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# Fertility Rate in Nigeria: A Multilevel Analysis Approach

***Mafolasire Sheyi*[1], *Abbas U. F.*[2], *K.E Lasisi.*[3], *Mbah J. J.*[4], *Pam D.J.*[5], *Kromtit F. M.*[6], *Echebiri C. J.*[7]**

[1,4]Department of Statistics, Federal College of Forestry, Jos, Nigeria

[2,3,5,6,7] Department of Mathematical Sciences, Abubakar TafawaBalewa University, Bauchi, Nigeria

**ABSTRACT.**

This study aimed at Fertility Rate in Nigeria: A Multilevel Analysis Approach. The researcher aimed at modification of the existing Multilevel Regression Analysis model, compare the modified Multilevel Regression Analysis model results with the existing Multilevel Regression Analysis model, and assess the impact of Fixed and Random effects on the intercept and to estimate the Intra-Class Correlation for assessing regional variation in fertility levels. The data for the research work was obtained from Nigerian Demographic and Health Survey (NDHS) 2018. The modification of the Multilevel Regression Analysis model was carried out by taking the root of the slope of the model and then the result was compared with the unmodified Multilevel Regression Analysis model, it was deduced that the modified model gives a better estimate than the unmodified model. Furthermore, the impact of Fixed and Random effects on the regions (South-East, South-South, South-West, North-East, North-West, and North-Central), and the independent variables (Religion, Number of wives, Highest educational levels, Sex of child) was determined, it was discovered that the variables (Number of wives and Highest educational levels) are statistically significant at 95% level of significant and also from the Intra-Class Correlation Coefficient (ICC) it was deduced that 1.7% of the variability of the Number of children ever born occurs between regions with over 98.3% occurring within the regions.

***Keywords:*** Demographic; Multilevel Analysis; Multilevel Regression Analysis model; Statistically Significant.

## 1.0 Introduction

Multilevel models (Also known as hierarchical linear models, linear mixed –effect, mixed model, nested data models, random coefficient, random-effect models, or split –plot designs ) are statistical model of parameter that vary at more than one level (Cohen 2003). Multilevel model have been used in education research or geographical research, to estimate separately the variance between pupils within the same school.

Fertility is one of the principal component of population dynamics that determine the size, structure and composition of the population in any country, Nigeria demographic and health survey (NDHS, 2013). Nigeria remains one of the top most populous nations in the world. As of 2018, Nigeria population was more than 180 million and seventh most populated country in the world (Obiyan*et al.*, 2019). The recent round of the Nigeria demographic and health survey estimated the total fertility rate per woman in Sub-Saharan Africa and stalled over the long term (Oyinlola*et al.*, 2017). Multilevel modelling is used in the analysis of data that have a hierarchical or cluster structure, Such data arise routinely in various fields, for instance in educational research in which pupils are nested within schools, in family Studies, in which children are nested within families. In medical research in which patients are nested within physicians or hospitals and in biomedical research, for instance the analysis of dental anomalies in which teeth are nested within different people's mouths. Clustered data may also arise as a result of the specific research design. For instance, in large-scale survey research the data collection is usually organized in a multistage sampling design that results in clustered or stratified data. Another example is a longitudinal design, in which the data are a series of repeated measurement nested within individual subjects (Hox and Maas, 2017). The recent round of the Nigeria Demographics and health survey (NDHS, 2013) estimated the total fertility rate at south- south children per woman (National population commission and ICF international, 2014) which is one of the highest total fertility rate per woman in Sub-Saharan Africa and stalled over the long term (Oyinlola, 2017). Fertility change in Sub-Saharan Africa has received a considerable amount of attention while rapid fertility declined have been observed in Asia, Latin America and Northern Africa, the Fertility transition in Sub-Saharan Africa Started later and bas been considerably slower (Bongaarts, 2017; Bongaarts and Casterline, 2013; Shapiro and Hinde, 2017) for Sub-Saharan African, Most of the studies have focused on countries that have achieved significant fertility decline or where fertility transition is well underway. Although the fertility transition is underway in the majority of Sub-Saharan African Countries, a handful of countries still experience high level of fertility. Many of those are located on the central and western part of the Sahel- a region bordering the Southern edge of the Sahara. Their Sahelian countries (Niger, Chad and Mali) rank in the top five countries with highest total fertility rate in the world (UNPD, 2019). In the countries of the Sahel, fertility has remained either high, rather stable or in the case where the onset of fertility decline has begun, fertility has either declined slowly or eventually stalled.

Given the limited change in fertility in the Sahel most of the demographic studies have focused on the consequence of the impeding population development and have identified the social, cultural, and political obstacles to the fertility decline (Groit and May, 2017). The focus had been mostly on the level of fertility using the total fertility rate and its proximate determinants, such as the early age at marriage, low prevalence of contraception and general low status of women in terms of education, employment and other markers (Hertrich, 2017; Tab Utin and Schoumaker, 2004). Surprisingly, few studies have investigated if change were indeed at work under the seemingly stable image given by the aggregate measure of fertility (Spourenberg and Issaka, 2018). This is even more puzzling given the widely acknowledge important of fertility in the determination of the future size of the population. A long–standing and still unresolved has developed on whether the historical fertility transition was caused by spacing (increase the time between births) or by stopping (terminating childbearing at younger age). Moreover, there is little consensus about the relative important of gender relations in effecting reproductive change. During the $19^{th}$ century and first decade of the $20^{th}$ century, most European societies went through the fertility transition, the shift from high to low fertility. Among historical demographers, a long- standing and still unresolved debate has developed about.

## 2.0 Statement of the Problem

Multilevel (Hierarchical) Modelling is a generalization of linear and generalized linear modelling in which regression coefficients are themselves given a model, whose parameters are also estimated from data. The Multilevel model is highly effective for predictions at both levels of the model, but could easily be misinterpreted for causal inference (German, 2009). The Limitation of using multilevel model adjustment factors to estimate direct and indirect effected or to control for factors which are simultaneously mediators and Confounders, have been noted and methods have been proposed to better account for the complex causal web (Roux, 2019). Hence, multilevel estimation criteria can be modified further to recognize qualitative difference in error and better accuracy of the estimates (Andrew *et al.*, 2018)

## 3.0 Aim and Objectives

The aim is to assess variability in fertility level across geopolitical zones in Nigeria and specific objectives are to:

i. Modification of the existing Multilevel Regression Analysis model

ii. Compare the existing Multilevel Regression Analysis model results with the modified Multilevel Regression Analysis mode results.

iii. Assess the impact of fixed and random effects on the intercept.

iv. Estimate the Intra-Class Correlation for assessing regional variation in fertility levels.

## 4.0 Brief Literature Review

Multilevel models (Also known as hierarchical linear models, linear mixed –effect, mixed model, nested data models, random coefficient, random-effect models, or split –plot designs ) are statistical model of parameter that vary at more than one level (Cohen, 2003). Multilevel model have been used in education research or geographical research, to estimate separately the variance between pupils within the same school.

Different co-variable pupils may be relevant on different levels. They can be used for longitudinal studies, as with growth studies to separate changes within one individual and differences between individual. Multilevel models are designed to simultaneously analyse variables at different level, properly including various dependencies, Multilevel analysis applies to Multilevel data structure and models the groups influence on the individual response. Individual of the same are similarly influenced by the same factors and hence the response data is not independent anymore, as in ungrouped data. By using multilevel analysis we can investigate the level 1 characteristic that influence the outcome and also the level 2 characteristics the influence the level 1 intercepts and slope. We perform Multilevel data analysis to assess the amount of variability due to each level, to model the level outcome in terms of level effect. There is no “adequate” level where data should be analysed but all levels are important in their own way (Hox, 2010).

## 5.0 METHODOLOGY

This research work is designed to study the fertility rate in Nigeria: a Multilevel Regression Approach was used to determine the total number of Children Ever born in geo-political regions (South-East, South-South, South-West, North-East, North-West, and North-Central), descriptive approach and Survey method was be used to describe the factors. The choice of the design survey is considered appropriate because it allows verifying whether the studied factors are statistically significant or not. The factors under consideration are: Religion, Highest Educational Level, Sex of Child, and Number of Wives.

### *5.1 Multilevel Regression Model*

The Multilevel Regression model is known on the research literature under variety of names, such as ‘Random Co-efficient Model’ (De leeuw andKreft, 1986: Longford, 1993), Variance component model’(Longford, 1993) and hierarchical linear model (Raudenbush and Bryk, 1986;Bryk and Raudenbush, 1992). It assumes hierarchical data, with one response variable measured at the lowest level and explanatory variable at all exiting level. Conceptually the model is often viewed as a hierarchical system of regression equation. For example assume we have data in J group or contexts, and a different number of individual $N_j$ in each group on the individual (lowest) level we have the dependent variable $Y_{ij}$ and the explanatory variable $X_{ij}$ and on the Group level we have explanatory variable $Z_j$. Thus, we have a separate regression Equation in each Group.

$$Y_{ij} = \beta_{oj} + \beta_{ij}X_{ij} + \varepsilon_{ij} \qquad \ldots(1)$$

The $\beta$ are modelled by Explanatory variable at the group level;

$$\beta_{oi} = Y_{oo} + Y_{oi}Z_j + U_{oj} \qquad \ldots(2)$$

$$\beta_{ij} = Y_{io} + Y_{ii}Z_j + U_{oj} \qquad \ldots(3)$$

Substitution of (2) and (3) in (1) gives

$$Y_{ij} = Y_{oo} + Y_{io}X_{oj} + Y_{oi}Z_j + Y_{ii}Z_jX_{ij} + U_{ij}X_{ij} + U_{oj} + \varepsilon_{ij} \qquad \ldots(4)$$

In general there will be more than one explanatory variable at the lowest and also more than one explanatory variable at the highest level. Assume that we have $P$ explanatory variables $X$ at the lowest level indicated by the subscript $(\beta_1 \ldots P)$ and $Q$ explanatory variables $Z$ at the highest level, indicated by the subscript$(q = 1\ldots Q)$. Then equation (4) becomes the more general equation;

$$Y_{ij} = Y_{io} + Y_{po}X_{pij} + Y_{oq}Z_{qj} + Y_{pq}Z_{qp}X_{pij} + U_{pj}X_{pij} + U_{oj} + \varepsilon_{ij} \qquad \ldots(5)$$

The estimators generally used in Multilevel Analysis are maximum likelihood Estimator, with standard error from the inverse of the information matrix.

### *5.2 Study Population*

This study was conducted to determine the Total Children Ever Born (Number of Children ever Born) in Nigeria according to Geo-political Zones: (North Central, North East, North West, South East, South-South, and South West) and the independent variables used are Religion, Number of Wives, Highest Educational Level, Sex of Child.

### *5.3 Parameters under Study*

This research work considered the following variables of interest: Religion, Number of Wives, Highest Educational Level, Sex of Child.

### *5.4 Method of Data Collection*

Secondary Source of data was employed in this research work and the data was collected from Nigeria Demographic and Health Survey (NDHS, 2018).

### *5.5 Sampling Techniques*

Cluster sampling was used to select the state according to the region they belong to in Nigeria; the regions are South East, South -South, South West, North Central, North East and North West. A cluster is a natural grouping of people from heterogeneous groups into homogenous groups. The clusters are constructed such that the sampling units are heterogeneous within the cluster and homogeneous among the cluster.

Stratified Random sampling is a technique which attempts to restrict the possible samples to those which are "less Extreme" by ensuring that all parts of the population are represented in the sample in order to increase the efficiency (That is to decrease the error in the estimation). In stratified sampling the population of $N$ unit is first divided into disjoint groups of $n_1, n_2, n_3, \ldots n_k$ Units respectively. These subgroups, called strata, together compromise the whole population, so that $n_1 + n_2 + n_3 + \ldots n_k = N$ from each stratum a sampling of pre-specified size is drawn independently in different strata. Then the collection of there samples constitutes a stratified sample. If a sample random sample selection scheme is used in each stratum then the corresponding sample is called a stratified random sample.

### *5.6 Sampling Size and Sampling Procedure*

Sampling is a process of selecting of individual or objects from a population such that the selected group contains element representative of the characteristics sought in the entire population. The sampling size of this research work is the six geopolitical regions in Nigeria and the target population of the study in the fertility level of the numbers of children Ever born

### *5.7 Method of Data Analysis*

Multilevel regression Analysis Models are models specifically geared toward the statistical analysis of data that have a hierarchical or clustered structure such data arises routinely in various fields. The method used for data analysis was by using computer software package: Statistical Package for Social Science (SPSS Version 24).

### *5.8 Proposed Modification of the Multilevel Regression Model*

We consider the modification of the random slope of the Existing model at the second level equation, modelling certain structure of the underlying categorical covariate in the hierarchical regression, we proceed as follows by taking square root of the coefficients of the variable of the interest the population under study which are Religion, Number of Wives, Highest educational Level and sex of child Respectively.

Thus we have a separate regression equation in each group.

$$Y_{ij} = \beta_{oj} + \beta_{ij}X_{ij} + \varepsilon_{ij} \quad \ldots(6)$$

Modification of the random slope

$$\beta_{oi} = Y_{oo} + Y_{oi}Z_j + U_{oj} \quad \ldots(7)$$

$$\beta_{ij} = Y_{io} + \sqrt{Y_{ii}Z_j + U_{oj}} \quad \ldots(8)$$

Where

$i =$ The coefficient of the variables (predictors of the model) $1, 2, 3, 4$

$1 =$ Religion

$2 =$ Number of Wives

$3 =$ Highest Educational levels

$4 =$ Sex of Child

$j =$ Indicate the regions in the multilevel regression $1, 2, 3, \ldots, 6$

$1 =$ North Central

$2 =$ North East

$3 =$ North West

$4 =$ South East

$5 =$ South -South

$6 =$ South West

## 6.0 ANALYSIS AND DISCUSSION

This section compared the modified Multilevel Regression Analysis Model and the existing Multilevel Regression Analysis Model to obtain numerical estimates of parameters which enables the researcher to measure the difference between the compared models.

In this research, we modified the slope of the existing Multilevel Regression Analysis Model by taking the root of the sloop of the existing Model, asset the impact of fixed and random effects on the intercept and estimate the inter-class correlation for assessing regional variation in fertility rate.

### *6.1 Modification on the Slope of the Model*

Certain operations were performed on the random slops of the model to see its effect on the expected number of Children Ever Born (TCEB) per family in the Regions.

i. **Taking the Root of the slop**

$TCEB_{(NC)} = 3.969\sqrt{\beta_{1(NC)}(\text{Religion})} + \sqrt{\beta_{2(NC)}(\text{No of wives})} + \sqrt{\beta_{3(NC)}(\text{Highest educational level})} + \sqrt{\beta_{4(NC)}(\text{Sex of child})}$

$TCEB_{(NC)}$ =3.969 – 0.228(2.62) + 0.707(1.28) – 0.724(1.13) +0.235(1.51)

$TCEB_{(NC)}$ = 3.813

ii. **Taking the square of the slop**

$TCEB_{(NC)}$ = 3.969 – $(\beta_{1(NC)})^2$(Religion) + $(\beta_{2(NC)})^2$(No of wives) + $(\beta_{3(NC)})^2$(Highest educational level) + $(\beta_{4(NC)})^2$(Sex of child)

$TCEB_{(NC)}$ = 3.969 – 0.002704(2.62) + 0.025(1.28) – 0.0275(1.13) + 0.003025(1.51)

$TCEB_{(NC)}$ = 3.967

**iii. Taking the inverse of the slop**

$TCEB_{(NC)} = \beta_0 - \left(\beta_{1(NC)}\right)^{-1}$(Religion) + $\left(\beta_{2(NC)}\right)^{-1}$(No of wives) +$\left(\beta_{3(NC)}\right)^{-1}$(Highest educational level) + $\left(\beta_{4(NC)}\right)^{-1}$(Sex of child)

$TCEB_{(NC)}$ = 3.969 – 19.231(2.62) + 2.000(1.28) – 1.908(1.13) + 18.182(1.51)

$$TCEB_{(NC)} = -18.557$$

**Remark**

Taking the root of the slop gives a better estimate for the Total Children Ever Born (TCEB) in all the Regions, as it is very close to average number of children born in all the regions (given in the descriptive statistics table below).

***6.3 Comparison of the Models***

A good strategy for developing a level-one model is to begin by testing the impacts of a minimal set of theoretically important predictors with fixed-slope coefficients, that is, by assuming the effect of each of these individual-level variables is homogeneous across regions. The level-one model with fixed coefficients is given as:

TCEB=$\propto_{00} + \propto_{10}\ (Religion) + \propto_{20}\ (No\ of\ wives)$

$+\propto_{30}\ (Highest\ educational\ level) + \propto_{40}\ (Sex\ of\ child) + e_{ij}$ …(9)

Where TCEB = Number of Children Ever Born

TCEB=3.969 – 0.064(Religion) + 0.526(Number of wives) – 0.556(Educational Level)

+ 0.055(Sex of Child) …(10)

The level-two model with varying intercept and slops is given as:

$\beta_{0j} = \propto_{00} + u_{0j} = 3.969 + 0.092_j$ …(11)

$\beta_{1j} = \propto_{10} + u_{1j} = -0.064 + 0.012_j$ …(12)

$\beta_{2j} = \propto_{20} + u_{2j} = 0.525 + 0.025_j$ …(13)

$\beta_{3j} = \propto_{30} + u_{3j} = -0.556 + 0.032_j$ …(14)

$\beta_{4j} = \propto_{40} + u_{4j} = 0.055 + 0.00_j$ …(15)

The level-two model with varying intercept and slop becomes:

TCEB=$\beta_{0j} + \beta_{1j}(Religion) + \beta_{2j}(No\ of\ wives)$

$+\beta_{3j}(Highest\ educational\ level) + \beta_{4j}(Sex\ of\ child)$ …(16)

Using the level-two model, we estimate the number of Children born in a family in the Regions, fixed intercept assumption.

**North-Central**

$\beta_{0(NC)} = 3.969 + 0.092(1) = 4.061$

$\beta_{1(NC)} = -0.064 + 0.012(1) = -0.052$

$\beta_{2(NC)} = 0.525 + 0.025(1) = 0.500$

$\beta_{3(NC)} = -0.556 + 0.032(1) = -0.524$

$\beta_{4(NC)} = 0.055 + 0.000(1) = 0.055$

$TCEB_{(NC)}$ = 4.061 -0.052(2.62) +0.500(1.28) -0.524(1.13) + 0.055(1.51)

$TCEB_{(NC)}$ = 4.06

$TCEB_{(NC)}$ (Modified) = 4.061 $-\sqrt{\beta_{1(NC)}(\text{Religion})} + \sqrt{\beta_{2(NC)}(\text{No of wives})} + \sqrt{\beta_{3(NC)}(\text{Highest educational level})} + \sqrt{\beta_{4(NC)}(\text{Sex of child})}$

$TCEB_{(NC)}$ (Modified) = 4.061 -0.228(2.62) +0.707(1.28) -0.724(1.13) + 0.235(1.51)

$TCEB_{(NC)}$ (Modified) = 3.9

**North-East**

$\beta_{0(NE)}\beta_{1(NE)} = -0.064 + 0.012(2) = -0.04$

$\beta_{2(NE)} = 0.525 + 0.025(2) = 0.575$

$\beta_{3(NE)} = -0.556 + 0.032(2) = -0.492$

$\beta_{4(NE)} = 0.055 + 0.000(2) = 0.055$

$TCEB_{(NE)}$ = 4.061 -0.04(2.78) +0.575(1.45) −0.492(0.54) + 0.055(1.48)

$TCEB_{(NE)}$ = 4.691

$TCEB_{(NE)}$ (Modified) = 4.153 $-\sqrt{\beta_{1(NE)}(\text{Religion})} + \sqrt{\beta_{2(NE)}(\text{No of wives})} + \sqrt{\beta_{3(NE)}(\text{Highest educational level})} + \sqrt{\beta_{4(NE)}(\text{Sex of child})}$

$TCEB_{(NE)}$ (Modified) = 4.153 -0.2(2.78) +0.7583(1.45) -0.7014(0.54) + 0.2345(1.48)

$TCEB_{(NE)}$ (Modified) = 4.618

**North-West**

$\beta_{0(NW)}$= 3.969 + 0.092(3) = 4.245

$\beta_{1(NW)} = -0.064 + 0.012(3) = -0.028$

$\beta_{2(NW)} = 0.525 + 0.025(3) = 0.600$

$\beta_{3(NW)} = -0.556 + 0.032(3) = -0.460$

$\beta_{4(NW)} = 0.055 + 0.000(3) = 0.055$

$TCEB_{(NW)}$ = 4.245 – 0.028(2.93) +0.600(1.51) −0.460(0.37) + 0.055(1.50)

$TCEB_{(NW)}$ = 4.981

$TCEB_{(NW)}$ (Modified) = 4.245 $-\sqrt{\beta_{1(NW)}(\text{Religion})} + \sqrt{\beta_{2(NW)}(\text{No of wives})} + \sqrt{\beta_{3(NW)}(\text{Highest educational level})} + \sqrt{\beta_{4(NW)}(\text{Sex of child})}$

$TCEB_{(NW)}$ (Modified) = 4.245 −0.1673(2.93) +0.7746(1.51) −0.6935(0.37) + 0.2345(1.50)

$TCEB_{(NW)}$ (Modified)= 5.019

**South-East**

$\beta_{0(SE)}$= 3.969 + 0.092(4) = 4.337

$\beta_{1(SE)}$= -0.064 + 0.012(4) = −0.016

$\beta_{2(SE)} = 0.525 + 0.025(4) = 0.625$

$\beta_{3(SE)} = -0.556 + 0.032(4) = -0.428$

$\beta_{4(SE)} = 0.055 + 0.000(4) = 0.055$

$TCEB_{(SE)}$ = 4.337 −0.016(1.61) +0.625(1.09) −0.428(1.82) + 0.055(1.45)

$TCEB_{(SE)}$ = 4.293

$TCEB_{(SE)}$ (Modified) = 4.337 $-\sqrt{\beta_{1(SE)}(\text{Religion})} + \sqrt{\beta_{2(SE)}(\text{No of wives})} + \sqrt{\beta_{3(SE)}}(\text{Highest educational level}) + \sqrt{\beta_{4(SE)}(\text{Sex of child})}$

$TCEB_{(SE)}$ = 4.337 −0.126(1.61) +0.7906(1.09) -0.7239(1.82) + 0.2345(1.45)

$TCEB_{(SE)}$ = 4.018

**South-South**

$\beta_{0(SS)}$= 3.969 + 0.092(5) = 4.429

$\beta_{1(SS)}$= -0.064 + 0.012(5) = −0.004

$\beta_{2(SS)} = 0.525 + 0.025(5) = 0.650$

$\beta_{3(SS)} = -0.556 + 0.032(5) = -0.396$

$\beta_{4(SS)} = 0.055 + 0.000(5) = 0.055$

$TCEB_{(SS)}$ = 4.429 −0.004(1.96) +0.650(1.16) −0.396(1.66) + 0.055(1.50)

$TCEB_{(SS)}$ = 4.600

$TCEB_{(SS)}$ (Modified) = 4.429 $-\sqrt{\beta_{1(SS)}(\text{Religion})} + \sqrt{\beta_{2(SS)}(\text{No of wives})} + \sqrt{\beta_{3(SS)}(\text{Highest educational level})} + \sqrt{\beta_{4(SS)}(\text{Sex of child})}$

$TCEB_{(SS)}$ (Modified) = 4.429−0.0632(1.96) +0.8062(1.16) −0.6293(1.66) + 0.2345(1.50)

$TCEB_{(SS)}$ (Modified) = 4.5474

**South-West**

$\beta_{0(SW)}$= 3.969 + 0.092(6) = 4.521

$\beta_{1(SW)}$= −0.064 + 0.012(6) = 0.008

$\beta_{2(SW)} = 0.525 + 0.025(6) = 0.675$

$\beta_{3(SW)} = -0.556 + 0.032(6) = -0.364$

$\beta_{4(SW)} = 0.055 + 0.000(6) = 0.055$

$TCEB_{(SW)}$ = 4.521 −0.008(2.29) +0.675(1.13) −0.364(1.75) + 0.055(1.50)

$TCEB_{(SW)}$ = 4.711

$TCEB_{(SW)}$ (Modified)= 4.521 $-\sqrt{\beta_{1(SW)}(\text{Religion})} + \sqrt{\beta_{2(SW)}(\text{No of wives})} + \sqrt{\beta_{3(SW)}(\text{Highest educational level})} + \sqrt{\beta_{4(SW)}(\text{Sex of child})}$

$TCEB_{(SW)}$ (Modified) = 4.521 −0.0894(2.29) +0.8216(1.13) −0.6033(1.75) + 0.2345(1.50)

$TCEB_{(SW)}$ (Modified) = 4.541

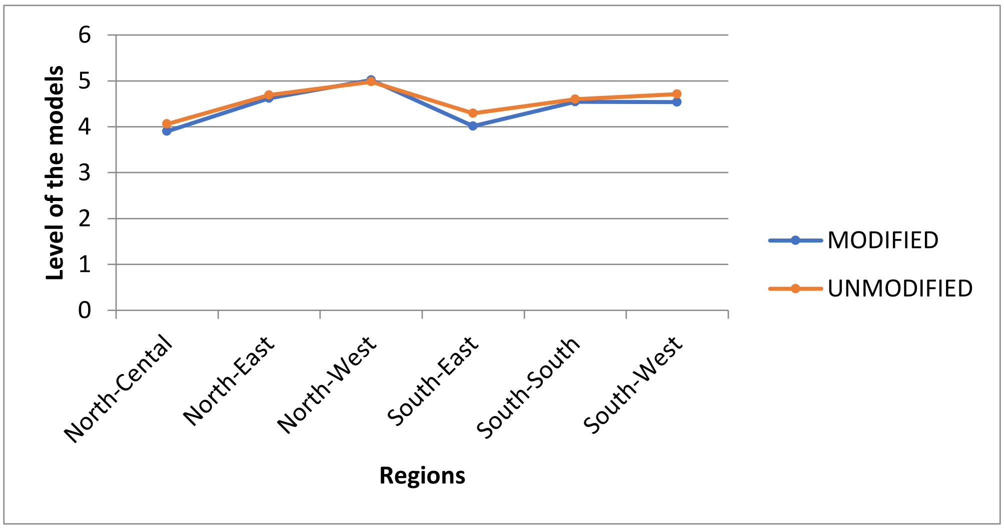


**Figure 1: A graph showing the level and variations of the two models**

### *6.4 Fixed and Random Effects*

The multilevel regression model assumes that there is a hierarchical data set, often consisting of subjects nested within groups, with one single outcome or response variable that is measured at the lowest level, and explanatory variables at all existing levels. The multilevel regression model can be extended by adding an extra level for multiple outcome variables, while multilevel structural equation models are fully multivariate at all levels. First, with multilevel regression there are at least two levels and two models. The independent variables

in a level-one model are also substantively conventional. Along with the intercept, they include obvious level-one measures such as race, gender etc. One or more of these measures, however, may have a coefficient with a random component as well as a fixed component. At level two, however, the dependent variables are random components of regression coefficients.Each random component, whether an intercept or a slope, has its own equation. Explanatory factors for random components are substantively conventional measures.

**Table 1:** Case Processing Summary

| | | Label | Count | Marginal Percentage |
|---|---|---|---|---|
| Region | 1 | North Central | 1264 | 16.3% |
| | 2 | North East | 1520 | 19.6% |
| | 3 | North West | 2492 | 32.1% |
| | 4 | South East | 473 | 6.1% |
| | 5 | South South | 954 | 12.3% |
| | 6 | South West | 1057 | 13.6% |
| Valid | | | 7760 | 100.0% |
| Excluded | | | 898 | |
| Total | | | 8658 | |

| | | Number of Levels | Covariance Structure | Number of Parameters | Subject Variables |
|---|---|---|---|---|---|
| Fixed Effects | Intercept | 1 | | 1 | |
| | Religion | 1 | | 1 | |
| | No of wives | 1 | | 1 | |
| | Highest educational level | 1 | | 1 | |
| | Sex of child | 1 | | 1 | |
| Random Effects | Intercept + Religion + No of wives +Highest educational level + Sex of child[b] | 5 | Variance Components | 5 | Region |
| Residual | | | | 1 | |
| Total | | 10 | | 11 | |

**Table 2:** a. Dependent Variable: Total children ever born.

As of version 11.5, the syntax rules for the RANDOM subcommand have changed. Your command syntax may yield results that differ from those produced by prior versions. If you are using version 11 syntax, please consult the current syntax reference guide for more information.

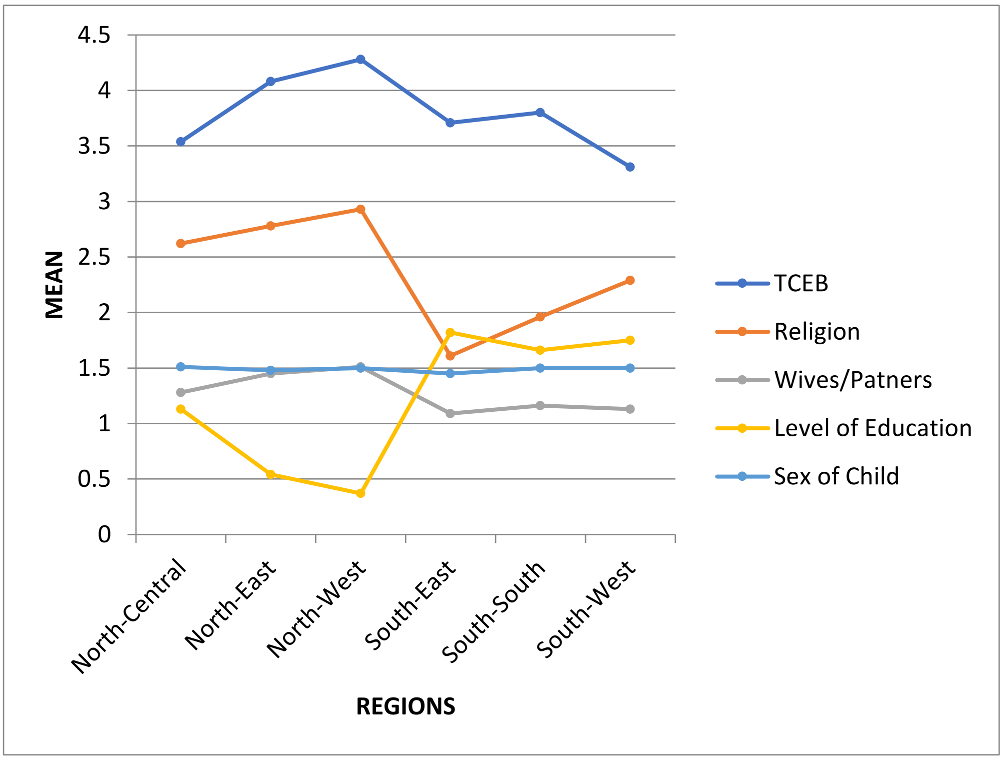


**Figure 2: A graph showing the obtained mean for each variable across the regions from**

**Table 3:** Information Criteria[a]

| | |
|---|---|
| -2 Log Likelihood | 34910.333 |
| Akaike's Information Criterion (AIC) | 34932.333 |
| Hurvich and Tsai's Criterion (AICC) | 34932.367 |
| Bozdogan's Criterion (CAIC) | 35019.857 |
| Schwarz's Bayesian Criterion (BIC) | 35008.857 |

The information criteria are displayed in smaller-is-better form.

a. Dependent Variable: Total children ever born.

**Fixed Effects**

**Table 4:** Type III Tests of Fixed Effects[a]

| Source | Numerator df | Denominator df | F | Sig. |
|---|---|---|---|---|
| Intercept | 1 | 96 | 366.036 | .000 |
| Religion | 1 | 2.973 | .951 | .402 |
| Numner of wives | 1 | 3.640 | 36.721 | .005 |
| Highest level of Education | 1 | 3.632 | 46.301 | .003 |
| Sex of child | 1 | 7736.932 | 1.122 | .289 |

a. Dependent Variable: Total children ever born.

The Fixed Effects Parameter Estimates report provides details for the fixed effect parameters specified in the model.

In effect, the random intercept, $\beta_{0j}$ takes the position of a dependent variable in a simple regression equation. The objective of the equation is to account for region to region variability in the random intercept. The random slope is expressed in the same general way, just another simple regression equation with all the usual terms, but now the random slope$\beta_j$ is the dependent variable.In effect, Intercepts and slopes are being expressed as outcomes, functions of higher-level variables.

**Covariance Parameters**

**Table 5:** Estimates of Fixed Effects[a]

| | | | | | | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| Parameter | Estimate | Std. Error | Df | T | Sig. | Lower Bound | Upper Bound |
| Intercept | 3.968739 | .207439 | 5.896 | 19.132 | .000 | 3.458984 | 4.478494 |
| Religion | -.063740 | .065370 | 2.973 | -.975 | .402 | -.272860 | .145381 |
| Number of wives | .526373 | .086863 | 3.640 | 6.060 | .005 | .275487 | .777260 |
| Highest level of Education | -.555514 | .081639 | 3.632 | -6.805 | .003 | -.791521 | -.319507 |
| Sex of child | 055089 | .052000 | 36.932 | 1.059 | .289 | -.046846 | .157024 |

a. Dependent Variable: Total children ever born.

Notice that the first subscript for the gamma coefficient used in estimating the intercept is a 0, while the first subscript for gamma coefficients used in estimating the slope is a 1. This is consistent with the subscript conventions represented in beta coefficients, wherein the first subscript for an intercept is always 0, and the first subscript for a slope is 1, 2, …,i, depending on how many independent variables are there in the equation.

If we are trying to account for variability in the random intercept in a two-level model, $\propto_{00}$is the common intercept across regions.$\propto_{01}$, $\propto_{02}$ … are the effects of the region-level predictors on region-specific intercepts.

**Table 6:** Estimates of Covariance Parameters[a]

| | | | | | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| Parameter | Estimate | Std. Error | Wald Z | Sig. | Lower Bound | Upper Bound |
| Residual | 5.234168 | .084206 | 62.159 | .000 | 5.071703 | 5.401838 |
| Intercept [subject = Region] Variance | .091529 | .146487 | .625 | .532 | .003974 | 2.107975 |
| Religion [subject = Region] Variance | .012305 | .017440 | .706 | .480 | .000765 | .197940 |
| No of wives [subject =Region] Variance | .025170 | .030078 | .837 | .403 | .002419 | .261849 |
| Highest educationalVariance level[subject = Region] | .032244 | .029252 | 1.102 | .270 | .005448 | .190839 |
| Sex of child [subject = Region] Variance | .000000[b] | .000000 | . | . | . | . |

a. Dependent Variable: Total children ever born.
b. This covariance parameter isredundant. The test statistic and confidence interval cannot be computed.

**Interpretation**

The output shows the results of fitting a multilevel multiple linear regression model to describe the relationship between total number of Children Ever Born and 4 independent variables(which are: Religion, Highest educational level, number of wives and sex of child) across the 6 geopolitical regions in Nigeria. The fixed component estimates show us that the contextual variable number of wives and the highest educational level both have statistically significant coefficients. Number of children born to individual families on average, decline as educational level increases, but also, children born actually increases on average, as the number of wives increases.

In determining whether the model can be simplified, notice that the highest P-value (on the estimate of fixed effect table) on the independent variables is 0.402, belonging to Religion. Since the P-value is greater than0.05, then it is not statistically significant at the 95.0% significant level.

### *6.5 Intra-Class Correlation (ICC)*

In statistics, the Intra-Class Correlation is a descriptive statistic that can be used when quantitative measurements are made on units that are organized into groups. It describes how strongly units in the same group resemble each other.

$$\rho = \frac{\sigma^2{}_{u0}}{\sigma^2{}_{u0}+\sigma^2_{eij}}$$

$$= \frac{0.092}{0.092+5.234}$$

= 0.017

With individuals grouped in 6 geopolitical regions, we are obliged to investigate the possibility that nesting is consequential. We compute the unconditional Intra-Class Correlation with a value of 0.017. This means that 1.7% of the variability number of children born occurs between regions, with the other 98.3% occurring within regions.

## 7.0 CONCLUSION

In this research, we modified the Multilevel Regression Analysis model by taking the root of the slope of the existing Multilevel Regression Analysis model. The modified model was then compared with the existing Multilevel Regression Analysis model and it was discovered that the modified Multilevel Regression Analysis model gave a better estimate of the Total Children Ever Born (TCEB) across the six (6) geopolitical zones in Nigeria (North-Central, North-East, North-West, South-East, South-South, and South-West). The Multilevel Regression Analysis model was fit to assess the Fixed and Random effects on the intercept to describe the relationship between the total number of children ever born and four (4) independent Variables (Religion, Highest Educational Level, Number of Wives, and Sex of child) across the six (6) geopolitical regions in Nigeria. The fixed component estimate shows that the contextual variables (Number of wives and highest educational level) both have statistical significant coefficients. Number of children born to individual families on average, decline as educational level increases, but also, children born actually increases on average, as the number of wives increases.

The random intercept $\beta_{oj}$ takes the position of a dependent variable in a simple regression equation. The objective of the equation is to account for region variability in the random intercept and was also discover that the Intra-Class Correlation (ICC) gives a value of 0.017 which implies that 1.7% of the variability of the total number of children born occurs between regions, with the other 98.3% occurring within regions.

### *7.1 RECOMENDATION*

Based on our findings from the results of this research work, we recommend that:

The modified Multilevel Regression Analysis model should be used for estimation of hierarchical data set or nested data.

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