Science World Journal Vol. 16(No 1) 2021
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

Full Length Research Article

MODELLING THE TREND AND DETERMINANTS OF STUNTED CHILDREN AGE 0-59 MONTHS IN NIGERIA

U.M. Hassan[1], C.L. Ani[2], M.M. Ndaware[3] and G.A. Adesue[4]

[1]Department of Mathematical Sciences, University of Maiduguri, Maiduguri, Nigeria.
E-mail: umarstat3@gmail.com

[2]Department of Mathematics and Statistics, Air Force Institute of Technology, Kaduna, Nigeria.
E-mail: emekaani605@gmail.com

[3]Department of Statistics, Federal Polytechnic, Bali, Taraba State, Nigeria.
E-mail: ndaware046@gmail.com

[4]Department of HIV Prevention, AIDS Healthcare Foundation, Lafia, Nigeria.
E-mail: adesue2005@gmail.com

ABSTRACT
Prevalence of Stunting among under-five children is very high in many developing countries of the World. As step towards reducing the prevalence, there is need to identify the important determinants and the Trend of Stunting in the specific context. This paper examined the general trend and determinants of stunting among children 0-59 months in Nigeria. The anthropometric indices Height for age z-score was used to determine a child's nutritional status as whether a child is stunted and the impacts of some socioeconomic, Demographic, Community level, Environmental and maternal factors on this are determined. Results from this study shows that Child's sex, mother's birth interval, Mother's and their partner's educational status, Locality, geopolitical zones of the mother's, Wealth index, parents source of drinking water among others contributed positively to Stunting among children 0-59 months in Nigeria ($p < 0.05$). The general results showed that Stunting among less than five years children in Nigeria has significantly improves over time between 1990 and 2003 ($p < 0.05$). Although following a sinusoidal pattern. Five waves of national data from the Nigerian Demographic and Health Surveys for 1990, 1999, 2003, 2008 and 2013 were employed in the study.

Keywords: Stunted, Malnutrition, Anthropometry, Height for Age, Logistic Regression.

1.0 INTRODUCTION

Malnutrition is a condition that occurs when people consistently do not consume or absorb the right amounts and types of food and essential nutrients. Globally, it contributes to nearly half of all child deaths, that is, more than 3 million children each year (Robert et al., 2013). It leads to lower individual productivity, deterioration of health, and lower life expectancy Caulfield et. al., (2004) and hinders the potential for countries to reduce poverty and maximize socioeconomic development (Pelletier and Frongillo, 2003). Poverty, poor health, nutrition, and deficient healthcare derail the potential for cognitive development of about 200 million children under age 5 in developing countries (Grantham et. al., 2007). Child malnutrition is a major international public health problem with consequences for both individuals and societies. Of 555 million children aged 0 to 5 years living in developing countries, 177 million (32%) are stunted (chronic malnutrition) (Ezzati et. al., 2002). One of the main indicator of childhood malnutrition is stunting, when children are too short for their age. Stunted children have poor physical growth and brain development, preventing them from thriving and living up to their full potential.

Stunting is defined as low height for age (i.e. < - 2 SD) from median height for age of reference population (Black et. al., 2008). Stunting may be a result of prolonged inadequate dietary intake, repeated infections or both. High stunting rates have been observed in children living in resource limited environments. There is evidence that stunted children may grow up to be adults who perform poorly education wise and will be less economically and physically productive (FASEB, 1995). Linear growth retardation also known as stunting is a useful anthropometric measure for children in terms of its positive correlation with social and economic deprivation. Stunting is now acknowledged as the best proxy measure for child health inequalities (Carlson et. al., 2008; WHO, 1995).

Several studies in low-income countries have indicated that male children are more likely to be stunted than their female counterparts, most of them in sub-Saharan Africa. A recent study disaggregated stunting prevalence rates by sex and socio-economic status (SES), it was revealed that in poorer households more boys were stunted than girls, and that the sex differences in stunting rates did not exist among children belonging to socio-economically better off groups (Pradhan et. al., 2003). Wamani et. al., (2004), the trends in child malnutrition between 1990 and 2013. They described stunting (low Height for age) as manifestation of undernutrition and exposes the child to health risks; in their severe forms. It stated that this constitute a threat to the child's survival. According to the study, the prevalence of stunting in Nigeria changed marginally between 1990 and 2013 from 43% to 37%. The findings of a study on factors affecting Nigerian children's nutritional status suggest that households' economic status is significantly associated with their nutritional status. The very poor and the poor constitute 74% of the population and cannot afford a nutritious diet (STC, 2016). In Nigeria, children from the poorest households are almost 3 times more likely to be stunted and almost 4.3 times more likely to be severely stunted compared to children from the wealthiest households (Wamani et. al., 2004). The aim of the study is to determine the trend and risk factors of Stunting among children age 0 to 59 months in Nigeria.

Science World Journal Vol. 16(No 1) 2021
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

2.0 METHODOLOGY

2.1 Dependent Variable

2.1.1 Height for age (stunting)

The anthropometric indices, height for age of children were calculated using growth standards published by the World Health Organization (2006). These growth standards were generated through data collected in the WHO Multicentre Growth Reference Study and expressed in standard deviation units from the Multicentre Growth Reference Study median. The height-for-age index is an indicator of linear growth retardation and cumulative growth deficits in children which is often associated with acute starvation and/or severe disease (Black et. al., 2008). Children with height-for-age Z-score below minus two standard deviations (−2 SD) from the median of the WHO reference population or less than third percentile (< 3^{rd}) are considered to be stunted or chronically malnourished children (Hosmer and Lemeshow, 2000).

In this research work, the response, Height for age (stunting) is measured based on the following binary categorical scale: 0 if "*Normal*" (i.e., if the i^{th} child is normal) and 1 if "*stunted*" (i.e., if the i^{th} child is stunted).

$$y_i = \begin{cases} 1 & \text{if the i}^{\text{th}} \text{ child is stunted} \\ 0 & \text{if the i}^{\text{th}} \text{ child is normal} \end{cases} \quad (1)$$

Apart from Height for age which is the response variable, information on the following independent variables was also available in the data, and they were therefore, included in data analysis. These are mother's and her partner's levels of educational attainment which are categorized into "no education," "primary," "secondary," and "higher" educational status with "no education" being the reference category. Other factors considered are Wealth index, Ethnicity, preceding and succeeding birth intervals, partners desire for children, source of drinking water, locality (urban or rural) where mother domiciled at the birth of the child, and others. Based on the 36 states and the federal capital territory (FCT) Abuja that make up the Federal Republic of Nigeria, the entire country has been divided into six mutually exclusive geopolitical zones comprising the North- East, North-West, North-Central, South-East, South-West, and South-South zones. While all these geopolitical zones may be similar in term of belonging to the same federation unit of Nigeria, each of them is unique in term of their sociocultural characteristics. Given this background, it is therefore necessary to compare the stunting on children from these six different geopolitical zones. This was fully captured and discussed in this study. The trend pattern of stunting on children aged 0-59 months, two dummy variables were created for the years of study beginning from 1990 to 2013 with 1990 being the reference category. This enables easy examination and comparisons of trends pattern of stunting behaviour on children in Nigeria from 1990 to 1999, 1990 to 2003, and 1990 to 2008.

2.2 Binary logistic regression analysis

Binary logistic regression analysis was employed to analyse the data. The binary logistic regression is a type of regression which is used when the response variable is dichotomous and the predictor variable are of any type. In binary logistic regression, a single outcome variable Y_i $(i = 1,2, \dots, n)$ follows a Bernoulli probability distribution that takes on the value of 1 with probability P_i and 0 with probability $1 - P_i$.

2.2.1 Odds ratio

Logistic regression analysis utilizes odds and odds ratio. The odds of success are simply the ratio of probability of success P (the probability that a patient will survive or $\mathrm{Y} = 1$) to the probability of failure $1 - P$ (the probability that a patient will not survive or $\mathrm{Y} = 0$). That is:

$$odds = \frac{P}{1-P} \quad (2)$$

The odds are non-negative with value greater than one when a success is more likely than a failure. The odds ratio denoted by OR, and is defined as the ratio of the odds for $\mathrm{Y} = 1$ to the ratio of $\mathrm{Y} = 0$ and is given by:

$$odds\ ratio = \frac{P_1/_{1-P_1}}{P_0/_{1-P_0}} \quad (3)$$

Odds ratio is an estimate of the risk of an exposed group relative to a control group or unexposed (reference group). Odds ratio less than 1 indicates negative relationship and odds ratio greater than 1 indicates positive relationship and odds ratio equal to 1 indicates no difference between exposed and control group.

2.3 Logistic Regression Analysis Model

Logistic regression model is used to study the relationship between a categorical or qualitative response (outcome) variable and one or more explanatory variable (independent or predictor) variables. In case of one predictor variable X and one dichotomous outcome variable Y, the logistic model predicts the logit of Y from X. The logit is a natural logarithm of odds of Y. Simply the logit model can be written as:

$$ln\left(\frac{P}{1-P}\right) = \alpha + \beta X \quad (4)$$

Hence,

$$P(X) = E(Y/X) = (p(Y = response(outcome)\ of\ interest)/X = x) = \frac{e^{\alpha+\beta X}}{1+e^{\alpha+\beta X}} \quad (5)$$

Where P is the probability of the outcome of interest, α is the Y intercept (constant) and β is the slope parameter. X is predictor that can be categorical or continuous variable and Y is always categorical (dichotomous). The simple logistic regression model can be extended to multiple logistic regression as follow:

$$ln\left(\frac{P}{1-P}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \quad (6)$$

Therefore,

$$P(X) = E(Y/X) = [p(Y = response(outcome)\ of\ interest)/X_1 = x_1, X_2 = x_2, \dots, X_k x_k)] = \frac{e^{\alpha+\beta X}}{1+e^{\alpha+\beta X}} \quad (7)$$

Where $P(X)$ is the probability of the outcome of interest, α is the Y intercept (constant) and β_s are the slope parameters. $X's$ are the set of predictors. α and β_s are estimated by the MLE method (NPC and ICF, 2013).

3.0 DATA ANALYSIS AND RESULTS

3.1 Data Source

The data employed for this study are from the four waves of the Nigeria Demographic and Health Surveys (NDHS). The survey was implemented by the National Population Commission (NPC) in

conjunction with ICF Macro, Calverton, MD, USA. For 1990, 1999, 2003, 2008 and 2013. For each NDHS data, a representative sample of W, households was selected for the survey; with a minimum target of I completed interviews per state. A stratified three-stage cluster design consisting of k clusters, k1 in rural areas and K2 in urban areas was used in the selection of samples for the survey, (multistage sampling). For each cluster, a fixed sample of n households was selected. All women of reproductive ages 15–49 years and men aged 15-59 years who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed. Child recode data of the surveys were used for all analyses of the data.
The principal objective of the Nigeria Demographic and Health Surveys is to provide current and reliable data on fertility and family planning behaviour, child mortality, child nutritional status, Anthropometrics indices, the utilization of maternal, and child health services, as well as knowledge and attitudes towards HIV/AIDS. Traditional statistical techniques assume that individual observations (responses) are independent from one another .However, due to the hierarchical nature through which these data were collected, it is sometimes appropriate to assume that responses from individuals that are within the same clusters might be correlated and those in different clusters are uncorrelated. Therefore, responses on child nutrition for the respondents that belong to the same cluster are assumed to be correlated but uncorrelated between different clusters.
The NDHS data for 1990, 1999, 2003, 2008 and 2013 contained Socio-demographic, community level, Environmental, proximate determinants (Maternal, delivery, and child factors) related responses from 7,902, 3,552, 5,138, 28,647 and 8,658 mothers of reproductive ages, Respectively .Thus, a total of 53,897 respondents were involved in the five NDHS data sets combined. Out of this figure, information On Height for age is 49,276. Moreover, respondents with incomplete information were excluded from the final analysis.

3.2 Descriptive and bivariate analysis

The descriptive results (in absolute figures and percentage) and the chi-square results based on bivariate analysis are given in "Table 1" below. The bivariate analysis was used to determine the association between height for age (response variable) and the risk factors (predictors).

Table1: Descriptive and Bivariate Analysis Results

Risk Factor	Risk Factor Levels	Height for age		Total 49909 (100%)	P value
		Normal (0) 11618 (23.3%)	Stunted (1) 38291 (76.7%)		
Geopolitical zones	North Central (ref)	2623 (5.3%)	7533 (15.1%)	10156 (20.4%)	0.000*
	North East	1401 (2.8%)	10647 (21.3%)	12048 (24.1%)	
	North West	2286 (4.6%)	10244 (20.5%)	12530 (25.1%)	
	South East	1293 (2.6%)	2627(5.3%)	3920 (7.9%)	
	South-South	2466 (4.9%)	3914 (7.8%)	6380 (12.7%)	
	South West	1549 (3.1%)	3326 (6.7%)	4875 (9.8%)	
Ethnicity	Others (ref)	10541 (21.1%)	34952 (70.0%)	45493 (91.2%)	0.000*
	Hausa	448 (0.9%)	2253 (4.5%)	2701 (5.4%)	
	Igbo	289 (0.6%)	401 (0.8%)	690 (1.4%)	
	Yoruba	340 (0.7%)	685 (1.4%)	1025 (2.1%)	
Mother's educational status	No education (ref)	4759 (9.5%)	20074 (40.2%)	24833 (49.8%)	0.000*
	Primary education	2602 (5.2%)	9085 (18.2%)	11687 (23.4%)	
	Secondary and above	4257 (8.5%)	9132(18.3%)	13389 (26.8%)	
Literacy	Cannot read at all	4975 (9.9%)	20586 (41.4%)	25537 (51.4%)	0.000*
	Can able to read	6643 (13.3%)	17538 (35.3%)	24157 (48.6%)	
Respondent's month of birth	January (ref)	1111 (2.2%)	3996 (8.0%)	5107 (10.2%)	0.058
	February	1202 (2.4%)	4181 (8.4%)	5383 (10.8%)	
	March	1359 (2.7%)	4310 (8.6%)	5669 (11.4%)	
	April	1320 (2.6%)	4463 (8.9%)	5783 (11.6%)	
	May	1097 (2.2%)	3572 (7.2%)	4669 (9.4%)	
	June	1121 (2.2%)	3794 (7.6%)	4915 (9.8%)	
	July	908 (1.8%)	3163 (6.3%)	4071 (8.2%)	
	August	852 (1.7%)	2800 (5.6%)	3652 (7.3%)	
	September	723 (1.4%)	2313 (4.6%)	3036 (6.1%)	
	October	728 (1.5%)	2284 (4.6%)	3012 (6.0%)	
	November	592 (1.2%)	1647 (3.3%)	2239 (4.5%)	
	December	605 (1.2%)	1768 (3.5%)	2373 (4.8%)	

Source of drinking water	Others (ref)	6430 (12.9%)	22996 (46.9%)	29426 (59.0%)	0.000*
	Pipe	1703 (3.4%)	4662 (9.3%)	6365 (12.8%)	
	Well	117 (0.2%)	181 (0.4%)	298 (0.6%)	
	Sachet	3368 (6.7%)	10452 (20.9%)	13820 (27.7%)	
Time to get to water source (minutes)	< 8 hours (ref)	2355 (5.1%)	8043 (17.3%)	36085 (77.6%)	0.069
	> 8 hours	8426 (18.1%)	27659 (59.5%)	10398 (22.4%)	
When a child was put to breast after birth	Immediately (ref)	10166 (25.2%)	2693 (8.5%)	12859 (33.7%)	0.000*
	Within first hour	3419 (8.5%)	10039 (24.9%)	13458 (33.4%)	
	Within first day	3430 (8.5%)	10598 (26.3%)	14028 (34.8%)	
Mother's birth interval	< 12 months (ref)	6025 (16.3%)	21269 (57.4%)	27294 (73.7%)	0.003*
	> 12 months	2171 (5.9%)	7589 (20.5%)	9760 (26.3%)	
partner's education level	No education (ref)	3733 (7.6%)	15848 (32.4%)	19581 (40.1%)	0.000*
	Primary education	2459 (5.0%)	8561 (17.5%)	11018 (22.6%)	
	Secondary and above	5196 (50.4%)	13046 (26.7%)	18242 (37.3%)	
Sex of household head	Male (ref)	1015 (2.0%)	2862 (5.7%)	3877 (7.8%)	0.000*
	Female	10603 (21.2%)	35429 (71.0%)	46032 (92.2%)	
Preceding birth interval (months)	< 24 months (ref)	9512 (23.8%)	30388 (76.1%)	39900 (99.9%)	0.174
	> 24 months	9 (0.0%)	18 (0.0%)	27 (0.1%)	
succeeding birth interval (months)	< 24 months (ref)	4368 (22.6%)	14893 (77.1%)	19261 (99.7%)	0.067
	> 24 months	18 (0.1%)	38 (0.2%)	56 (0.3%)	
Locality	Urban (ref)	10527 (21.1%)	4317 (8.6%)	14844 (29.7%)	0.000*
	Rural	7301 (4.6%)	27764 (55.6%)	35065 (70.3%)	
	Male	5755 (11.7%)	19134 (39.0%)	24889 (50.7%)	0.000*
Child's Sex	Female	5682 (11.6%)	18514 (37.7%)	24196 (49.3%)	
Wealth index	Poor (ref)	3796 (9.1%)	16374 (39.4%)	20170 (48.5%)	0.000*
	Middle	4082 (9.8%)	9269 (22.3%)	13351 (32.2%)	
	Rich	1827 (4.4%)	6213 (14.9%)	8040 (19.3%)	

* denotes significance at 0.05 level of significance

The bivariate analysis result shows that the association between Respondent's month of birth (p = 0.058), Time to get to water source (p = 0.069), Preceding birth interval (p = 0.174), Succeeding birth interval (p = 0.067) and height for age (response variable) are insignificant at 5% level of significance.

Analysis of all the five waves of the NDHS data, and the result obtained are presented in this section. From the distribution of stunting behaviour for all the 49,909 children 0-59 months that are involved in this study as presented in Table 1. It was observed that about three quarter (77%) of the children 0-59 months are stunted in Nigeria.

From the descriptive statistics in table 1, it was revealed that about 70% of children are from rural community of the country out of which 56% are stunted. 50% of stunted children were born by illiterate women and 40% were born by illiterate parents. 57% of the stunted children belonged to the mothers who give an interval of less than twelve months from one birth to another birth and among the stunted children 39% are males and 37% are females. Table 1 has also shown that 27% of stunted children belonged to the parents that used sachet water as their drinking water. It was also revealed that 9% of the children whom where breastfed immediately after birth are stunted, 25% of the stunted children are among those whom were breastfed within the first hour after birth, while 26% of the stunted children are those who were breastfed hours after delivery. With respect to the six geopolitical zones in Nigeria, children from the North-Eastern zone had the worst cases of stunting among children 0-59 months in Nigeria with (21%) and the North- Central region zone had the best cases of stunting

Science World Journal Vol. 16(No 1) 2021
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

among children 0-59 months in Nigeria with about (5.3%).
In terms of Wealth index, 39% of stunted children are from poor family, 22% from middle class family, and only 15% of stunted children belonged to a rich family. 90% of the covariates in "Table 1" from the Pearson's chi-square test of bivariate association between each of the previous identified factors and the response variable (Height for age), is significant at 5% level.

Table 2: Frequency Distribution (Percentage in parenthesis) of all the 49,909 Children by their Nutritional Status Behaviour from 1990 to 2013

	Height for Age			
Factor	**Normal (0)**	**Stunted (1)**	**Total**	**P-Value**
Year				
1990 (ref)	1022 (2.0%)	4491 (9.0%)	5513 (11.0%)	
1999	891 (1.8%)	1944 (3.9%)	2835 (5.1%)	
2003	1180 (2.4%)	3853 (7.7%)	5033 (10.1%)	0.000*
2008	6459 (38.9%)	21510 (43.1%)	27969 (56.0%)	
2013	2066 (4.1%)	6493 (13.0%)	8559 (17.1%)	
Total	**11,618 (23.3%)**	**38,291 (76.7%)**	**49,909 (100%)**	

* denotes significance at 0.05 level of significance

The chi-square test of association between Height for age (stunting) and years of study is statistically Significant (P = 0.000) at 5% level of significance.
In terms of trend of stunting behaviour among the children 0-59 months from 1990 to 2013, the summary statistics in "Table 2" revealed decrease in the cases of stunting from 1990 to 1999 in which the percentage of stunted children dropped from 9.0% in 1990 to 3.9% in 1999. However, this apparent improvement in the reduction of cases of stunting was not sustained for long before the percentage of stunted children increased in the country up to 7.7% in 2003. In 2008, the prevalent of stunting among the children 0-59 months has become worst, as the percentage of stunted children rise up to 43.1%. There was a drastic decrease of stunting cases among children 0-59 months between 2008 to 2013 in which the percentage of stunted children dropped from 43.1% in 2008 to 13.0% in 2013.This shows that the trend undergoes sinusoidal (quadratic) pattern which revealed an apparent improvement from 1990 to 1999 and between 2008 to 2013, but there was a high deterioration prevalence of stunting in 2008.

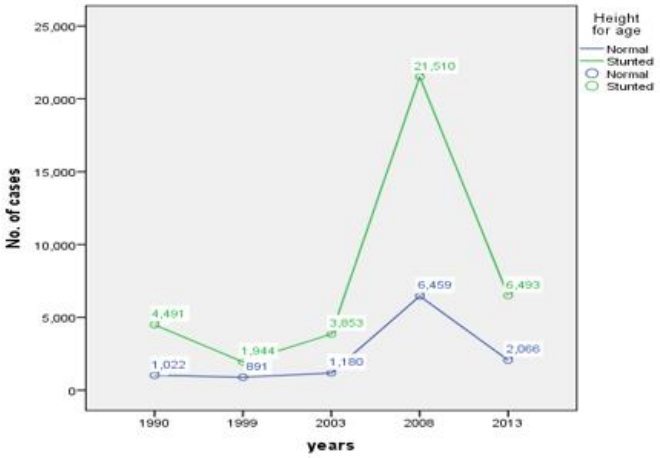

Figure 1: The Line Graph of Number of Cases of Stunted and Normal Children Age 0-59 Months from 1990 to 2013

The graph shows a sinusoidal behaviours over the period with apparently similar experience recorded in 1990, 1999 and 2003 among the stunted and normal children. But there was a high deterioration prevalence of stunting in 2008.

The odds ratio (OR), standard error, P value, 95% confidence intervals, and the percentage change in odds ratio for unit change in the level of each of the risk factors are presented in Table 3 below.

Table 3: Results of Logistic Regression Model of Stunting among Children 0-59 Months on some Socio-demographic, Community Level, Environmental, and Maternal Factors

Risk factor	**Risk factor levels**	**Odd ratio Exp. (B)**	**S.E (B)**	**P-value**	**95% C.I for EXP (B) LOWER**	**UPPER**	**% change in odd OR**
Year	Year 1990 (ref)						
	Year 2003	0.526	0.039	0.000	0.454	0.610	-47.4
	Year 2008	2.498	0.268	0.000	2.025	3.082	+150
	Year 2013	1.422	0.158	0.002	1.144	1.767	+42.2
Geopolitical zones	North- Central (ref)						
	North- East	2.526	0.106	0.000	2.327	2.741	+153
	North- West	2.050	0.070	0.000	1.917	2.120	+105
	South- East	1.325	0.904	0.000	1.159	1.514	+33.0
	South- South	1.790	0.076	0.015	1.654	2.956	+21.0
	South- West	1.377	0.046	0.000	1.289	1.471	+37.7
Mother's Educational status	No education (ref)						
	Primary education	0.632	0.086	0.001	0.484	0.826	-37.0
	Secondary and above	0.594	0.080	0.000	0.456	0.774	-41.0
Sex of child	Male (ref)						
	Female	0.697	0.075	0.021	0.511	0.893	-30.0
Wealth index	Poorest (ref)						
	Middle	0.800	0.056	0.001	0.698	0.918	-20.0
	Richest	0.577	0.042	0.000	0.500	0.665	-42.3
Locality	Urban (ref)						
	Rural	1.621	0.337	0.020	1.079	2.434	+62.1
When a child was put to breast after birth	Immediately (ref)						
	Within the first hour	1.178	0.072	0.008	1.043	1.327	+17.4
	Within hours	1.180	0.087	0.024	1.022	1.362	+18.0
Partner's education	No education (ref)						
	Primary education	0.786	0.094	0.044	0.621	0.994	-21.4
	Secondary and above	0.895	0.073	0.172*	0.763	1.050	-10.5
Mother's birth interval	< 12 months (ref)						
	> 12 months	0.770	0.039	0.000	0.693	0.884	-23.0
Constant	Constant	2.740	0.415	0.000			

* denotes significance at 0.05 level of significance

According to the result of logit model in "Table 3" above revealed that child's sex is associated with stunting in Nigeria, more specifically, female children have about 30% (OR=0.697, p=0.021) lower risk of being stunted compared to the male children. Mothers education is also associated with stunting, and the result has revealed that mothers with primary level of education have a reduced risk of about 37% (OR= 0.623, p=0.001) of having a stunted children compared to their illiterate counterparts, and the

mothers who have secondary and above levels of education have lower risk of about 41% (OR=0.594, p=0.000) of having a stunted children relative to their illiterate counterparts. Similarly, mothers whose husbands (partners) have a primary level of education have a reduced risk of about 21% (OR=0.786, p=0.044) of having a stunted children compared to their illiterate counterparts.
In terms of locality (mothers place of residence), the result showed that mothers that deliver in the rural communities have a higher risk of about 62% (OR=1.621, p=0.020) of having a stunted children compared to the mothers that deliver in the urban communities. The result further revealed that children that were breastfeed within the first hour after birth have increased risk of about 17% (OR=1.178, p=0.008) of being stunted compared to the children that were breastfeed immediately after birth. In the same manner, children whom were breastfeed within hours after delivery have a higher risk of about 18% (OR=1.180, p=0.024) of being stunted relative to the children that were breastfeed immediately after delivery.

The result also revealed that mothers who take an interval of more than twelve months between one birth to another birth are 23% (OR=0.770, p=0.000) less likely to have a stunted children relative to their counterparts that give an interval of less than twelve months between one birth to another. In terms of wealth index, the model has revealed that children that were born in average class family, have a reduced risk of about 20% (OR=0.800, p=0.001) of being stunted compared to the children that were born in poorest family. Likewise, children who were born in richest family are about 42% (OR=0.577, p=0.000) less likely to be stunted relative to the children whom were born in the poorest family.
In terms of geopolitical zones, the behaviour of stunting among children 0-59 months in Nigeria across the six geopolitical zones differ. Out of all the 49,909, o-59 months children that are involved in this study, the result in "Table 3" above has shown that geopolitical zones of the children is negatively associated with stunting. More specifically children from the North-Eastern zone have a higher risk of about 153% (OR=2.562, p=0.000) of being stunted compared to the children in the North-Central zone. Also children from the North-West, South-West, South-East, South-South, and the South-West zones have a higher risk of 105% (OR=2.050, p=0.000), 33% (OR=1.325, p=0.000), 21% (OR=0.790, p=0.015), and 38% (OR=1.377, p=0.000) of being stunted respectively, compared to the children in the North-Central zone. This shows that the probability of mothers to give birth to stunted children is higher in the North-Eastern zone, followed by North-West, South-East, South-South, and South-West, in that order.

The result of the logit model has also shown the sinusoidal trend that characterized the behaviour of stunting among children 0-59 months in Nigeria, from 1990 to 2013. It was revealed that the relative risk (odds) of children to be stunted has significantly reduced by about 47% (OR=0.526, p=0.001) from 1990 to 2003. The risk of children to be stunted has significantly increased by 150% (OR=2.498, p=0.000) and 42% (OR=1.422, 0.002) from 1990 to 2008 and from 1990 to 2013 respectively. The odds ratio estimates from the logit model for the year 1999 was 1.085 which is not significant at 5% level (p=0.288), and hence it was removed from the analysis. This further entails that there is no significant increase in the cases of stunting among children 0-59 months in Nigeria from 1990 to 1999.

4.0 CONCLUSION

Child nutritional status assessment not only serves as a means for evaluating the health condition and survival of children but also provides an indirect measurement of the quality of life of an entire population. Findings from this research have provided information which permits opportunity of discerning the trend and determinants of stunting in Nigeria. Mother's educational status plays an important role at determining a child being stunted. Out of 49,909 mothers covered by this study, about half (precisely 24,833) of them are illiterates who can neither read nor write. Unfortunately, about 40% (20,074) of the stunted children belonged to the 24,833 illiterate mothers which coincided with the conducted by (Akombi et al, 2017), mothers with primary and secondary education are less likely to be stunted compared with mothers with on education OR (0.42 & 0.31). The cases of stunting, significantly decrease (between 1990 and 1999 and between 2008 and 2013) which is also based on the report of World Bank data 1990-2018 on prevalence of stunted child in Nigeria. Obviously, this is not unconnected with apparent increase in literacy levels among women of reproductive age in Nigeria over time. The localities where mothers domiciled up to the time of delivery also play a significant role at determining a child to be stunted. About 70% of the mothers who lives in the rural areas, their children were stunted. The relative risk of stunting among children 0-59 months increased by about 62% for children living in the rural areas compared to their counterparts living in the urban areas (OR=1.621, p=0.020). These results generally shows nursing mothers that live in urban areas at the time of delivery are less likely to deliver stunted children compared to their rural counterparts. Based on (Akombi et al, 2017) mothers residing in urban their children are 56% less likely to be stunted. Wealth index also plays a significant role at determining a child being stunted. The study shows that among under five children that are stunted in Nigeria, 39% (precisely 16,373 children) are from poor family, 22% (precisely 9,269) are from average family and only 15% (precisely 6,213) are from rich family. The study has further shown mothers from average family, and rich family are 20% and 42% less likely to deliver a stunted children respectively, relative to their counterparts that live in the poor family. Based on the research conducted by (Akombi et al, 2017) poor, middle, rich and richest family are 36%, 61%, 64% and 78% less likely their children to be stunted compared to the poorest family.
The geopolitical zone in which the child resides has a part to play in the likelihood of children being stunted. Although appreciable decrease in the percentage of stunting recorded in the North-Central with about (5.3%, precisely 2,623) relative to others. While the worst percentage of stunting were recorded in the North-Eastern part of the country with about (21.3%, precisely 10,647) relative to others. The entire results of the study has shown that children that reside in the Northern region of the country exhibit a greater tendency of being stunted compared to children in the Southern region of the country. Based on report of (Akombi et al, 2017) north East and North West are 2.20 and 4.62 times more likely to be stunted compared to North Central. South East, South West and South are 0.58, 0.73 and 0.94 times less likely to be stunted compared to North Central.
Child's sex also plays an important role at determining a child being stunted. We observed that 39% of the stunted children of under five years of age were males while 38% were females. Furthermore, the study shows that a female child is 30% less likely to be stunted compared to a male child. Based on research conducted by (Akombi et al, 2017) females are 21% less likely to be stunted.

Other risk factors associated with stunting and wasting are mother's birth interval, the time a child breastfed after birth, partner's education status, sex of household head, and parents source of drinking water.

In view of this, the study recommend that Sustainable approaches to addressing stunting (chronic malnutrition) encompass strengthening livelihood systems for poor people and supporting policies that improve women's nutrition, childcare practices and increase access to nutritious food. At the community level, intervention among uneducated mothers of low socioeconomic status is also needed and such intervention should focus on mothers residing in the Northern geopolitical zones especially the North-Eastern part of the country. These would tremendously help at reducing the spate of neonatal deaths in order to align Nigeria with the WHO global nutrition target of achieving a 40% reduction in the number of stunted children under 5 years by 2025

REFERENCES

Akombi, B. J., Agho, K. E., Hall, J. J., Merom, D., Astell-Burt, T. & Renzaho, A. (2017). Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. BMC Pediatrics, 17 (1), 15-1-15-16.

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De-Onis, M. and Ezzati, M. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. Lancet. 71(9608):243-60.

Carlson, S. A., Fulton, J. E., Lee, S. M., Maynard, M., Drown, D. R., Kohl, H. W. and Dietz, W. H. (2008). Physical education and academic achievement in elementary school: data from the Early Childhood Longitudinal Study. American Journal of Public Health. 98(4): 21-727.

Caulfield, L.E., De Onis, M., Blössner, M. and Black, R.E. (2004). Undernutrition as an Underlying Cause of Child Deaths Associated with Diarrhea, Pneumonia, Malaria, and Measles. The American Journal of Clinical Nutrition 80(1): 193-8.

Ezzati, M., Lopez, A. D., Rodgers, A., Vander-Hoorn, S. and Murray, C. J. L. (2002). Selected Major Risk Factors and Global and Regional Burden of Disease. Lancet 360(9343): 1347-60.

Federation of American Societies for Experimental Biology (FASEB). (1995). Third report on nutrition monitoring in the United States. Prepared for the Interagency Board for Nutrition Monitoring and Related Research, Washington D C.

Grantham, M. S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L. and Strupp, B. (2007). Developmental Potential in the First 5 Years for Children in Developing Countries. Lancet 369(9555): 60-70.

Hosmer, W. D. and Lemeshow, S. (2000). Applied Logistic Regression. New York, United States of America: John Wiley and Sons.

National Population Commission (NPC), Nigeria and ICF International. Nigeria Demographic and Health Survey (2013). Abuja, Nigeria, and Rockville, Maryland, USA.

Pelletier, D. L., and Frongillo, E. A. (2003). Changes in Child Survival Are Strongly Associated with Changes in Malnutrition in Developing Countries. The Journal of Nutrition 133(1): 100-107.

Pradhan, M., Sahn, D. E., and Younger, S. (2003). Decomposing world health inequality. Journal of Health Economics. 22: 271-293.

Robert et al., (2013). Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries, Lancet 382, no. 9890: 427-51.

Save The Children (STC). (2016). Trends of child malnutrition in Nigeria between 1990 and 2013. Nigeria Country Office, FCT-Abuja, Nigeria.

Wamani, H., Tylleskär, T., Åstrøm, A. N., Tumwine, J. K., and Peterson, S. (2004). Mothers' education but not fathers' education, household assets or land ownership is the best predictor of child health inequalities in rural Uganda. Int. J Equity in Health 3: 9-10.

WHO Physical status: the use and interpretation of anthropometry. (1995). Report of a WHO Expert Committee. World Health Organization Tech. Rep Ser. Geneva.

World Health Organization, MGRSG. (2006). Multicentre Growth Reference Study Group. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva.