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This special issue is dedicated to Professor Onukwuli Okechukwu Dominic (FAS), marking his retirement and celebrating a remarkable career. His legacy of exemplary scholarship, mentorship, and commitment to advancing knowledge is commemorated in this collection of works.

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Evaluation of anemia determining factors among children in Nigeria using multinomial logistics regression

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Abstract
Anemia is a disorder characterized by insufficient hemoglobin or red blood cells that affects the blood's ability to carry oxygen, which can cause weakness, exhaustion, and other health issues. It is a serious public health concern in Nigeria that affects children under five years old, impeding their growth, immunity, and vulnerability to diseases. This study evaluates factors influencing anemia levels amidst Nigerian children under the age of five years using data from the Nigeria Demographic and Health Survey (NDHS), covering 8,061 observations. The study examined levels of anemia as the dependent variable, socio-demographic factors such as maternal age, region, residence type, education, wealth index, among others as independent variables. Stepwise logistic regression selection procedure was used to identify significant predictors. The Chi-square tests of association, independence and multinomial logistic regression were used to assess the existence of association, independence and influence of these variables on anemia levels respectively. Variables such as educational level, wealth index and residence type are major determinants of anemia level in children below the age of five years. Children whose parents are without formal education were more prone to severe anemia, compared with children whose parents are formally educated. Children from urban areas have a lower likelihood of contracting moderate anemia compared to their rural counterparts. Also, the parents' wealth index is significantly associated with mild anemic levels in children below the age of five years with respective odds of (1.424, 1.376 and 1.252) for the poorest, poorer and middle-wealth index parents compared to the richest The study, therefore, concludes that education, economic status, and types of residence are significant determinants of anemia levels. It recommends enforcing basic education for parents, improving the wealth index and living in urban areas to reduce the prevalence of anemia among children under the age of five years in Nigeria.

Keywords: Anemia level, red blood cells, children, Stepwise, multinomial logistic

1. Introduction

Anemia is a medical condition that arises when the body lacks an adequate number of red blood cells or hemoglobin, reducing the bloodstream's capacity to transport oxygen. This deficiency can lead to symptoms such as fatigue, weakness, and other health complications. It is diagnosed based on a significant drop in hemoglobin levels, hematocrit, or the count of circulating red blood cells (Mayo Clinic, 2023). This condition presents a serious health challenge, particularly for children, as it hampers their physical and mental development, weakens their immune system, and heightens their vulnerability to infections and mortality (Jahid et al., 2022). Research indicates that addressing the various root causes of anemia can facilitate targeted interventions to lower its prevalence in at-risk populations (Smith, 2023).

Anemia is classified into multiple types based on its causes, including iron-deficiency anemia, vitamin-deficiency anemia, and hemolytic anemia (World Health Organization, 2024). The CDC (2020) further categorizes it according to etiology, severity, morphology, and hemoglobin concentration. Understanding the underlying mechanisms of anemia is crucial, as it is associated with increased risks of morbidity and mortality. Nutritional deficiencies, such as a lack of iron, folate, or vitamin B12, are major contributors to anemia, while nearly one-third of cases stem from chronic diseases (Cappellini & Motta, 2015). Genetic forms, like sickle cell anemia and thalassemia, result from inherited disorders (Mahmoud et al., 2024), whereas acquired anemia can be triggered by infections, inflammation, or medication use (Xu et al., 2024). The World Health Organization classifies anemia severity into three groups: severe (hemoglobin <7.0 g/dL), moderate (7.0–9.9 g/dL), and mild (10.0–11.9 g/dL).

Anemia remains a significant public health concern, particularly for children under five years old, as it negatively impacts their physical growth, cognitive development, and overall health (Ogunsaki et al., 2020; Kirby et al., 2021). Globally, anemia affects over 40% of children, with the highest prevalence in low- and middle-income countries. Sub-Saharan Africa has the most severe rates, with Nigeria among the most affected nations. Contributing factors include poor nutrition, malaria, and limited healthcare access. Understanding anemia's prevalence can help design effective interventions (Olaniran, 2020). Childhood anemia is linked to developmental delays and long-term consequences for education and productivity, in addition to increasing child mortality risks (Kwambai et al., 2022).

The causes of anemia are multifaceted, involving nutritional, environmental, socioeconomic, and infectious factors. A comprehensive approach is necessary to address its root causes, such as malnutrition, malaria, poverty, and poor sanitation. Cornelia et al. (2023) explored preventive strategies, categorizing them into nutrient-based and non-nutritional methods. Their study emphasizes public health initiatives aimed at women of reproductive age and young children, considering factors such as inflammation, genetics, nutrient absorption, and bioavailability while identifying key research areas for intervention effectiveness.

Malaria is a major driver of anemia disparities, particularly in northern Nigeria, where it is endemic. The disease destroys red blood cells, significantly contributing to anemia prevalence (Nigeria Malaria Indicator Survey, 2021). Higher malaria rates in the region are linked to warm climates conducive to mosquito breeding and inadequate access to preventive measures like insecticide-treated nets and antimalarial drugs. Economic instability further worsens anemia rates, as poverty and food insecurity in northern Nigeria limit access to essential nutrients (World Bank, 2022). Additionally, cultural beliefs can influence healthcare-seeking behaviors, with some communities preferring traditional or herbal remedies over modern treatments, delaying effective anemia management (Azeez & Babalola, 2021).

Anemia rates are disproportionately high in rural areas, where inadequate access to clean water and sanitation exacerbates infections and malnutrition (Ugwu et al., 2020). Children in households without clean water are more susceptible to infections such as diarrhea and intestinal parasites, which impair nutrient absorption and contribute to anemia (World Bank, 2022). A study by Tessema et al. (2021) on children aged 6 to 59 months in sub-Saharan Africa found an anemia prevalence of 64.1%, with 26.2% classified as mild, 34.9% as moderate, and 3% as severe. Higher anemia rates were associated with factors such as low maternal education, poverty, larger family size, male gender, and recent illness. Conversely, children aged 24 to 59 months, those receiving antiparasitic treatment, and those with mothers aged 20 or older had lower anemia risks.

Al-Kassab-Córdova et al. (2022) analyzed anemia prevalence among Peruvian children aged 6 to 59 months in urban and rural settings. Their study found an 88.61% difference in anemia rates, with rural areas exhibiting significantly higher prevalence (38.25%) compared to urban areas (26.39%). Key contributing factors included wealth index, maternal education, employment status, household size, and child age. Spatial analysis revealed clusters of high anemia prevalence, underscoring the need for targeted interventions to address geographic disparities.

Maternal education plays a crucial role in child health outcomes, particularly in anemia prevention. Mothers with higher education levels are more knowledgeable about nutrition, healthcare, and sanitation, reducing their children's anemia risk. Studies show that children of mothers who completed secondary education or higher are less likely to develop anemia than those whose mothers lacked formal education (Badolo et al., 2022). A study by Tirore et al. (2024) analyzing Demographic Health Survey data from 21 sub-Saharan African countries found an anemia prevalence rate of 51.26%. Lower anemia rates were linked to older maternal age and higher education levels, while higher rates were associated with having multiple children, being in later pregnancy stages, and living in poverty.

Faghir-Ganji et al. (2023) investigated anemia prevalence during pregnancy in Iran, reporting a 15% occurrence rate. The highest prevalence was observed among young mothers, those with multiple children, and housewives. The condition was most commonly detected in the first trimester and linked to low education levels, low birth weight history, and socioeconomic disadvantages. Similarly, Kassie et al. (2024) examined anemia risk factors in Tanzanian women of reproductive age, revealing a 42.02% prevalence rate. Among affected individuals, 19.82% had mild anemia, 19.35% had moderate anemia, and 2.84% had severe anemia. Major risk factors included poverty, low body weight, pregnancy, and residing in impoverished regions. On the other hand, employment, moderate alcohol consumption, and hormonal contraceptive use were associated with lower anemia rates. These findings highlight the importance of initiatives focused on nutrition, healthcare access, and education to combat anemia.

Preventing anemia effectively requires a comprehensive strategy that tackles its multiple determinants. Health education programs integrating nutrition, sanitation, and healthcare accessibility while considering socioeconomic and cultural differences have been shown to be more effective in reducing anemia prevalence (World Health Organization, 2022). Community health workers play a vital role in delivering targeted anemia education tailored to specific community needs. Addressing sanitation, dietary habits, socioeconomic challenges, and language barriers allows these programs to support families at higher risk (Iqbal et al., 2018).

Anemia remains a critical public health challenge in Nigeria, particularly for children, who face heightened risks due to their rapid growth and increased nutritional demands. Despite numerous national health initiatives, recent data reveal persistently high anemia prevalence among Nigerian children, impacting their physical and cognitive development. This condition, primarily driven by malnutrition, infections, poor sanitation, and socioeconomic inequalities, continues to hinder future generations' potential and perpetuate cycles of poverty and poor health.

Therefore, this research seeks to model the determinants of anemia among children in Nigeria, with a focus on how various socio-demographic and environmental factors contribute to the persistence of this condition. By determining the factors that contribute to the prevalence of anemia among children in Nigeria, this research aims to inform policymakers and health practitioners, enabling them to develop more effective strategies for reducing anemia rates and improving child health outcomes across Nigeria. The rest of the study is structured as follows: Section 2 details the methodology of the Multinomial Logistics Regression model, Section 3 presents the empirical examples, Section 4 offers a discussion of the findings, and Section 5 concludes the study

2.0 Materials and methods

2.1 Data description and variables selection procedure

The Demographic Health Survey website https://dhsprogram.com/methodology/survey/survey-display-609.cfm of dataset contains 8,061 observations with 18 variables that determine anemia level in children under 5 years old are included in the data. The seventeen (17) independent variables comprise of Age in 5-year groups, Region, Type of place of residence, Native language of respondent, Type of toilet facility, Ethnicity, Educational level, Sex of household head, Religion, Toilet facilities shared with other households, Births in last five years, State, Current marital status, Source of drinking water, Wealth index for urban/rural, Literacy, Sex of child. A stepwise, backward and forward elimination was conducted to check the variables that are highly significant in the determination of anemia level which is the dependent variable. After eliminating non-significant explanatory variables, seven (7) of the explanatory variables as suggested by stepwise regression variable selection procedure were adopted. These include the parent’s highest educational level, Type of toilet facility, Type of place of residence, state, wealth index¸ the native language of respondents, and Mother age interval. It is important to note that many of these variables were utilized in modeling levels of anemia in the existing literatures by Ogunsaki *et al.,* (2020).

2. 2 The Multinomial Logistics Regression Model

Multinomial logistic model is of the form:

$$P(Y) = \log\left[\frac{\beta(x)}{1-\beta(x)}\right] = \beta_{k0} + \beta_{k1}X_1 + \beta_{k2}X_2 + \cdots + \beta_{ki}X_i \qquad 1$$

2.3 Maximum likelihood estimation of Multinomial logistic regression models

The linear component of the multinomial logistic regression model is equivalent to the logarithm of the jth category's probabilities in comparison to the baseline or omitted category. The baseline category is used as the reference point to compute the logits for the original J-1 categories.

$$\log\left(\frac{\pi_{ij}}{\pi_{iJ}}\right) = \log\left(\frac{\pi_{ij}}{1+\sum_{j=1}^{J-1}\pi_{ij}}\right) = \frac{\pi_{ij}}{1-\pi_j} = \alpha + \beta x. i = 1,2,\dots,N \; and \; j = 1,2,\dots,J-1 \quad 2$$

Solving for π_{ij}, we have

$$\pi_{ij} = \frac{e^{\sum_{K=0}^{K} x_{ik}\beta_{kj}}}{1+\sum_{j=1}^{J-1} x_{ik}\beta_{kj}} \; j < J \quad 3$$

$$\pi_{ij} = \frac{1}{1+\sum_{j=1}^{J-1} x_{ik}\beta_{kj}} \quad 4$$

For multinomial logistic regression models, the likelihood function is:

$$L\left(\frac{\beta}{y}\right) = \prod_{i=1}^{N}\prod_{j=1}^{J}\left(\pi_{ij}\right)^{y_{ij}} \quad 5$$

3.0 Result and Discussion

Data used in this study was analyzed using frequency count, and percentages for the demographic, and socioeconomic variables. Crossed tabulation was used to obtain the prevalence of anemia across the all states. The chi-square test of independence was applied to investigate the relationship between the level of anemia and the place of residence. The chi-square test of association was used to analyze the connection between educational attainment, wealth index, and levels of anemia. Multinomial logistic regression was employed to assess how the independent variables influenced the levels of anemia.

3.1 Results

Table 1: The descriptive statistics of dependent and independent variables

Variables	Categories	Frequency	Percentage
Anemia level	Severe	136	1.7
	Moderate	2354	29.2
	Mild	2160	26.8
	not anemic	3411	42.3
	Total	8061	100.0
Educational level	no education	2430	30.1
	Primary	1425	17.7
	Secondary	2868	35.6
	Higher	1338	16.6
	Total	8061	100.0
Type of place of residence	Urban	3009	37.3
	Rural	5052	62.7
	Total	8061	100.0
Type of toilet facility	flush to piped sewer system	249	3.1
	flush to septic tank	1002	12.4
	flush to pit latrine	582	7.2
	flush to somewhere else	50	0.6
	flush, don't know where	2	0.0
	ventilated improved pit latrine (vip)	293	3.6
	pit latrine with slab	2057	25.5
	pit latrine without slab/open pit	1607	19.9
	no facility/bush/field	2097	26.0
	composting toilet	5	0.1
	bucket toilet	13	0.2

	hanging toilet/latrine	79	1.0
	Other	3	0.0
	not a dejure resident	22	0.3
	Total	8061	100.0
	Sokoto	191	2.4
State	Zamfara	296	3.7
	Katsina	335	4.2
	Jigawa	280	3.5
	Yobe	291	3.6
	Borno	282	3.5
	Adamawa	185	2.3
	Gombe	286	3.5
	Bauchi	322	4.0
	Kano	339	4.2
	Kaduna	371	4.6
	Kebbi	289	3.6
	Niger	344	4.3
	fct Abuja	243	3.0
	Nasarawa	194	2.4
	Plateau	175	2.2
	Taraba	208	2.6
	Benue	214	2.7
	Kogi	117	1.5
	Kwara	164	2.0
	Oyo	206	2.6
	Osun	175	2.2
	Ekiti	153	1.9
	Ondo	167	2.1
	Edo	80	1.0
	Anambra	248	3.1
	Enugu	134	1.7
	Ebonyi	249	3.1
	cross river	88	1.1
	akwaibom	150	1.9
	Abia	156	1.9
	Imo	156	1.9
	Rivers	193	2.4
	Bayelsa	130	1.6
	Delta	152	1.9
	Lagos	303	3.8
	Ogun	195	2.4
	Total	8061	100.0
Wealth index for urban/rural	Poorest	1629	20.2
	Poorer	1534	19.0
	Middle	1568	19.5
	Richer	1671	20.7
	Richest	1659	20.6
	Total	8061	100.0
Native language of respondent	English	241	3.0
	Hausa	3402	42.2
	Yoruba	1105	13.7
	Igbo	1025	12.7
	Other	2288	28.4
	Total	8061	100.0
Mother Age Interval	15-19	487	6.0
	20-24	1258	15.6

25-29	1886	23.4
30-34	1668	20.7
35-39	1405	17.4
40-44	818	10.1
45-49	539	6.7
Total	8061	100.0

Table 1 shows the frequency distribution of the variables. The result shows that 136 (1.7%), 2354 (29.2%), 2160 (26.8%) and 3411 (42.3%) respectively depicts severe, Moderate, Mild and non- anemic respondents. Under the educational level, a total of 2430 (30.1%), 1425 (17.7%), 2868 (35.6%), and 1338 (16.6%) respectively describes respondents with No education, Primary education, Secondary education and Higher education. Out of a total of 8061 (100%), 3009 (37.3%) and 5052 (62.7%) of the respondents lives in the urban and rural settlements respectively. There are 3009 (37.3%) of urban and 5052 (62.7%) of rural for the place of residence. For the toilet facility, 2097 (26%) used no facility/bush/field. 2057 (25.5%) use pit latrine with slab, 1607 (19.9%) of the respondents use pit latrine without slabs, 1002 (12.4%) of the respondent's flush to septic tank, 582(7.2%) flush to pit latrine amidst others. Under Native Language of respondent, 241 (3.0%) of the respondents speaks English, 3402(4.2.2%) of the respondents speaks hause. 1105 (13.7%) of the respondents speaks Yoruba. 1025 (12.7%) of the respondents speaks igbo, while the remaining 2288 (28.4%) speaks other languages. For the Mother age interval, 487(6.0%) , 1258 (15.6%) , 1886(23.4%) , 1668(20.7%) , 1405(17.4%), 818 (10.1%), and 539(6.7%) of the respondents are between 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49 years old respectively.

Table 2: The Cross tabulation between and Anemia level Region

			"Anemia level"				Total
			Severe	moderate	mild	not anemic	
"Region"	north central	Count	16	397	403	635	1451
		% within "Anemia level"	11.8%	16.9%	18.7%	18.6%	18.0%
	north east	Count	27	468	441	638	1574
		% within "Anemia level"	19.9%	19.9%	20.4%	18.7%	19.5%
	north west	Count	46	630	542	883	2101
		% within "Anemia level"	33.8%	26.8%	25.1%	25.9%	26.1%
	south east	Count	18	341	263	321	943
		% within "Anemia level"	13.2%	14.5%	12.2%	9.4%	11.7%
	south south	Count	18	255	190	330	793
		% within "Anemia level"	13.2%	10.8%	8.8%	9.7%	9.8%
	south west	Count	11	263	321	604	1199
		% within "Anemia level"	8.1%	11.2%	14.9%	17.7%	14.9%
Total		Count	136	2354	2160	3411	8061
		% within "Anemia level"	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2 shows the level of anemia across the region, when the levels of Anemia is severe, north west has the highest level of anemia with 46(33.8%) and south west has the lowest level of anemia with 11(8.1%). For the Moderate anemia, there are 397(16.9%), 468(19.9%), 630(26.8%), 341(14.5%), 255(10.8%), 263(11.2) for North central, North east, North west, South east, South south, and South west respectively. North west has the highest percentage of mild anemic with 542(25.1%) showing the lowest mild anemic in North central having 403(18.7%). For those respondents from region without anemic, North central has 635(18.6%), North east has 638(18.7%), North west has 883(25.9%), South east has 321(9.4%), South south has 330(9.7%), and South west has 604(17.7%).

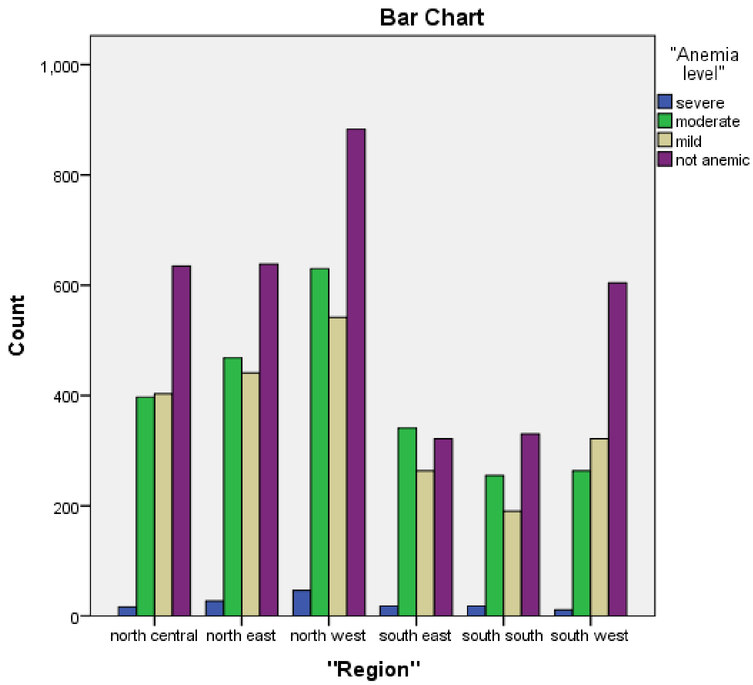

Figure 1: The bar chart of Anemia level with Region

Figure 1 is the bar chart of anemia level with regions which shows that not anemic has the highest prevalence in North Central, North east, Northwest, South-South, and Southwest. While Severe has the lower prevalence in all the regions.

3.2 Test of Association between anemia and the explanatory variables

The Chi-square test for independence was used to evaluate the connection between anemia levels and the location of residency. Additionally, the Chi-square test for association was employed to explore the relationship among educational level, wealth index, and anemia levels.

3.3 Chi-square test of association between anemia and wealth indices
Hypothesis 1

H_0: There is no association between levels of anemia and wealth indices of the respondents

H_1: There is an association between levels of anemia and wealth indices of the respondents

Table 3: Chi Square Tests of Association between levels of anemia and wealth indices

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	77.936[a]	12	0.000
Likelihood Ratio	77.946	12	0.000
Linear-by-Linear Association	70.001	1	0.000
N of Valid Cases	8061		

Decision rule: Reject H_0 If the p-value < (0.05), otherwise do not reject H_0
Decision: Since the p-value (0.000) < (0.05), hence we reject H_0.
Conclusion: There is an association between levels of anemia and wealth indices of the respondents

3.4 Chi-square test of association between anemia and levels of education
Hypothesis 2
H_0: There is no association between levels of anemia and levels of education of the respondents
H_1: There is an association between levels of anemia and levels of education of the respondents
Table 4: Chi square test of Association levels of anemia and levels of education

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	107.935[a]	9	0.000
Likelihood Ratio	108.547	9	0.000
Linear-by-Linear Association	93.341	1	0.000
N of Valid Cases	8061		

Since the p- value is less than the significance level (0.05), we reject the null hypothesis and conclude that there is an association between levels of anemia and of education of the respondents.

3.5 Chi-square test of association between anemia and place of residence
Hypothesis 3
H_0: The levels of anemia are independent of respondent's place of residence
H_1: The levels of anemia are dependent of respondent's place of residence
Table 5: Chi Square tests of independence

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	80.441[a]	3	0.000
Likelihood Ratio	80.316	3	0.000
Linear-by-Linear Association	71.978	1	0.000
N of Valid Cases	8061		

Decision rule: Reject H_0 If the p-value < (0.05), otherwise do not reject H_0
Decision: Since the p-value (0.000) < (0.05), hence we reject $H_{0.}$
Conclusion: There is an association between levels of anemia and place of residence of the respondents.

3.6 Multinomial logistic regression results
3.7 Test for the model fit

Table 6: Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	14586.803			
Final	13835.764	751.039	201	0.000

The model significantly improves the predictors included ($p < 0.05$), suggesting that the independent variables contribute valuable information for anemia level. This means the multinomial model is effective for this dataset.**3. 8**

Test for the Likelihood ratio

Table 7: Pseudo R-Square

Cox and Snell	0.089
Nagelkerke	0.099
McFadden	0.041

The model explains about 8.9% of the variability in the outcome. However, Cox and Snell's R^2 cannot reach a maximum value of 1 in multinomial regression, so its interpretation as an effect size is limited. The Nagelkerke R^2 adjusts the Cox and Snell value to allow for a maximum possible value of 1, making it more interpretable. Here, it's 0.099, indicating that the model explains about 10% of the variance in the outcome variable.

3.9 Parameter Estimates of the explanatory variables for the severe anemic

Table 8: Parameter Estimates of the explanatory variables for the severe anemic

"Anemia level"[a]		B	Std. Error	Wald	Df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Severe	Intercept	-19.172	3610.639	0.000	1	0.996			
	no education	1.251	0.517	5.849	1	0.016	3.493	1.268	9.624

Table 8 shows the parameter Estimates of the explanatory variables for the severe anemic When other variables are held constant the odds of being severely anemic rather than not being anemic for no educated respondents is 3.493 times higher than those with a high level of education.

From the table 9 holding other variables constant the odds of being moderately anemic rather than not being anemic for respondents with no education has 1.759 times higher than those with a high level of education while the odds of respondents with primary education has 1.344 times higher than those with a high level of education. The aforementioned table further revealed that the odds of urban residence being moderate anemic rather than not being anemic when other variables are held constant the odds is 0.590 times lower than those respondents in rural areas. The table 9 indicate that the odds of being moderately anemic rather than not being anemic for respondents living in Kano, Kaduna, Nasarawa, Kogi, Osun, Ekiti, Anambra, Enugu, Ebonyi, Imo, Rivers, Bayelsa, and Delta has 0.524, 0.532, 2.208, 1.948, 1.877, 1.787, 2.709, 2.347, 4.295, 3.102, 4.226, 2.240, and 2.507 times higher than those living in other states keeping other variables constant.

The table 9 further revealed that the likelihood of poorest class of respondents being moderately anemic rather than not being anemic is 1.659 times higher than the richest class of respondents when other variables are held constant. Also, the odds of the poorer class of respondent being moderately anemic rather than not being anemic is 1.605 times higher than that of the richest class of respondents when other variables are held constant. Furthermore, the odds of the middle class of respondents being moderately anemic rather than not being anemic is 1.338 times higher than the that of richest class of respondents. Finally, the odds of the richer class of respondents being moderately anemic rather than not being anemic is 1.232 times higher than the richest respondents when other variables are held constant.

The table 9 further indicates that the odds of Hausa being moderate anemic rather than not being anemic when other variables are held constant the odds is 1.478 times higher than those respondents in Speaking other languages. The table 9 also revealed that the likelihood of 15-19 age range of respondents being moderately anemic rather than not being anemic is 1.414 times higher than the 45-49 age range of respondents when other variables are held constant. Also, the odds of the 20-24 age range of respondent being moderately anemic rather than not being anemic is 1.307 times higher than that of the 45-49 age range of respondents when other variables are held constant. Finally, the odds of the 30-34 age range of respondents being moderately anemic rather than not being anemic is 1.337 times higher than the richest respondents when other variables are held constant.

3.10 Estimates of the explanatory variables for the moderate anemic

Table 9: Parameter Estimates of the explanatory variables for the moderate anemic

"Anemia level"[a]		B	StdError	Wald	Df	Sig.	E(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Moderate	Intercept	-1.196	0.567	4.448	1	0.035			

	no education	0.565	0.138	16.674	1	0.000	1.759	1.341	2.306
	Primary	0.296	0.138	4.884	1	0.027	1.344	1.034	1.748
	Urban	-0.528	0.083	40.352	1	0.000	0.590	0.501	0.694
	Kano	-0.647	0.309	4.392	1	0.036	0.524	0.286	0.959
	Kaduna	-0.632	0.299	4.455	1	0.035	0.532	0.296	0.956
	Nasarawa	0.792	0.284	7.774	1	0.005	2.208	1.265	3.853
	Kogi	0.667	0.338	3.902	1	0.048	1.948	1.005	3.775
	Osun	0.630	0.281	5.006	1	0.025	1.877	1.081	3.258
	Ekiti	0.580	0.288	4.060	1	0.044	1.787	1.016	3.142
	Anambra	0.997	0.317	9.880	1	0.002	2.709	1.455	5.043
	Enugu	0.853	0.345	6.110	1	0.013	2.347	1.193	4.616
	Ebonyi	1.457	0324	20.183	1	0.000	4.295	2.274	8.111
	Imo	1.132	0.335	11.392	1	0.001	3.102	1.608	5.986
	Rivers	1.441	0.307	22.099	1	0.000	4.226	2.317	7.708
	Bayelsa	0.807	0.329	5.999	1	0.014	2.240	1.175	4.272
	Delta	0.919	0.321	8.204	1	0.004	2.507	1.337	4.703
	Poorest	0.506	0.130	15.185	1	0.000	1.659	1.286	2.141
	Poorer	0.473	0.118	16.152	1	0.000	1.605	1.274	2.021
	Middle	0.291	0.109	7.209	1	0.007	1.338	1.082	1.656
	Richer	0.208	0.097	4.610	1	0.032	1.232	1.018	1.490
	Hausa	0.391	0.125	9.753	1	0.002	1.478	1.157	1.889
	15-19	0.346	0.160	4.660	1	0.031	1.414	1.032	1.936
	20-24	0.268	0.134	3.999	1	0.046	1.307	1.005	1.699
	30-34	0.290	0.129	5.074	1	0.024	1.337	1.038	1.721

3.11 Parameter Estimates of the explanatory variables for the mild anemic

Table 10: Parameter Estimates of the explanatory variables for the mild anemic

"Anemia level"[a]		B	Std. Error	Wald	Df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Mild	Intercept	- 1.130	0.736	2.355	1	0.126			
	Urban	-0.385	0.083	21.273	1	0.000	0.680	0.578	0.801
	Sokoto	-1.042	0.323	10.430	1	0.001	0.353	0.188	0.664
	Borno	-0.559	0.282	3.911	1	0.048	0.572	0.329	0.995
	Adamawa	-1.002	0.298	11.280	1	0.001	0.367	0.205	0.659
	Kano	-0.806	0.278	8.405	1	0.004	0.447	0.259	0.770
	Kaduna	-0.817	0.265	9.515	1	0.002	0.442	0.263	0.742
	Plateau	-0.594	0.285	4.333	1	0.037	0.552	0.316	0.966
	Oyo	-0.489	0.245	3.968	1	0.046	0.613	0.379	0.992
	Poorest	0.354	0.131	7.319	1	0.007	1.424	1.102	1.840
	Poorer	0.319	0.118	7.359	1	0.007	1.376	1.093	1.733
	Middle	0.225	0.107	4.371	1	0.037	1.252	1.014	1.545

The table 10 reveals significant associations between anemia status and place of residence, state, and wealth index. For place of residence, the odds of urban dwellers being mildly anemic rather than not anemic are 0.680 times lower compared to those in rural areas, holding other variables constant. Regarding state-level differences, the odds of being moderately anemic rather than not anemic for respondents in Sokoto, Borno, Adamawa, Kano, Kaduna, Plateau, and Oyo are 0.353, 0.572, 0.367, 0.447, 0.442, 0.552, and 0.613 times lower, respectively, compared to respondents from other states, when other factors are controlled. For wealth index, the odds of respondents in the poorest class being mildly anemic rather than not anemic are 1.424 times higher than those in the richest class. Similarly, the odds for the poorer class and middle class are 1.376 and 1.252 times higher, respectively, compared to the richest class, when other variables are held constant.

4.0. Conclusion

The study concludes a significant association between level of education and levels of anemia. It also affirmed the dependency of level of anemia and place of residence of respondents. There also exists a significant association between levels of anemia and respondent’s wealth indices. Although, the study reveals an even distribution of anemia in the states in the country. Factors like highest level of education are a significant contributor to levels of anemia. Place of residence of respondents also determines levels of anemia as those in urban residence has a less likelihood of being moderately anemic. Individuals in their early thirties are more likely to be moderately anemic compared to older individuals and wealthier counterparts, when other factors are constant. In mild anemic some states also reduced succession. It could also be concluded that the higher the wealth index of respondents the reduced their odds of being anemic. Although, no class of wealth index of respondents significantly contribute to severe level of anemia.

5.0 Recommendation

After observing the results of the studies conducted on the reasons for anemia cases in children in Nigeria, it is advised that the government formulate policies that guarantee basic education to all parents, especially mothers, since it has been shown that higher education reduces the risk for anemia in children significantly. Furthermore health and nutrition education programs aimed at low literacy and poorly educated parents should also be provided.

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