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AN ASSESSMENT OF THE IMPACT OF SELECTED DEMOGRAPHIC CHARACTERISTICS ON FERTILITY DIFFERENTIALS

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Abstract

The current fertility rate(FR) reporting in developing and under developed countries of the globe has drawn the attention of national and demographic planners in seeking for solution to reduce the population growth and its attendant global consequences. It is in this light that this study seeks to determine some significant demographic characterization responsible for influencing fertility behavior and differentials. Using a random sample of 570 mothers both from a rural and urban environment, a set of data on demographic characteristics were obtained and analyzed using the binary logistic regression model. Findings revealed a strong evident that the education level of women, location of resident of families and labour participation has significant effect in influencing the fertility of women and perhaps create fertility differentials. In this communication it was observed that women with little or no education, living in rural location and lack of a decent employment is associated with high fertility behavior.

Keywords: Demographic characteristics, Fertility differential, Binary Logistic regression, Female labour force participation, Birth rate

Introduction

Fertility is the natural capability to produce offspring. Fertility is culturally believed as the joy of every marriage. Fertility is an important factor in demographic research and national planning. In most areas of the African countries, when a woman bears many children she is praised for being able to produce offspring that will live on with family name. However, this appraisal tends to affect national planning in one way or the other especially policies towards avoiding population explosion and the Sustainable Development Goals (SDGs). Over the years, several factors have women been identified to be responsible for the reported increase in fertility rate in most developing countries. Fertility analysis is important in understanding past, current and future trends of population size, composition and growth. Information on fertility levels, patterns and trends experienced by a country is important for socio-economic planning, monitoring and evaluating programs. It is the analysis of fertility that can explain the pattern or trend of population growth in a society as well as its variation among strata or areas in a society. Fertility is a good achievement for couples but an uncontrolled fertility can land a nation into poor health delivery and poverty in the home as an entity and to the entire nation as a whole.

No doubt, fertility is a function of various factors such as age, income level, labour participation, education level, etc. and as a result these factors affect it randomly. Therefore an understanding of how these factors relate to fertility will enable parents and demographers to plan effectively towards an avoidance of population explosion which is certain to result from an uncontrolled fertility.

According to Child Trends Databank (2015), fertility rate measures the number of births occurring per 1000 women between the ages of 15 and 44 in a particular year; birth rates refer to this measure within particular age groups. The report added that tracking trends in fertility and birth rates is essential in planning for the future needs of multiple generations. High population growth is related to the socio-economic development of any nation. Effects of rapid population growth include reduced per capita income, high rural to urban migration, heavy pressure on social services such as healthcare and education, high unemployment rates, poverty, land fragmentation and degradation, and communal clashes.

The rapid population growth been recorded in Nigeria has become a source of concern as the act is gradually swaying from being a blessing to being a reason for panic. The improvement in the standard of living in a country when population growth is continuously sky-rocketing would

remain a mirage unless a concerted is made reduce the population growth rate. In some developing and under developed countries that are densely population, the society will increasingly be unable to feed its children and rising unemployment for its school leavers with its negative impact on the society. Regardless of the warning concerning birth control, fertility continues to grow and at the same time, the level of mortality decreases significantly in response to the advances in medicine and nutritional intake in a Nigeria. World Health Organization (WHO) reported in 2018 that in Nigeria, every woman is expected to have about six children during her reproductive age. Considering the fact that rate of birth is still alarming and the root factors responsible for high fertility need to be identified and carefully examine. As a result of the increasing fertility rate, the quality of the population in terms of medical provision, jobs and education and other economic factors are affected.

Several empirical studies have examined the factors influencing fertility differentials and their results have proved that in most countries, fertility differential is affected by various factors. Bale (2005) examined the determinants of cohort fertility in Uganda. The determinants of fertility considered in this study were the use of contraceptives by the mother and father, hours spent by the mother in taking care of children and personal characteristics of household members, such as the age of the mother, age square of the mother and education of the mother; age of the father, age square of the father and education of the father; consumption expenditure per adult. The study found that women in the rural areas had higher fertility preferences than their counter parts in urban areas. Women who had attained secondary level of education and above had lower fertility preference than those with no education at all. In the study, increasing age of mother was associated with increasing fertility preference. Increasing age at first birth was associated with decreasing fertility preference.

El Lahga and Olfa (2008) assessed some socioeconomic determinants of fertility decision among couples in Tunisia. They used count data model, which reasonably describes observed completed fertility patterns. A Poisson regression model of household fertility decision was also appled and the result reported that a husband's characteristics are almost as important as those of wives in determining fertility decision. Ashraf (2005) examined the fertility differentials between women of less and more developed countries. In his study, he investigated the relationship between fertility rate differentials and child mortality, female life expectancy, age at the first marriage for women. He used the descriptive statistics, correlation and a multiple regression to model the

study and his results reported that increase total fertility rate in less developed countries are more occur among women who have more children die, more number of years of life expectancy, more participate in labor force.

Tsegaye (2010) assesses the association between employment status and fertility behavior of married women in the context of Ethiopia. The analysis was made based on the 2000 and 2005 Ethiopian Demographic and Health Survey data. The findings showed that there was an insignificant relationship between women employment status and fertility behavior at a country level.

Yang and Morgan (2003) selected education, occupational class, income, and the participation of women in the labour force. They tested the hypothesis that the educational level, economic status, and proportion of women working had direct negative effects on a community's fertility level; and these effects varied with place of residence. Findings showed significant rural-urban difference in each of the variables. No rural-urban differences were found in the relationship between fertility and occupational class. They were inversely related in both rural and urban areas. In rural areas, education had a direct negative effect, income had a positive effect, and women working had no effect on fertility.

Hoffman-Novoting (2007) asserts that fertility behaviour of an individual is connected with structural and cultural characteristics of his/her micro and macro social environment. Boyle (2003) also stressed the importance of geographical variations in place or context in understanding fertility decision-making of individuals. Cernic and Kveder (2008), posits that fertility behaviour of individuals is closely linked with economic and social characteristics of their life settings. This study therefore evaluated the differentials in fertility among women considering basic socio-demographic factors as age of women at first birth, number of children current born to each woman, education level of women, location of resident (village or township), female labour force participation, ideal number of children desired by women to give birth to during her reproductive age, religion and fertility rate of women.

MODEL SPECIFICATION METHODS

This study used a purposeful method of sampling of two locations to examine the fertility behaviour among women, one being a township environment (Sapele Township) and the other being a village (Ijomi). In both locations responses of women were examined through a method of questionnaire administration

Table 1: Variable specification

Variable of study	*Data Nature*	*Data coding values*
Age of women at first birth	Quantitative	-
Current number of children given birth to by each woman	Quantitative	-
Education level of women	Qualitative	Secondary/tertiary = 1, primary/none = 0
Location of resident	Qualitative	Town = 1, village = 0
Labour participation	Qualitative	Working = 1, not working = 0
Ideal number of children desired	Quantitative	-
Religion	Qualitative	Christian = 1, Traditional = 0
Fertility rate (number of children born to each woman)	Qualitative	High (4 and above) = 1, low (3 to none) = 0

Using the fertility rate as the response variable in this study with two levels, we modeled a binary logistic model with age of women at first birth, number of children current born to each woman, education level of women, location of resident, female labour force participation, ideal number of children desired by women and religion as the predictor variables. The study sued the Statistical Packages for Social Sciences Version 22 to fit the model for the study data as well as fitting summary statistics for the variables being studied.

Binary logistic model

The goal of logistic regression is to correctly predict the category of outcome for individual cases using the best model. To accomplish this goal a model is created that include all predictor variables (specified above) that are useful in predicting the response variable (fertility rate of women).

Suppose we have a sample of n independent observations of the pair (x_i, y_i), $i = 1,2,\ldots,n$ where y_i denotes the values of a dichotomous outcome variable and x_i is the value of the independent variable for the i^{th} subject. Furthermore, assume that the outcome variable has been coded as 0 and 1, representing the absence or the presence of the characteristic, respectively. This coding for dichotomous outcome is used throughout this study. To fit the logistic regression model to a set of data requires that we estimate the values of β_j, the unknown model parameters.

In linear regression, the method used most often for estimating unknown parameters is least squares. In that method, we do choose those values of the parameters which minimizes the sum of squared deviations of the observed values of Y from the predicted values based upon the model. Under the usual assumptions of linear regression the method of; least squares yields estimators with a number of desirable statistical properties. Unfortunately, when the method of least squares is applied to a model with a dichotomous outcome, the estimators no longer have these same properties. The maximum likelihood method of estimation provides the foundation for the approach of estimating a logistic regression model. The method of likelihood estimation yields values for the unknown parameters which minimizes the probability of obtaining the observed set of data. In order to apply this method, we first construct a likelihood function. This function expresses the probability of the observed data as a function of the unknown parameters. The maximum likelihood estimators of these parameters are chosen to be those that minimize this function. Thus the resulting estimators are those which agree most closely with the observed data.

In this study, since Y is coded as 0 or 1 then the expression for $\pi(x) = E(Y|x)$ given in

$$\pi(x) = \frac{e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_7 X_7}}{1+e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_7 X_7}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

A transformation of $\pi(x)$that is central to the study of logistic regression is the logit transformation. This stranformation is defined, in terms of $\pi(x)$, as

$$g(x) = ln\left[\frac{\pi(x)}{1-\pi(x)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_7 X_7 \ldots\ldots\ldots.. (2)$$

The importance of this transformation is that *g(x)* has many of the desirable properties of a linear regression model. The logit, *g(x)*, is linear in its parameters, may be continuous, and may range from $-\infty$ to $+\infty$, depending on the range of x.

The function ($\pi(x)$) provides for an arbitrary value of β_j, the conditional probability that *Y* is equal to 1 given *X*. This will be denoted as P($Y = 1|x$). It follows that the quantity 1 - $\pi(x)$ gives the conditional probability that *Y* is equal to zero given *x*, P($Y = 0|x$). Thus, for those pairs (x_i, y_i), where $y_i = 1$, the contribution to the likelihood function is $\pi(x_i)$, and for those pairs where $y_i = 0$, the contribution to the likelihood function is $1 - \pi(x_i)$, where the quantity $\pi(x_i)$ denotes the value of $\pi(x)$ computed at x_i. A convenient way to express the contribution to the likelihood function for the pair (x_i, y_i) is through the expression

$$\pi(x_i)^{y_i}[1 - \pi(x_i)]^{1-y_i} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Since the observations are assumed to be independent, the likelihood function is obtained as a product of the terms given in the above expression in equation (3)

$l(\beta_j) = \prod_{i=1}^{n} \pi(x_i)^{y_i} [1 - \pi(x_i)]^{1-y_i}$ ..... (4)

The principle of maximum likelihood states that we use our estimate of β_j the value which minimizes the expression in equation (4). However, it is easier mathematically to work with log of equation (4). This expression, the log likelihood is defined as

$L(\beta_j) = \ln(l(\beta_j) = \sum_{i=1}^{n} \{y_i \ln[\pi(x_i)] + (1 - y_i) \ln[1 - \pi(x_i)]\}$ .. ..(5)

To find the value of β_j that minimizes L(β_j) we differentiate L(β_j) with respect to $\beta_0, \beta_1, \beta_2, \ldots, \beta_n$ and set the resulting expression equal to zero (David and Stanley, 2000).

The Wald Statistic

The univariate Wald test compares the difference between a maximum likelihood point estimate of a single parameter and a hypothesized value to its standard error which is compared to chi-squared table value:

$Wald = \frac{(\hat{\beta}_j - \theta)^2}{S^2_{\hat{\beta}_j}}$ ..... (12)

Where;

$\hat{\beta}_j$ is the estimate

θ is hypothesized value

$S_{\hat{\beta}_j}$ variance of estimate

The test statistic is compared against a chi-square distribution with one degree of freedom. The basis of this univariate procedure is that the maximum likelihood estimates are assumed to be asymptotically normal.

DISCUSSION OF RESULTS

Table 2: Summary Statistics

Statistics

		Age of women at first birth	Current number of children given birth to by each woman	Education level of women	Location of resident	Labour participation	Ideal number of children desired	Religion	Fertility rate (number of children born to each woman)
N	Valid	570	570	570	570	570	570	570	570
	Missing	0	0	0	0	0	0	0	0
Mean		24.68	4.95	.47	.52	.48	4.04	.87	.96
Median		25.00	5.00	.00	1.00	.00	4.00	1.00	1.00
Std. Deviation		3.980	1.989	.499	.500	.500	1.936	.338	.193

In this study, the average age of mothers examined is about 25 years of age with expected number children as 5 per woman. The average education level of mother appears to be within primary education with the average of no female labour force participation. The women appear to be mostly Christians and average wanted to four children throughout their reproductive age. The description depicted in table two indicated that most of the women examined are not engaged and a viable occupation and they plan to bear 4 children on the average. Their ideal number of desired children is quite disturbing because in this study, the fertility is considered to be high if a woman have 4 or more children and low if she has 3 or less.

Table 2: Frequency distribution of categorical predictors

Categorical Variables Codings

		Frequency	Parameter coding (1)
Religion	Traditional	75	.000
	Christian	495	1.000
Location of resident	Village	275	.000
	Town	295	1.000
Labour participation	Not working	297	.000
	Working	273	1.000
Education level of women	primary/none	303	.000
	Secondary/tertiary	267	1.000

Table 3: Efficiency of variable classification

Classification Table[a]					
Observed			Predicted		
			Fertility rate (number of children born to each woman)		Percentage Correct
			Low fertility	High fertility	
Step 1	Fertility	Low fertility	0	22	.0
		High fertility	0	548	100.0
	Overall Percentage				96.1

a. The cut value is .500

In this study, a validation of the classification of the response variable indicated that the overall correct percentage was 96.1% which implies that the model overall explanatory strength is efficient enough for prediction.

Table 4: Tests of Model Coefficients

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	87.448	7	.000
	Block	87.448	7	.000
	Model	87.448	7	.000

For us to achieve a reliable inference, we examined the fitted model through different statistics. From the result, we found from the table of goodness of fit test (table 4) on the fitted model, that the chi-square test is statistically significant by reporting a p-value less than 0.05. The test result described that both the intercept and all other coefficients are nonzero in fitted model.

Table 5: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	98.894[a]	.642	.810

a. Estimation terminated at iteration number 17 because parameter estimates changed by less than .001.

Cox and Snell R Square statistic explained that 64.2% probability of an event of having a high fertility is explained by the logistic regression model while the Nagelkerke R Square explained that the model is efficient (81%).

Table 6: Parameter estimates of the model

		β	S.E.	Wald	df	Sig.
Step 1[a]	Age of women at first birth	.020	.063	.101	1	.750
	Current number of children given birth to by each woman	-.071	.173	.170	1	.681
	Education level of women	-4.389	.392	11.196	1	.027
	Location of resident	1.637	.227	7.211	1	.000
	Labour participation	1.278	.380	11.310	1	.001
	Ideal number of children desired	.065	.144	.205	1	.651
	Religion	.398	.579	.474	1	.491
	Constant	20.670	2246.256	.000	1	.993

It is evident that the education level of women, location of resident of families and labour participation have significant effect in influencing the fertility of women in this study since they possesses p values of less than 0.05. For examining the significance of the estimates, the Wald statistic was used to double check the result of the p-values. The Wald statistics yielded results that appear to be greater than 5.024 of the $\chi^2_{0.05,1}$. This result therefore implies that for the area covered by this study, the effect of women's age at first birth, ideal number of children and religion have no place in determining fertility differentials among women.

The most efficient model found to be determining high fertility among women is given below:

$$P(Y = 1/X_3X_4X_5) = \frac{e^{-4.389X_3+1.637X_4++1.278X_5}}{1 + e^{-4.389X_3+1.637X_4++1.278X_5}}$$

$$P(High\ fertility/X_3X_4X_5) = \frac{e^{-4.389(education\ level)+1.637(location\ of\ resident)+1.278(labour\ participation)}}{1 + e^{-4.389(education\ level)+1.637(location\ of\ resident)+1.278(labour\ participation)}}$$

By a way of simulation, the following scenario will explain our findings better;

Table 7: Fertility Simulation

Education level of women	Location of women's residence	Female participation	Probability of high fertility
Primary/none	Village	Not working	0.50
Secondary/tertiary	Village	Not working	0.04
Primary/none	Township	Not working	0.30
Primary/none	Village	Working	0.78
Secondary/tertiary	Township	Not working	0.01
Secondary/tertiary	Village	Working	0.04
Primary/none	Township	Working	0.21
Secondary/tertiary	Township	Working	0.01

Table 7 result explained the various probabilities of having high fertility with regards to given living location, educational level and labour force participation of women as a various mixed combination. The combination with the highest probability of high fertility as depicted by the estimated model from this study is that scenario where a woman has a primary or no education; she resides in the village and is working. The probability of having high fertility with such scenario is 0.78. Our analysis on the simulation procedure indicated a favouarble option of low fertility (i.e. the least probability of high fertility) as a scenario where a woman has a woman has a secondary/tertiary education, living in the town (urban area) and is working or not working since they both have a 0.01 probability.

Conclusion and Recommendation

This study has been able to show that there is a relationship between some selected demographic variables and the fertility differential among women in the analysis. The study reveals that the factors that contributed to high fertility among women include their education level, location of resident and the participation in labour force which are significant at conventional level. Moreover, from the findings, it was there recommended that women/girl-child education should be taken seriously as they help in playing a very crucial role in the reduction over population in the society. It will also help if they are educated, participation in labour force by women will be increased and this will help in fertility control as shown by the results of the study.

References

Ashraf, J. E. (2005). An Examination of Factors Affecting Fertility Rate Differentials as Compared Among Women in Less and More Developed Countries. *J. Hum. Ecol*., 18:(3) 181-192

Bale, L. K. (2005). Uganda experienced fertility transitions. *Fertility Research and Practice* 1:(14).

Boyle, R. G. (2003). Fertility, Biology and Behaviour: An Analysis of the Proximate Determinants. New York Academic Press.

Cernic-Istenic, I. and Kevder, J. C. (2008). Fertility Decline in Africa: A New Type of transition? *Population and development Review.* 18:(2).211-242.

Child Trends Databank. (2015). Fertility and birth rates. Available at: www.childtrends.org

David, W. H. and Stanley, L. (2000). Applied Logistic Regression. Second Edition. A Wiley-Interscience Publication, John Wiley & Sons Inc., New York.

El Lahga, L. and Olfa, O. P. (2008). The Effect of Female Education on Fertility and Infant Health: Evidence from School Entry Policies Using Exact Date of Birth. Am Econ Rev 101:23

Hoffman-Novoting, L. W. (2007). The Value of Children to Parents, in Fawcett, J. T. (ed), Psychological Perspectives on Population: New York Basic Books. Pp.19-76.

Tsegaye, O. P. (2010). Family Planning as an Investment in Development: Evaluation of a Program's Consequences in Matlab, Bangladesh. IZA Discussion Paper No. 2639

Yang, Y. and Morgan, S. P. (2003). How Big Are Educational and Racial Fertility Differentials in the U.S.? *Social Biology* 50(3/4):167–187