportunity for all cannot be formed where there is continued rapid population growth (2). Therefore, it is required to reduce fertility and birth rates. A study on the global burden of disease from the US suggests that continued trends in female educational attainment and access to contraception will hasten declines in fertility and slow population growth (5). The fertility rate seems to be high while the prevalence of contraceptive use is reported to be low (5, 6).

Nigeria has a high fertility rate and a low level of contraceptive use of less than 10%. The Nigeria Demographic and Health Survey (NDHS) report gave the number of births per woman in 2008, 2013 and 2018 as 5.7, 5.5 and 5.3 births per woman, respectively. There were fertility differentials by zones where the Northern part of the country had a higher fertility compared with the Southern part of the country (7, 8, 9). In a bid to direct policies to address fertility in the country, it is important to identify factors associated with fertility in the country so that population growth can be controlled, leading to the achievement of the SDGs.

Some studies from Nigeria have identified the age of respondents at first birth, contraceptive methods, marital status, and educational level among others as associated factors of fertility (10, 11, 12, 13). Other studies have also reported that region and unemployment influenced fertility (11,13).

However, there are very few studies particularly looking at the northern part of the country which has a relatively high fertility level compared with the southern part of the country. This study therefore is aimed at identifying the factors associated with fertility among women in northern Nigeria.

Methods

Study design/Data collection

The study made use of the 2018 Nigeria Demographic and Health Survey (NDHS) data**.** This was a two-stage stratified sample design. A total of 25540 women from the Northern zone were extracted from the data set for this study. A detailed description of the study design and data collection procedures is found in the report of NDHS 2018 (7).

Study variables

The response variable was the fertility of the women (children ever born) while the independent variables were the age of the respondent, place of residence, highest educational level, husband/partner's education level, sex of household head, wealth index, religion, ethnicity, ever use of FP method, age at marriage,

respondent's occupation, other wives, and child death experience.

Statistical Analysis

Statistical package for Social Sciences (SPSS) IBM version 23 (SPSS Inc., Chicago, Illinois, USA) and R programming package were used for the analysis. A negative Binomial model was applied to the data, and Incidence rate ratios (IRR) were obtained. A negative Binomial model is used when the variance of the data is greater than the mean and p-value < 0.05 was considered to be significant.

The Negative Binomial regression model is given as:

$$P(y;\mu,\alpha)=\frac{\Gamma\left(y+\alpha^{-1}\right)}{y!\Gamma\left(\alpha^{-1}\right)}\left(\frac{\alpha\mu}{1+\alpha\mu}\right)^{y}\left(\frac{1}{1+\alpha\mu}\right)^{\alpha^{-1}},\ \alpha>0 \quad (1)$$

$$\mu_{ij}=\exp\left(\beta_0+\beta_i X_{ij}\right) \quad (2)$$

$$\log\left(\mu_{ij}\right)=\beta_0+\beta_i X_{ij} \quad (3)$$

Results

The estimates and Incidence Rate Ratios (IRR) of the Negative Binomial Model on children ever born or the fertility of women in Northern Nigeria are shown in Tables 1 and 2a. Women aged 20- 49 years had more fertility than women aged 15 -19 years (p< 0.001). Urban women experienced 3.1% less fertility than women in the rural area of the Northwest zone (p< 0.05). Women with no education, primary education and secondary education experienced 42%, 43% and 26% (p<0.001) less fertility respectively than those with higher education. Women who knew their husband's level of education had lower fertility as compared to those who did not know their husband's level of education (p<0.001), while those with secondary education in the Northwest had high fertility (p<0.05).

Women with male household heads gave birth more than female household heads. The same results occurred in the North-Central and North-East (p< 0.05). Women with the poorest wealth index had fertility 2.7% (p<0.05) more than the middle wealth index, while women with the richest wealth index had 6.1% (p<0.001) less fertility than the middle wealth index in Northern Nigeria. Moreover, women from Islamic, 17% (p<0.001) and traditional, 24% (p<0.001) religious backgrounds had more children than those from the Catholic denomination. Also, women with an Islamic background in the North-Central had 13.1% (p<0.001) more fertility than those from a Catholic background. Women from other Christian religious backgrounds (except for the catholic religion) had 14% less fertility in the Northeast than the Catholics (p<0.05). Moreover, women with Islamic and African traditional religious backgrounds had 25% and 33.1% respectively more fertility than those with Catholics in the Northwest zone.

Women from the Yoruba ethnic group and others (except for the Igbo ethnic group) had about 17% (p<0.001) and 5% (p<0.001) respectively less fertility than women from the Hausa ethnic group. In the North-Central, women from the Yoruba ethnic group and others (not Igbo) also had significantly (p<0.01) less fertility than women from the Hausa ethnic group. Women from the Yoruba ethnic group alone had significantly less fertility than the Hausa ethnic group in the North-West zone. Respondents who ever used family planning (FP) methods had a 12.4% (p<0.001) increase in the number of children than those who did not use them. Furthermore, women whose ages at first marriage were 15-30 years,31-48, and those who did not marry had fertility of 12.8%, 32.4% and 90.1% less respectively than those with less than 15 years (p<0.001). Respondents who engaged in petty trading had 2.3% (p <0.05) less fertility than those engaged in Agriculture.

Moreover, the number of other wives had no significant association with fertility (p>0.05). Women who experienced child death had fertility 40.1% (p<0.001) more than those without child death while 37.2, 41.6 and 38.5% (p<0.001) more fertility occurred in the North-central, North-East and North-West zones respectively than those without child death (Tables1 and 2b).

Table 1: Negative Binomial Regression of the relationship between Fertility of Women and their Characteristics in Northern Nigeria

Variable	β	IRR Exp(β)	Z- Value	Variable	β	IRR Exp(β)	Z- Value
AGE				**RELIGION**			
15-19 (Ref)	Ref	Ref	Ref	Catholic (Ref)			
20-24	1.146	3.146	35.668***	Islam	0.157	1.17	8.094***
25-29	1.683	5.381	53.872***	Other	0.093	1.097	0.245
30-34	2.015	7.5	64.511***	Other-Christian	-0.021	0.979	-1.078
35-39	2.219	9.198	70.904***	Traditionalist	0.215	1.24	4.320***
40-44	2.335	10.325	74.182***	**ETHNICITY**			
45-49	2.417	11.217	76.553	Hausa (Ref)			
TYPE OF PLACE OF RESIDENCE				Igbo	-0.051	0.95	-1.313
Rural (Ref.)				Others	-0.049	0.952	-6.206***
Urban	0.009	1.009	-0.975	Yoruba	-0.181	0.834	-7.564***
HIGHEST EDUCATIONAL LEVEL				**EVER USE OF FP METHODS**			
No Education	0.353	1.423	14.880***	No (Ref)			
Primary Education	0.359	1.432	15.122***	Yes	0.117	1.124	13.462***
Secondary Education	0.23	1.259	10.194***	**AGE AT FIRST MARRIAGE**			
Higher (Ref)				Less than 15 years (Ref)			
HUSBAND EDUCATION LEVEL				15-30 years	-0.137	0.872	-18.279***
No Education	0.019	1.019	0.644	31 – 48 years	-0.392	0.676	-10.415***
Primary Education	-0.013	0.987	-0.424	Never married	-2.31	0.099	-48.255***
Secondary Education	0.047	1.048	1.57	**RESPONDENT'S OCCUPATION**			
Higher Education	0.049	1.05	1.578	Agriculture (Ref)			
Don't know (Ref)				Artisan	-0.021	0.979	-0.904
SEX OF HOUSEHOLD HEAD				Others	0.058	1.06	0.741
Female (Ref)				Petty trading	-0.023	0.977	-2.189*
Male	0.065	1.067	4.715***	Professional, Technicians and others	-0.024	0.976	-1.117
WEALTH INDEX COMBINED				**NUMBER OF OTHER WIVES**			
Poorer	0.011	1.011	1.041	1-3 wives (Ref)			
Poorest	0.027	1.027	2.517*	None	0.011	1.011	1.569
Richer	-0.022	0.978	-1.744	Others	-0.087	0.917	-1.054
Richest	-0.063	0.939	-3.616***	CHILD DEATH EXPERIENCE			
Middle (Ref)				No (Ref)			
				Yes	0.337	1.401	45.230***

IRR= Incidence Rate Ratio; * p< 0.05, **p<0.01, ***p< 0.001

Table 2a: Negative Binomial Regression of the relationship between Fertility of Women and their Characteristics in Northern Nigeria by Zone

Variable	North-Central Zone			North-East Zone			North-West Zone		
	β	Exp(β)	Z- Value	β	Exp(β)	Z- Value	β	Exp(β)	Z- Value
Age									
15-19 (Ref)									
20-24	0.985	2.678	13.237***	1.134	3.108	20.416***	1.194	3.3	25.630 ***
25-29	1.482	4.402	20.432***	1.675	5.339	30.968***	1.754	5.778	38.770 ***
30-34	1.818	6.16	24.998***	1.978	7.228	36.558***	2.1	8.166	46.451 ***
35-39	2.011	7.471	27.663***	2.189	8.926	40.386***	2.306	10.034	50.795 ***
40-44	2.118	8.314	28.926***	2.293	9.905	42.051***	2.434	11.404	53.395 ***
45-49	2.212	9.134	30.167***	2.356	10.549	42.822***	2.519	12.416	55.120 ***
Type of place of residence									
Rural (Ref.)									
Urban	-0.017	0.983	-0.893	0.024	1.024	1.175	-0.031	0.969	-2.254 *
Highest educational level									
No Education	0.349	1.418	9.119***	0.321	1.379	6.588***	0.338	1.402	8.085 ***
Primary Education	0.332	1.394	8.864***	0.358	1.43	7.247***	0.356	1.428	8.374 ***
Secondary Education	0.212	1.236	6.159***	0.214	1.239	4.497***	0.225	1.252	5.454 ***
Higher (Ref)									
Husband education level									
No Education	0.01	1.01	0.142	-0.026	0.974	-0.468***	0.035	1.036	0.908
Primary Education	-0.015	0.985	-0.222	-0.075	0.928	-1.283***	0.006	1.006	0.148
Secondary Education	0.011	1.011	0.16	0.007	1.007	0.116	0.081	1.084	1.991*
Higher Education	0	1	0.006	-0.017	0.983	-0.284***	0.082	1.085	1.928
Don't know (Ref)									
Sex of household head									
Female (Ref)									
Male	0.063	1.065	3.058**	0.065	1.067	2.099*	0.043	1.044	1.8
Wealth index combined									
Poorer	0.016	1.016	0.823	-0.001	0.999	-0.044	-0.007	0.993	-0.433
Poorest	0.018	1.018	0.78	0.024	1.024	1.139	-0.002	0.998	-0.103
Richer	0.011	1.011	0.506	-0.028	0.972	-1.079	-0.032	0.969	-1.568
Richest	-0.039	0.962	-1.403	-0.029	0.971	-0.716	-0.052	0.949	-1.8
Middle (Ref)									
Religion									
Catholic (Ref)									
Islam	0.123	1.131	4.966***	0		0.005	0.219	1.245	3.802 ***
Other	-0.139	0.87	-0.241	0.239	1.27	0.464	-0.055	0.946	-0.908
Other-Christian	-0.008	0.992	-0.346	-0.149	0.862	-2.434*	0.286	1.331	3.530 ***
Traditionalist	0.087	1.091	1.035	-	-	-	0.219	1.245	3.802 ***

IRR= Incidence Rate Ratio; * p< 0.05, **p<0.01, ***p< 0.001

Table 2b: Negative Binomial Regression of the relationship between Fertility of Women and their Characteristics in Northern Nigeria by Zone

Variable	North-Central Zone			North-East Zone			North-West Zone		
	β	IRR Exp(β)	Z- Value	β	IRR Exp(β)	Z- Value	β	IRR Exp(β)	Z- Value
Ethnicity									
Hausa (Ref)									
Igbo	-0.033	0.968	-0.653	-0.154	0.857	-1.434	0.004	1.004	0.036
Others	-0.075	0.928	-3.176**	-0.026	0.974	-1.657	0.009	1.009	0.624
Yoruba	-0.138	0.871	-4.233***	-0.057	0.945	-0.288	-0.254	0.776	-3.085**
Ever-use of FP methods									
No (Ref.)									
Yes	0.154	1.166	10.159***	0.119	1.126	7.701***	0.087	1.091	5.775 ***
Age at first marriage									
Less than 15 years (Ref)									
15-30 years	-0.175	0.839	-10.053***	-0.147	0.863	-10.627***	-0.113	0.893	-10.722 ***
31 – 48 years	-0.504	0.604	-8.787***	-0.491	0.612	-4.835***	-0.208	0.812	-3.554 ***
Never married	-2.472	0.084	-30.471***	-2.093	0.123	-27.706***	-2.572	0.076	-25.113 ***
Respondent's occupation									
Agriculture (Ref)									
Artisan	-0.134	0.875	-2.703**	-0.027	0.973	-0.722	0.011	1.011	0.248
Others	0.104	1.11	0.621	0.052	1.053	0.441	-0.033	0.968	-0.235
Petty trading	-0.067	0.935	-3.850***	-0.011	0.989	-0.677	-0.032	0.969	-1.043
Professional, Technicians and others	-0.084	0.919	-2.187*	-0.062	0.94	-1.094	-0.022	0.978	-0.548
Number of other wives									
1-3 wives (Ref)									
None	0.002	1.002	0.118	0.009	1.009	0.656	0.017	1.017	1.583
Others	-0.051	0.95	-0.579	-0.59	0.554	-1.442	0.018	1.018	0.048
Child death experience									
No (Ref)									
Yes	0.316	1.372	21.567***	0.348	1.416	25.957***	0.326	1.385	28.080 ***

IRR= Incidence Rate Ratio; * p< 0.05, **p<0.01, ***p< 0.001

Discussion

This study has looked at factors associated with the fertility of women in Northern Nigeria which consists of three zones. Generally, in the Northern zone, the age of the respondents was significantly associated with fertility. Children born to women aged 20- 49 years were more than those of ages 15 -19 years. This was similar in all the three zones. This means that as the age of the women was increasing, they were giving birth to more children. The result was similar to that of Fagbamigbe et al and others (11, 14, 15, 16, 17). In the Northwest zone, fertility was higher in the rural than in the urban, which was similar to previous studies (10, 11, 16, 18, 19, 20, 21, 22). Women with no education, primary education and secondary education gave birth to more children than those with higher education. This indicates that those with higher education might have spent some time in school before giving attention to marriage which will eventually affect their fertility rate. In the Northwest zone, women whose husbands had secondary education delivered more children than others. More educated husbands must have been more informed about the importance of family planning than those who were not. This conformed with other studies that

higher educational attainment reduces the number of children ever born (10, 13, 14, 16).

The household head was another factor significantly associated with the fertility of women in the North; North Central and North-East zones. Studies have reported that women whose household heads were males gave birth to children more than female household heads (13, 18). Sometimes female becomes household head as a result of divorce, widowhood or non-marriage. Women with female household heads with no sexual activity or infrequent sex are at minimal risk of pregnancy. Those who are married are less sexually active than women in male household heads because their husbands frequently do not live with them, therefore resulting in a low birth rate (18, 23, 24). Supporting previous studies, women with the poorest wealth index delivered more children than those in the middle wealth index (10, 11, 13, 19, 20, 25, 26, 27).

Mothers who practiced Islamic and traditional religions had more births than their counterparts who were of catholic background in north central and northwestern zones. This might be a result of the belief of women practising Islamic or traditional religion about the number of children a particular person has in a family. It might also be due to desire or preference for a particular sex. Previous studies gave similar reports that women from Islamic backgrounds and highly religious had more children than their counterparts from other religions. People from the Islamic religion see having many children as a great achievement, especially in their old age (16, 27, 26).

Furthermore, the Hausa/Fulani ethnic group gave birth to children than other ethnic groups. Apart from the fact that this study concentrated on northern Nigeria, studies have shown that fertility among the Hausa/Fulani ethnic group was higher than others (10, 19, 26). The use of family planning (FP) methods is supposed to reduce the fertility of women as found in other studies (25, 26). In this study, those who claimed to have used one method of family planning or the other experienced more fertility than those who did not, which is contrary to some previous studies. However, this was similar to what was reported by Akpa and Ikpotokin (10). The improper or ineffective use and failure of the methods might be the cause of the pregnancy.

Early marriage has been established to significantly affect fertility, especially in northern Nigeria. Women of ages less than 15 years experienced more fertility than other age groups in this study, which is in line with other studies (16, 26)**.** One of the reasons for early marriage in this zone might be due to their orientation concerning education and religious belief.

This study has also shown that respondents who engaged in agriculture experienced higher fertility than other types of occupation. Some people believe in having many children because they will assist them in taking care of their farm. The result was similar to the previous studies reported by Fagbamigbe, Olatoregun and Alaba that those who were employed gave birth to more children than those who were not (11, 13, 19).

Finally, this study revealed that the number of children ever born has a direct relationship with child mortality. The reason might be as a result of finding a way of compensating for the dead children; similar to the report that as the number of deaths increased, fertility also increased (21).

Conclusion

This study has shown that there were variations in determinants of fertility in the Northcentral, Northeast and Northwest zones. Age of the respondents, sex of household head, wealth index, religion, ethnicity, use of FP, and child death experience were among the factors associated with fertility. Intervention programmes aimed at reducing fertility with more attention to the factors mentioned above will go a long way toward controlling the fertility rate in Nigeria. Education of female children should be given extra attention because this will enable them to be more informed.

List of Abbreviations

SDG: Sustainable Development Goals
NDHS: Nigeria Demographic and Health Survey
FP: Family planning
IRR: Incidence rate ratios

Declarations

Ethics approval and consent to participate

Ethical approval for data collection for the NDHS was documented in the 2018 NDHS report (7).

Consent for publication

All the authors gave consent for the publication of the work under the Creative Commons Attribution-Non-Commercial 4.0 license.

Availability of data and materials

The data sets used and analyzed during the current study are available from the corresponding author on request.

Competing interests.
The authors declare that they have no competing interests

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Nil.

Authors' contributions
OKS conceived the study, did the data extraction, and analysis and wrote the first draft of the manuscript. OOO reviewed the manuscript and made substantial input into the intellectual content of the manuscript. DOJ reviewed, reconstructed the introduction and made substantial input into the intellectual content of the manuscript.

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