Spatial Determinants of Fertility Rate and Child Survival in Nigeria's Geopolitical Zones

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ABSTRACT

This study examines the spatial determinants of fertility rate and child survival in the six geopolitical zones in Nigeria. Data were sourced from the Nigeria Demographic and Health Survey report (NDHS, 2018). By employing probit and OLS techniques, the study outcome indicates that women from the South-south and South-west have significantly lower fertility rates compared to women in other geopolitical zones in Nigeria. However, women from North-west were found to have the highest fertility rate. The second finding of the study disclosed that the child parent education level, their wealth level and their occupation has a positive impact on the child survival. Given these outcomes the study thus suggests that there is a need for women of child-bearing age, most especially those in northern part of Nigeria to be well educated on issues relating to infant's nutritional needs, values of immunization, and vaccinations.

Keywords: fertility rate, child survival, geopolitical zones, probit, OLS, immunization, vaccinations, household, wealth and Nigeria.

INTRODUCTION

Fertility and child health have continued to attract the attention of policymakers around the world as the two concepts lie at the nucleus of population change. One of the objectives of the Sustainable Development Goals (SDGs) is to achieve good lifestyles and to promote well-being for all. The major purpose of this objective is to reduce unnecessary fatalities among newborns and children under five years of age. All groups need to witness a 50% drop in the early childhood death rate by 2030 to accomplish this target (SDG 3.2).

Although Nigeria holds the largest economy in West Africa, more than 64 per cent of the population lives in poverty, with three in four children living with multi-dimensional poverty (UNICEF, 2017). One in eight children does not live to witness their fifth birthday, and 19.5 million children under the age of five have no birth registration, or more than 60%. For example, in Nigeria 43 percent of the population is in the richest quintile, with a Gini factor of 0.18, vs 4.6 percent in the rural population, with a Gini factor of 0.35. [UNICEF, 2015]. Moreover, the geopolitical area of the South West has the greatest quintile of wealth, at 49.8%, followed by South-South and South-East respectively, with 31.3%, and 27.9% (National Demography and Health Survey, 2013). The North East and North West are the lowest quintile with 40 percent and 35 percent respectively.

Currently, Nigeria is experiencing an exponential population growth rate and there is a large population momentum with a 3.2% growth rate (Stonawski, Potančoková, Cantele, & Skirbekk, 2016) leading to the projected population of 195.87 million (TradingEconomics.com / National Bureau of Statistics Nigeria, 2019). The figure below shows the population trend in Nigeria from 2009-2018.

Figure 1.1: Population Trend in Nigeria from 2009-2018

Source: Trading Economics.com/National Bureau of Statistics, Nigeria 2019.

According to estimates, Nigeria would be the world's seventh most populous country by 2050, with a population of close to 300 million people (United Nations, Department of Economic and Social Affairs, Population Division (UNDESAPD), 2017). Nigeria's population increased significantly from 17.3% in 1967 to 49.4% in 2017 (Policy Project/Nigeria, 2018).

Nigeria consists of 36 States and a Federal Capital Territory (FCT) that are currently classified in six geopolitical regions: The North-central, the North-Eastern, North-West, South-South and the South-west. With all these population increase and different geopolitical zones, Nigeria's socio-economic indicators still varies. Future population growth is highly dependent on future fertility and child survival rates, as even slight variations in childbirth frequency and survival rates, when projected over several decades, can result in substantial alterations in the total population. The country is faced with an 86 percent dependency rate (Central Intelligence Agency World Factbook, 2019) and a slight movement of Gross National Income from $1,180 in 2010 to $1,812 per capita in 2016 (World Data Atlas, 2018). Likewise, 50 percent (86.9 million) of Nigerians are living in extreme poverty (Yomi, 2018), combined with other related longitudinal factors (climate, women occupations, culture, etc.) which have implications for the health status of Nigeria, especially infant, pregnant women, and child mortality rates.

The fertility rate is an excellent predictor of a country's population change potential. In the late 1990s, most affluent countries saw a significant drop in the number of children per woman, from the typical six to two or fewer (Bongaarts, 2001; 2010). This is pronounced in industrialized countries, particularly Western Europe, where populations are predicted to decline histrionically over the next 50 years (CIA World Factbook, 2018). Despite the dropping fertility rate, the total fertility rate (TFR) in Sub-Saharan Africa, and particularly Nigeria, remains high. The TFR in SSA is on average five children per woman, although countries like Chad, Mali, Niger, and Nigeria have around six to seven children per woman (United Nations: World fertility report, 2013). The fertility rate in Nigeria in five years interval (2015-2020) is given at approximately 5 children per woman (UNDESAPD, 2019).

Davis and Blake (1956) highlighted the role of socioeconomic fertility factors, specifically distinguishing between factors that directly affect fertility and factors indirectly influencing fertility by identifying the direct drivers or intermediate fertility variables as they mediate fertility with any other variables. According to Bongaarts (2010), the direct and indirect variables together comprise a whole series of methods through which socioeconomic and cultural factors influence fertility. For example, those with more education have access to more contraceptive knowledge that can alter fertility. According to Nigeria's 2013 NDHS report, urban women had an average of five children per woman, while women had an average of six children per woman in rural

communities. The Northwest area has the greatest fertility rate in geopolitical areas with an average of 7 children per woman and a lowest fertility in the South-South zone with an average of four children per woman. Fertility rates vary depending on education and economic status, with women who have more than one secondary school having three children on average compared to women without an education with seven children, with a difference of three. Thus, the fertility rate appears to be highly correlated with low income and poverty. The report shows that young motherhood is common in the North particularly North West Zone with 36 percent compared to South East and South West Zones with 8 percent each (NDHS, 2013), which could be attributed to cultural practices. In addition, the desired family size by Nigerian women on average is "7 children while men want 8 children. Women's ideal family size is highest in North West Zone (8) and lowest in South West Zone (5)".

Table1.1. Total fertility rate distribution in the six geopolitical zones in Nigeria

Regions	TFR (2008)	TFR (2011)	TFR (2013)	TFR (2016)
North Central	5.4	4.9	5.3	5.3
North East	7.2	6.7	6.3	6.4
North West	7.3	7.2	6.7	7.3
South East	4.8	5.1	4.7	4.6
South-South	4.7	4.9	4.3	4.3
South West	4.5	5.1	4.6	4.4

Source: UNICEF Multiple Indicator Cluster Surveys, 2017 and NDHS Program, 2013.

In the years 2045-2050, no country is predicted to have a fertility rate higher than five births per woman (UNDESA/PDWPP, 2017), and the child survival rate must have improved to a reasonable height. In analyzing the rate of population of a country, fertility rate and child survival rate are of importance.

In Nigeria, dealing with the deaths of infants and pregnant women throughout the perinatal, early, or late neonatal periods, childhood, or adolescent years is a challenging undertaking. Given these, any struggle or investment towards reducing under-five and maternal mortality and fertility rate in addition to constant evaluation of the progress will totally be accepted. The rates of fertility, maternal mortality, and child survival in Nigeria vary by geopolitical zone. Regional disparities in infant mortality, maternal mortality, and fertility rates are linked to societal, ethnic, and individual characteristics that distinguish these geographical zones. Differences in economic, social, demographic, environmental, communal, or behavioral development (Antai, 2010 & Buwembo, 2010) are some of these determinants, as are the availability of mother and child health care services. Mosley and Chen (1984) and Mosley (2006) classified these factors as direct and indirect, with indirect factors referred to as underlying factors such as the mother's education, wealth status, place of residence, and religion, among others, and direct factors referred to as proximate determinants such as birth order, breastfeeding, type of birth (single or multiple), immunization, and so on. Overall, each of the factors discussed below has influenced the differences across Nigeria's six geopolitical zones in some way. The North West and North East regions among the rest are worst hit on average by the under-five and maternal mortality in addition to high fertility rate in the country. The index of education level, wealth distribution, access to health facilities (antenatal, etc.), occupation, and access to basic amenities among women are least in the zones.

The efforts toward attaining the SDGs in the country seem to be far from being achieved as the proportion of infant and child survival and maternal mortality rate decrease cannot be compared with the rate at which the Nigerian population is growing (fertility rate problem). Furthermore, weak health systems stifle growth in many low- and middle-income nations, highlighting the significance of investing in health system reinforcement, with a particular focus on the community as a vital component of the broader health system (UNICEF, 2016). Thus the issue of population control by the government which translates to improved standard of living and decrease in the mortality rates of all form among other indicators are very important in Nigeria, knowing that the six geopolitical zones in Nigeria have shown varying degrees in the levels of education, wealth, vegetation, health facilities, and awareness to the importance of vaccination, among others.

There are studies in Nigeria that have looked at issues around fertility. These studies among others include the work by Akpotu (2008); Akpa and Ikpotokin (2012); Oyefara (2012); Nigerian Demographic Dividend Report

(2016), Alaba, Olubusoye and Olaomi (2017) and Olawole-Isaac, Oni, Oladosun, and Amoo (2018) which will be discussed later. For instance, Low fertility conditions in Nigeria include secondary or higher educational levels of mothers, Yoruba ethnicity, religion, family planning, increased wealth, previous Caesarean births at first birth, a residence on a rural site and numbers of children in a household, gainful employment, marriage and living with a partner, community and household (Alaba, Olubusoye & Olaomi, 2017).

However, this study examines the spatial determinants of fertility rate and child survival in the six geopolitical zones in Nigeria. Data were sourced from the Nigeria Demographic and Health Survey report (NDHS, 2018). By employing two probit models and one OLS technique, the study outcome indicates that women from the South-south and South-west have significantly lower fertility rates compared to women in other geopolitical zones in Nigeria. However, women from North-west were found to have the highest fertility rate. The second finding of the study disclosed that the child parent education level, their wealth level and their occupation has a positive impact on the child survival. Finally, the study results further disclose that household's size has a positive impact on the child's weight.

LITERATURE REVIEW

METHODOLOGY

Theoretical Framework

The theoretical framework in this research is the analytical framework for the study of child survival in developed countries by Mosley & Chen (1984). This framework was an extension of the framework on fertility that was first proposed and introduced by Davis & Blake, (1956) as a result of the growing study of fertility and other determinants of child survival. It suggests that there are certain factors socially that help to influence the level of fertility which usually operated within the group of three out of eleven selected variables that are intermediate. Thus the social factor has a way of affecting the intermediate variable which may lead to either an increase or a total decline in fertility conditions as a result of a possible change in the intermediate variable which sometimes is not sufficient conditions to change the pattern of fertility. The framework on fertility has been proven by social scientists to be better off than the household health production function given that both social factors and intermediate variables are all closely related to the reproduction process. Mosley & Chen (1984) expanded this assertion in their analytical framework in which they argue that there are basically four variables that can promote the level of fertility. These are the cultural factors, the health system, the social background factors, and economic variables, not to say that there are no other determinants that can exhaustively influence fertility which could be under-listed as proximate determinants which can directly affect a single outcome.

These proximate determinants could be in five variables of which are maternal factors, environmental effects in air, food, the nutrient deficiency in food components, injury due to accidents and finally illness under control. The framework suggests that both child growth and child mortality are all affected by one nutritional condition; the weight for age is mainly ascertained by the measure of their health degree which agrees with their nutritional status (Kenneth, 1984). Most researchers argue that the proximate determinants should not just be for the purpose of making reproductive growth and death but can be used in the measurement of population study which could be a direct influx or indirect mix to socioeconomic determinants. These are always the independent variables as seen in the proximate determinants which have the tendency to affect mortality and falter growth. Thus, these socioeconomic factors proxied by proximate determinants could be grouped into three: (1) the individual variable that encloses the father and mother and other norms and traditional attitudes, (2) household variable which focuses on the income and wealth levels, and (3) the community variable which relates to political tempo, health, economy, and the ecological conditions. However, the central aim of the analytical framework is to present a wide study of child survival and clarify our understanding and quest to the factors that are involved in the reproduction process of healthy children in the family. Thus, the framework allows for the incorporation of spatial factors in the study of fertility and child health. The proximity to the capital, temperature, soil type, altitude, rainfall amongst other indicators, affect the economic activities of people in a different geopolitical locations which invariably reflects on the poverty status. The framework is shown schematically in the following diagram.

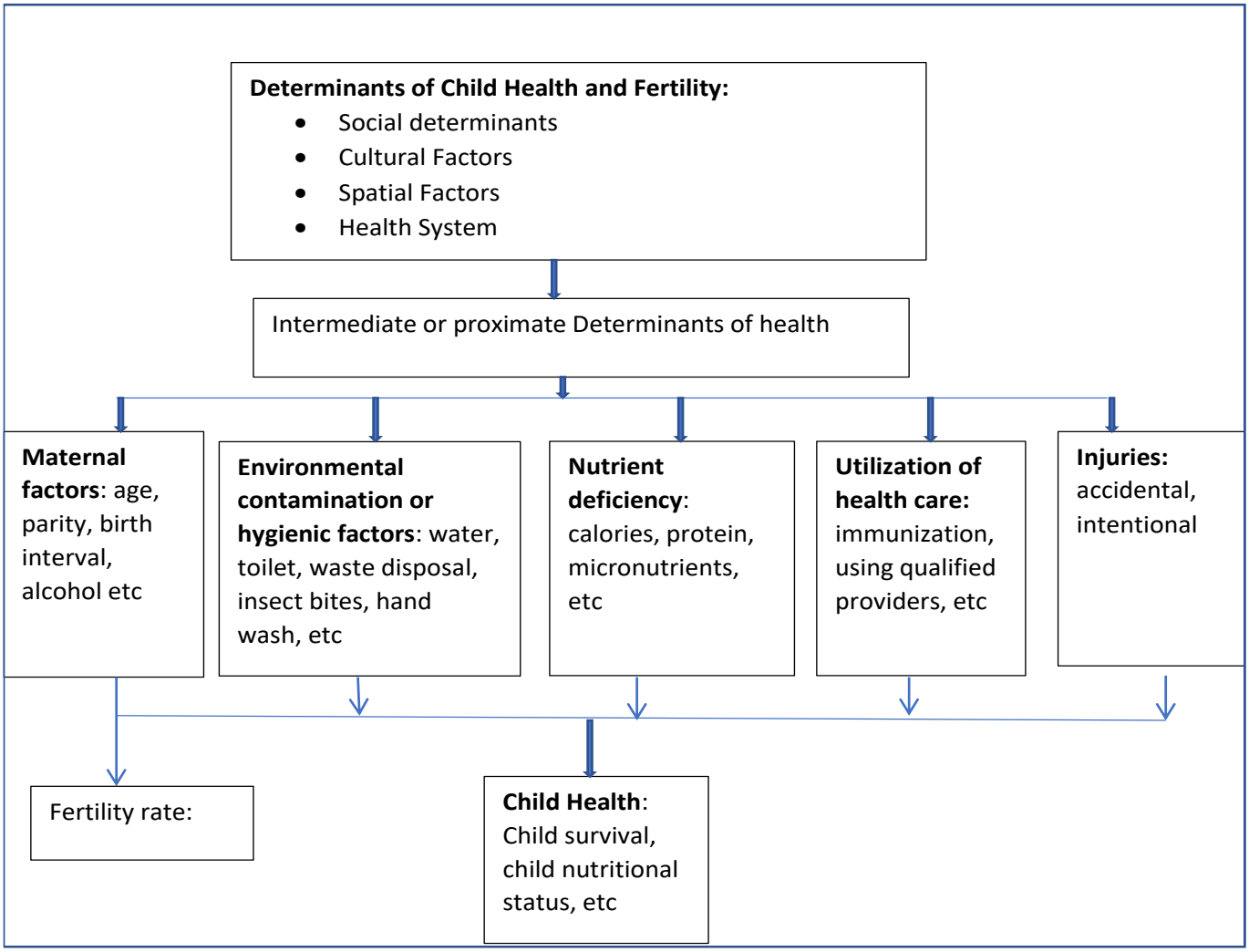

Figure 3.1: Adapted from Mosley and Chen (1984) Analytical Framework for the Study of Child Survival

Model Specifications

To ascertain the impact of spatial factors on child survival and child health in the geopolitical zones in Nigeria, two models are specified. The first model has the child survival indicator as the dependent variable and the second model has the child health indicator, for example, child nutritional status as the dependent variable. These models are specified in equations (3.1) and (3.2) respectively. The models estimated are probit models because the dependent variables take 1 and 0.

For Child Survival

$$Survive = \beta_0 + \beta_1 Geopolitical + \beta_2 Mothereduc\ level + \beta_3 Hhwealth + \beta_4 Hhsize + \beta_5 Mothoccup + \beta_6 Ethnic + \mu --3.1$$

Where;

$Survive$ = Child survival

$Geopolitical$ = Geopolitical zones

$Mothereduc\ level$ = Mother's education level

$Hhsize$ = House hold wealth size

$Hhwealth =$ Head of household wealth

$Mothoccup$= Mother's occupation

$Ethnic =$ Ethnicity

$\beta_0 =$ Intercept

$\beta_1 - \beta_6 =$ Coefficient of Independent Variables

$\mu =$ Error term

For Child Health

$$Chihealth = \beta_0 + \beta_1 Vitamin + \beta_2 Mothereduc\ level + \alpha_1 Mothoccup + \alpha_2 Hhwealth + \alpha_3 Presid + \alpha_5 Gender + \delta_1 Ethnic + \varphi_2 Hhsize + \theta Geopolitical + \mu - -3.2$$

Where;

$Chihealth =$ Child health, however in this study, we proxy child health with the variable child nutritional status which is described in terms of child stunting and underweight.

$Gender =$ Child's gender

All other variables as contained in the model are explained as the ones in equation 3.1.

Another objective is to ascertain if the fertility rate in the geopolitical zones in Nigeria is determined by spatial factors. Nigeria has six geopolitical zones and the closer a geopolitical zone is to another the more they share similar geographical characteristics. However, there are some spatial factors that vary significantly across the geopolitical zones that may exert some influence on the fertility rate. These factors include religion, ethnicity, education, temperature, household size, poverty rate, climate, and so on. However, not all the spatial factors are captured in the DHS 2018 survey. Based on the variables that were captured in the dataset, we specify equation (3.3) for spatial determinants of fertility rate-controlling also for socioeconomic determinants and other proximate determinants.

$$Fertility = \beta_0 + \beta_1 Mothereduc\ level + \alpha_1 Hhwealth + \alpha_2 Motherage + \alpha_3 Motheroccup + \delta_1 Utilization + \varphi_1 Ftype + \varphi_2 Ethnic + \theta Geopolitical + \mu - - - - - - - - - 3.3$$

Where;

$Fertility$ = fertility rates are calculated as an average number of children born per woman using the all women factor in the DHS data and it is not necessarily counting the number of births as counts.

$Utilization =$ Mother Healthcare utilization rate; mother's utilization of health facilities and adult health status of the mothers etc.

$Ftype =$ Family type

All other variables as contained in the model are explained as the ones in equation 3.1.

Variable Description and Source

Table 3.1: Variable Description and Source

Variable	Description	Source
Survive	This is a measure of child survival and it is inversely proxy by child deaths	NDHS

Geopolitical	This represents the six geopolitical zones we have in Nigeria it indicates whether the child's mother is from southeast, southwest and so on	NDHS
Mothereduc level	A measure of the child's mother's educational qualification, it entails whether the child's mother is illiterate or educated at any level.	NDHS
Hhwealth	This measures the wealth of the head of the household, it is classified as rich, middle class and poor	NDHS
Mothoccup	This a measure of the child-mother employment status it entails whether the child mother is employed or not	NDHS
Ethnic	A variable for ethnicity; it indicates whether the child mother is Igbo, Hausa, or Yoruba	NDHS
Chihealth	A measure for child health, however in this study, we proxy child health with the variable child nutritional status which is described in terms of child stunting and underweight.	NDHS
Gender	This shows whether the child is a male or a female	NDHS
Fertility	This is calculated as an average number of children born per woman using the women factor in the DHS data and it is not necessarily counting the number of births as counts.	NDHS
Ftype	Family type; it indicates whether the child mother is from a polygamous or monogamous family	NDHS
Utilization	Mother Healthcare utilization rate; mother's utilization of health facilities and adult health status of the mothers etc.	NDHS

Source: Constructed by the author

This study used secondary data from the 2018 Nigeria Demographic and Health Survey (NDHS), which was downloaded with permission from ICF Macro Inc. in the United States. It collected data on women aged 15 to 49 and children aged 0 to 5 years in Nigeria. Maternal education and child mortality were among the topics included in the sample survey, which was conducted at the national, regional, and state levels across rural and urban areas. The sample for the 2018 NDHS was chosen using a stratified two-stage cluster design, with enumeration areas serving as sampling units in the first stage. The second stage will consist of a complete listing of households in each of the 1,400 (1389 clusters) enumeration regions that have been selected. For the poll, a representative sample of around 40,680 households was chosen.

The cluster design, however, consisted of 1389 clusters divided between urban and rural areas, with a total of 40,680 families interviewed (16,740 in urban areas and 23,940 in rural areas). For each cluster, non-fixed sample households were chosen. A nationally representative sample of 28,000 women in all chosen families, as well as 14,000 men aged 15 to 59 in one-third of the households, were interviewed. All women aged 15 to 49 who were either permanent residents or visitors in the houses in the 2018 NDHS sample on the night before the survey were interviewed equally.

Estimation Techniques

One of the challenges in estimating models with social determinants of health as proximate determinants is structural versus reduced form models since endogeneity problem often characterizes estimation of structural models. But estimating the reduced-form models has little policy implications since parameters only measure correlation but not causality. Given this problem, the estimation of equations 3.1, 3.2, and 3.3 requires a technique that will be sufficient to overcome the endogeneity problem. One of these techniques is the instrumental variable (IV) technique which involves the use of relevant instruments that are correlated with our main explanatory variable, but not with the explained variable. The instrument (commonly referred to as Z) must satisfy the following two conditions: (i) cov (Z, aid) $\neq 0$, and (ii) cov (Z, ε) = 0, that is; the instrument should be highly correlated with main explanatory variable but uncorrelated with the error term (Asra, et al., 2005). Our search for ideal instruments was so frustrating this, however, complicates our efforts at implementing the instrumental variable (IV). However, the endogeneity was tests carried on the models and the results indicated

that spatial factors included in the models are exogenously determined and thus makes unbiased and consistent estimation of the coefficients possible of maxim.

Furthermore, since the dependent variables of equations (3.1) and (3.2) are dichotomous, they are estimated as probit models using the method of maximum likelihood estimator. The probit model is appropriate because the distribution of child health variables used in the model is approximately normal. Equation (3.3) can be estimated by using OLS since the calculation of fertility in DHS data adjusted by all women factor appears is continuous instead of countable.

RESULTS PRESENTATION

Descriptive Statistics and Analysis

Table 4.1 shows the distribution of child health outcomes and child deaths by the six geopolitical zones in Nigeria. Even though the mean outcomes are not so favourable in the Northern parts of the Country, North West appears to have the worst mean outcomes in terms of the proportion of children that are stunted, underweight, and the number of child deaths. For example, a look at an average number of children that are stunted shows that while it is 57.58%, 48.83%, and 28.21% in the North West, North East, and North Central respectively, the corresponding numbers for the South East, South-South and South West are respectively 18.99%, 22.22%, and 22.81%. Also, the number of children that are underweight across the geopolitical zones follows a similar trend. While the percentage of children that are underweight are respectively 36.88%, 29.37% and 14.80% in North West, North East and North Central, the figures for the South East, South-South and South West are 11.16%, 11.93%, and 13.45% respectively. These numbers suggest that there are significant differences in the extent of child malnourishment across the geopolitical zones which consequently are risk factors for child deaths which are also different across the zones. A look at the numbers shows that North East and North West have outcomes that are more than 2 to 3 times those of other zones.

Furthermore, the number of child deaths which is the inverse of child survival varies significantly between the North and South. Again, the North West and North East are worse off compared to other zones especially the South West that shows a relatively lower number of child deaths. In terms of percentages, these are 12.80%, 7.91%, and 5.21% for North West, North East, and North Central respectively. In the South, the percentage of child deaths are slightly higher the South East at 3.59%, followed by South-South at 3.21%, while South West is the lowest at 2.79%. These are shown differently in Figure 1 where the probability of child survival between age 0 and 6 is reported. These Figure shows that child survival follows similar trend being lowest in the North West and highest in the South West. The likelihood ratio test statistic of the null hypothesis of homogeneity of child deaths across the zones can be rejected even at the 1% level of significance. This suggests that child deaths and of course child health outcomes are spatially different and may be related to spatially different household and individual characteristics across the zones as well as factors such as terrorism, armed banditry, kidnapping, number of internally displaced persons, and insecurity generally.

Table 4.1: Mean of Child Health Indicators by Nigeria's Geopolitical Zones

Region	mean(stunted)	mean(underweight)	mean(child deaths)
North central	0.2821	0.1480	0.0521
North east	0.4883	0.2937	0.0791
North west	0.5758	0.3688	0.1280
South east	0.1899	0.1116	0.0359
South south	0.2222	0.1193	0.0321
South west	0.2281	0.1345	0.0279

Source: author's estimations with Nigeria DHS using stata software.

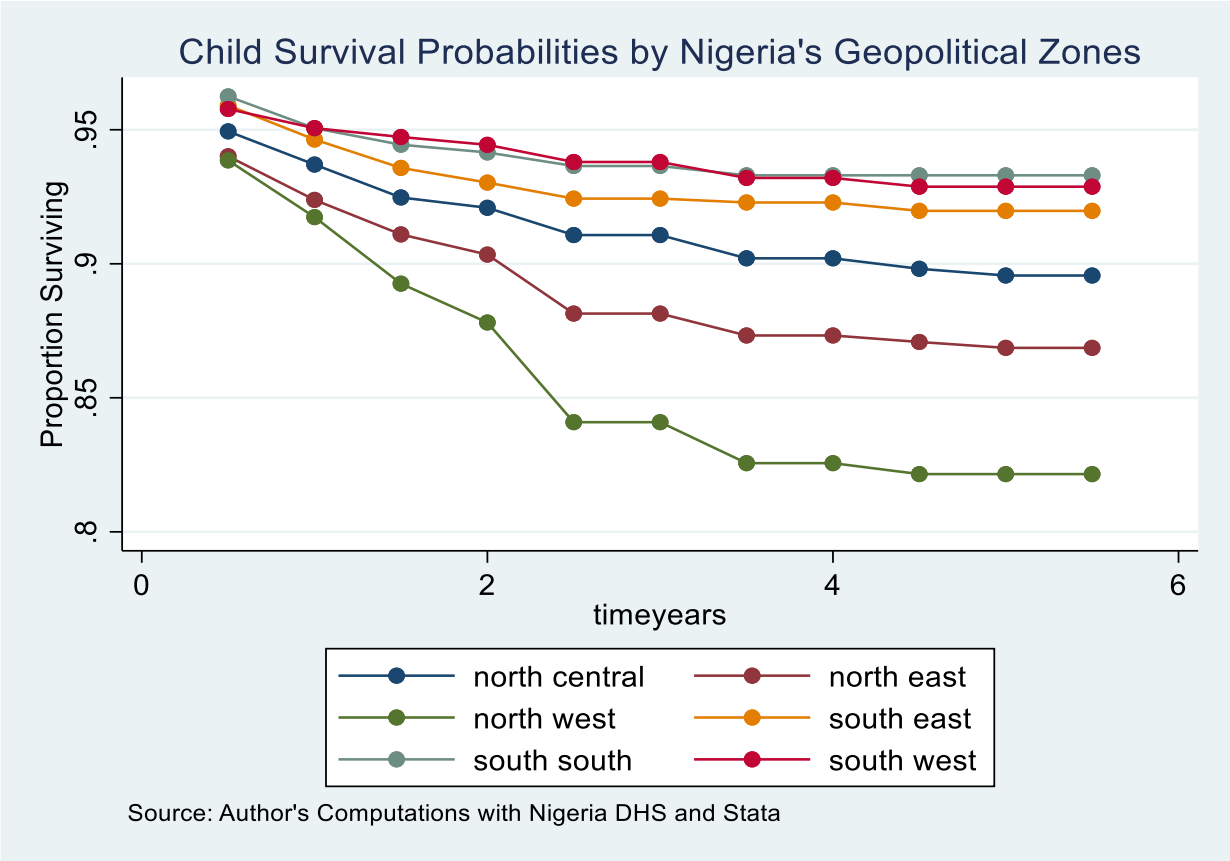

Figure 4.1: Likelihood-ratio test statistic of homogeneity (group=zones): chi2(5) = 367.37109, P = 0.0000

In Table 4.2, the spatial distribution of household characteristics and health utilization variables are reported by geopolitical zones. The variable vita means that the child was given vitamin A supplement and vaccinated means that the child was fully vaccinated. These are used as proxies for health care utilization. It can be seen that these indicators are spatially distributed across the zones. For example, while 7.71% of children had access to vitamin A supplements, in the North East, 8.76% and 14.04% had access in the North West and North Central respectively. But in the Southern part of the country, while 18.84% of southeast children had access to vitamin A supplement, 14.60% and 15.34% had access in the South-South and southwest respectively. The number of children vaccinated follows a similar trend as those that received vitamin A supplements. While the North East saw the lowest percentage of 58.7%, the highest was in the South East where about 85.37% of children received full vaccination. This shows that health care utilization is significantly different by zones except in the South-South and South East the figures look very close. In the case of the North East, one might argue that the activities of terrorists may have affected vaccination outreach. The same can be said of other geopolitical zones in the North where insecurity has made it impossible for women and children to access health care.

Table 4. 2: Spatiality of household Characteristics in Nigeria's Geopolitical Zones

Variable	north central	northeast	northwest	southeast	south-south	southwest
child_deaths	0.0521	0.0791	0.1280	0.0359	0.0321	0.0279
Vita	0.1404	0.0771	0.0876	0.1884	0.1460	0.1534
Education	0.9701	0.4586	0.3356	1.6246	1.5841	1.6057
Wealth	2.9141	2.0476	2.1977	3.4658	3.5263	3.8010
vaccinated	0.7074	0.5870	0.6198	0.8537	0.7557	0.7568
hhsize	7.0680	9.0538	8.9818	6.0546	5.5927	5.1041
occupation	6.5779	5.7870	3.6620	5.8050	5.8840	4.4862
female	0.4873	0.4814	0.4911	0.4939	0.4824	0.4798

Source: author's estimations with Nigeria DHS using stata software.

Table 4.2 also reports household socioeconomic characteristics such as education level of the mother, household wealth index score, and occupation. Demographic characteristics of the households were captured by household size and the gender of the child which in this case takes the value 1 if female child and 0 otherwise. Starting with household demographics, it can be seen that the average household size ranges between 5 to 9, with North East and North West having approximately mean household size of 9, North Central had an average household size of 7, while in the southern part of the country South East commands an average household size of 6 and South West an average of 5. The proportion of children that are females ranges from 0.4798 in the South West to 0.4939 in the South East. In other words, male children account for slightly more than half of the children in the geopolitical zones.

The socioeconomic characteristics show that the education level of the mother, wealth, and occupation are spatially different across all the zones. The Table shows that the average level of education for women is highest in the South East with an average of 1.62, followed by the South West with an average of 1.60 and South-South with an average of 1.58. This suggests that women in these zones on average have at least completed primary education. On the other hand, the average level of education for women in the North West is 0.336, while it is 0.459 in the North East and 0.9701 in the North Central. This implies that the majority of the women in these areas have less than primary education. The wealth characteristics of the households follow the different trends. The South West appears to have the highest wealth index score of 3.80, followed by the South-South with a score of 3.53 and South East with a score of 3.50. But in the Northern part of the country, North East understandably has a wealth index score of 2.05, while the North Central has a score of 2.91. Again, one can see that the wealth characteristics of the households across the geopolitical zones are spatially different and may thus reflect in the health characteristics of the population especially women and children.

Presentations and Discussion of Results.

Table 4.3 reports the probit results and their corresponding marginal effects for objective one which ascertains how spatial characteristics of the geopolitical zones affect child survival. In this case, we chose to use the inverse of survival which is child death in the regression. Two variants of the model were estimated. The first variant is parsimonious in the sense that it was extended in the second estimation reported in column four of the table and the corresponding marginal effects in column five, where rural and ethnicity were introduced in the model to measure how they affect child deaths and hence child survival. In all the estimations, we consistently found that household socioeconomic variables namely education, wealth, and occupation reduce the probability of child deaths and invariable increase the probability of child survival. For example, one level increase in a mother's education increases the probability of child survival by between 1.72% and 2.5% looking at the marginal effects. A unit increase in the household's wealth score increases the probability of child survival by about 1%, while migration to a better occupation or well-paying job by household members increases the probability of child survival by between 0.2% and 0.4%. These results are statistically significant even at the 1% level of significance and suggest that households with better socioeconomic status are highly likely to have a significant number of children surviving in a particular cohort.

Table 4.3: Determinants of Child Deaths and Survival in Nigeria's Geopolitical Zones

	Child_Deaths	**Margeff**	**Child_Deaths**	**Margeff**
Geopolitical Zones				
North East	0.334*** (**0.000**)	0.884*** (**0.001**)	0.984*** (**0.004**)	0.388*** (**0.004**)
North West	0.6078428 (**0.000**)	0.873 *** (**0.000**)	0.325*** (**0.000**)	0.074*** (**0.000**)
South East	-0.1803 (**0.113**)	-0.862 (**0.633**)	-0.743 (**0.864**)	-0.503 (**0.425**)
South South	-0.193*** (**0.004**)	-0.193 *** (**0.019**)	-0.193 *** (**0.055**)	-0.193*** (**0.054**)
South West	-0.114 (**0.182**)	-0.746 (**0.562**)	-0.063 (**0.954**)	-0.1141 (**0.111**)

Mothered Edu Level	-0.205***	-0.0249***	-0.143***	-0.0172***
	(0.000)	(0.000)	(0.000)	(0.000)
Hhwealth	-0.105***	-0.0128***	-0.0776***	-0.00934***
	(0.000)	(0.000)	(0.000)	(0.000)
Hhsize	-0.00389*	-0.000475*	-0.0105***	-0.00126***
	(0.016)	(0.016)	(0.000)	(0.000)
Motheroccup	-0.0316***	-0.00385***	-0.0150***	-0.00181***
	(0.000)	(0.000)	(0.000)	(0.000)
Ethnicity				
Hausa (d)			0.270***	0.0348***
			(0.000)	(0.000)
Yoruba (d)			-0.140***	-0.0155***
			(0.000)	(0.000)
Igbo (d)			-0.0815**	-0.00939***
			(0.001)	(0.001)
r2_p	0.0467	0.0467	0.0543	0.0543
Correctly Classified	92.91%	92.91%	92.91%	92.91%
N	99163	99163	99163	99163

Marginal effects; *p*-values in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: author's estimations with Nigeria DHS using stata software.

As presented in Table 4.3, being a resident of northeast and northwest increases the probability of a child's death and this effect is found to be statistically significant. While a resident of the southeast, south-south, and southwest decreases the probability of child death. However, the impact is only found to be statistically significant only in the south-south while that of southeast and southwest were statistically insignificant.

A further look at table 4.3 shows that households with more members may imply a high survival rate but not necessary to argue that large household size increases survival. Mothers' educational level, head of house wealth, household size, and mother's occupation all decrease the probability of child death. In other words, these variables increase the probability of child survival.

In the extended model in which the major ethnic groups were controlled for, we found that a child born in Hausa has a 3.48% significantly low probability of survival or high probability of dying compared to children born in Yoruba and Igbo ethnic groups that respectively have 1.6% and 0.9% significantly high probability of survival. The model has a high percentage of a correctly classified proportion of children that may die. So it adequate enough for the reliability of the estimates.

Objective two of this study looks at the spatial determinants of child health. In the descriptive statistics, we saw that socioeconomic variables are spatially different across the geopolitical zones. Table 4.4 shows the probit model results of child health variables namely stunting and underweight which are used to measure the extent of malnutrition in children. The marginal effects are used to interpret the results as was done in the case of the child survival model. The results show that one additional level of education of a mother decreases the probability of stunting by about 5.6% and that of underweight by 21.5%. This may be attributed to the fact that women who are more educated are more likely to manage the household health production function better in terms of diets and health care. The household wealth which is a proxy for household expenditure or income in DHS data shows that a unit increase in wealth index score reduces the probability of stunting by about 3.4% and

that of underweight by about 6.1%. The effect of the region is not significant because the variables that are spatially different across regions have been controlled for in the model.

Table 4.4: Determinants of Child Health in Nigeria

Child health	**Stunting**	**Margeff**	**Underweight**	**Margeff**
Vitamins	0.110	0.0417	0.0686	0.0686
Mothereduc level	(0.053)	(0.053)	(0.262)	(0.262)
	-0.147***	-0.0555***	-0.215***	-0.215***
	(0.000)	(0.000)	(0.000)	(0.000)
Mothoccup	-0.00453	-0.00171	-0.0179	-0.0179
	(0.624)	(0.624)	(0.074)	(0.074)
Hhwealth	-0.105***	-0.0398***	-0.0605*	-0.0605*
	(0.000)	(0.000)	(0.041)	(0.041)
Presid				
Rural (d)	0.00110	0.000414	0.0815	0.0815
	(0.986)	(0.986)	(0.248)	(0.248)
Gender				
female (d)	-0.209***	-0.0789***	-0.130*	-0.130*
	(0.000)	(0.000)	(0.019)	(0.019)
Ethnicity				
Hausa (d)	0.318***	0.122***	0.310***	0.310***
	(0.000)	(0.000)	(0.000)	(0.000)
Yoruba (d)	-0.00899	-0.00339	0.0295	0.0295
	(0.930)	(0.930)	(0.797)	(0.797)
Igbo (d)	-0.302**	-0.109***	-0.194	-0.194
	(0.001)	(0.001)	(0.070)	(0.070)
Hhsize	0.0328***	0.0124***	0.0157*	0.0157*
	(0.000)	(0.000)	(0.043)	(0.043)
Geopolitical	0.00249	0.000941	-0.000227	-0.000227
	(0.899)	(0.899)	(0.992)	(0.992)
r2_p	0.0851	0.0851	0.0831	0.0831
N	2631	2631	2655	2655

Marginal effects; *p*-values in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NB: for ethnicity, the base category is the aggregation of other ethnic groups in Nigeria.

Source: author's estimations with Nigeria DHS using stata software.

The results further show that households with more members tend to have an increasing likelihood of getting stunted and underweight children. One additional household member increases the probability of stunting by about 12.4% and that of underweight by 15.7%. This can be attributed to the fact that more household members would reduce the calorie intake per capita and this would result in malnutrition. For reasons we cannot explain the female also tends to have a low probability of severe malnutrition. However, one may argue that since their adult equivalent consumption rate is low compared to their male counterparts, they are less likely to be exposed to malnutrition even when the household's consumption level drops. Looking at the major ethnic groups relative to the minor ones, the results show that children born in Hausa ethnic group significantly have a high probability of suffering malnutrition. For example, the probability that they would be stunted is 12.2% and underweight is

31%. This may be as a result of many children per household and the household itself is characterized by low income. Other the other hand, children born in Igbo ethnic group are 10.9% less likely to be stunted relative to the minor ethnic groups.

Objective three of this work is to ascertain spatial determinants of fertility rate among women in Nigeria. The results are reported in Table 4.5 and three variants of the fertility model were estimated as reported in columns 2, 3, and 4. Since results reported in columns 2 and 3 are nested in 4, we chose to interpret the model with the results in the last column. Instead of using education as a single variable, we use it as a categorical variable with no education as the base category. The results show that education has a decreasing effect on the fertility rate and significantly so. This means that as the level of education of women increases, their level of awareness of the dangers of having large family size increases. The coefficient estimates show that while women with primary education tend to have 0.127 fewer children compared to those with no education, women with secondary and higher have 0.760 and 1.817 fewer children relative to those with no education. These are statistically significant at the 5 % level of significance. Similarly, the wealth categories were used in the model instead of the wealth index. The base category is the poorest households. Again, the results show that as the household becomes richer, women tend to have significantly fewer children. There is a nonlinear effect of maternal age on the fertility rate. At 57, fertility among Nigerian women goes to zero.

Table 4.5: Determinants of Fertility Rate among women in Nigeria

	Fertility	**Fertility**	**Fertility**
Mothereduc level			
primary	-0.182**	-0.130*	-0.127*
	(0.003)	(0.029)	(0.033)
secondary	-0.811***	-0.764***	-0.760***
	(0.000)	(0.000)	(0.000)
higher	-1.764***	-1.824***	-1.817***
	(0.000)	(0.000)	(0.000)
HhWealth			
poorer	-0.129*	-0.128*	-0.137*
	(0.045)	(0.042)	(0.030)
middle	-0.226***	-0.246***	-0.264***
	(0.001)	(0.000)	(0.000)
richer	-0.477***	-0.500***	-0.526***
	(0.000)	(0.000)	(0.000)
richest	-0.876***	-0.902***	-0.929***
	(0.000)	(0.000)	(0.000)
motherage	0.210***	0.472***	0.480***
	(0.000)	(0.000)	(0.000)
Motheragesq		-0.00408***	-0.00420***
		(0.000)	(0.000)
Motheroccup	-0.0160*	-0.00911	-0.00958
	(0.013)	(0.150)	(0.130)
Use_modern_facility	0.651***	0.538***	0.542***
	(0.000)	(0.000)	(0.000)
No. of wives			0.0562**
			(0.002)
Ethnicity			
hausa	0.488***	0.483***	0.473***
	(0.000)	(0.000)	(0.000)
igbo	-0.239*	-0.229*	-0.214*
	(0.021)	(0.024)	(0.035)
yoruba	-0.175*	-0.152	-0.140

	(0.043)	(0.074)	(0.101)
Geopolitical zones			
north east	0.334***	0.354***	0.343***
	(0.000)	(0.000)	(0.000)
north west	0.608***	0.622***	0.618***
	(0.000)	(0.000)	(0.000)
south east	0.180	0.126	0.120
	(0.113)	(0.260)	(0.282)
south south	-0.193**	-0.226***	-0.216***
	(0.004)	(0.001)	(0.001)
south west	-0.114	-0.190*	-0.177*
	(0.182)	(0.024)	(0.035)
rural	0.00153	0.00724	0.00854
	(0.973)	(0.868)	(0.845)
_cons	-2.317***	-6.217***	-6.417***
	(0.000)	(0.000)	(0.000)
r2_a	0.577	0.591	0.592
F	755.9	761.3	726.1
rmse	1.870	1.838	1.838
N	10511	10511	10511

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NB: the base category for education level is no education, the base category for wealth index is poorest, while the base category for region or zone is the North Central. Three variants of the model were estimated.

Source: author's estimations with Nigeria DHS using stata software.

A look at the effect of geopolitical zones shows that North East and North West women have significantly higher fertility rate compared to women from North Central which is the base category. On the other hand, women from the South-South, and South West have significantly lower fertility rates compared to women in the North Central. This again transcends across the major ethnic groups from the North and South. Hausa women tend to have a higher fertility rate while Igbo women tend to have fewer children compared to women in the other ethnic groups used as the based category. This means that ethnicity has something to do with the average number of children a woman bears in Nigeria. Health care utilization which is captured by the use of the modern facility has a positive and statistically significant effect on the number of children born by a woman. This is because modern health facilities offer expert advice on the conception and antenatal care services. This makes it easier for women who are finding childbearing difficult to conceive or overcome certain health challenges that result in miscarriages.

SUMMARY, CONCLUSION AND RECOMMENDATION

This study examined spatial determinants of fertility rate and child survival in Nigeria's geopolitical zones. The variables considered for the study include the educational level of women, occupation of women, household income, age at first birth, birth interval, residence, and vaccination utilization among others. Findings from the study revealed that household characteristics and health utilization indicate that zones as South-east south-south and south-west tends to enjoy increased health care utilization which has led to greater number of vaccination within the zone whereas the northern zones of Nigeria witnessed decrease trends in healthcare utilization leading to vaccination. This differences in zones leading to vaccination could be attributed to the level of education, wealth and household size among women. Findings from the demographic features shows that the southeast enjoys a high level of education among women than other zones while the Northwest has the highest percent

with respect to household size, while the wealth index shows that the southwest has the highest trends of wealth than other regions.

The study, therefore, concludes that spatially different geopolitical characteristics such as socioeconomic status, and demographic characteristics should be accounted for in policy design to influence child survival, child nutritional status, and fertility rate of women in Nigeria. Given these outcomes the study thus suggests that there is a need for women of child-bearing age, most especially those in northern part of Nigeria to be well educated on issues related to child's health.

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