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Research Article

Statistical Overview of Prevalence of Anaemia with Associated Socioeconomic and Demographic Factors in Nigeria

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Objectives: The study aimed at providing a comprehensive and updated statistical overview of the prevalence of anemia and its associated socioeconomic and demographic factors in Nigeria

Study design: The Demographic and Health Survey (DHS) website provided secondary data for this study, which came from the 2021 Malaria Indicator Survey (MIS).

Methods: A total of 10,714 children aged 6-59 months were observed in the survey and tested and frequency of under-five children with malaria tested positive of anemia is 3,850. Chi-square test and binary logistic regression were employed to examine and identify factors linked to anemia.

Results: Under-five children who were male (OR = 1.124, 95%CI 1.031-1.226, p=0.008) have a significant higher risk of having anemia compared to female. Also, Under-five children living in a rural area (OR = 1.024, 95%CI 0.923-1.137) have the higher risk of having anemia compared to those in urban areas. Under-five children with negative malaria rapid test are less likely to have anemia compare to those who are tested positive.

Conclusion: Intervention efforts should target rural areas and mothers with lower levels of education.

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1. Introduction

A condition called anaemia take place when there are less red blood cells or haemoglobin in the blood than usual, resulting in reduced oxygen delivery to the tissues. Also with various causes, such as nutritional deficiencies, infections, chronic diseases, genetic disorders and blood loss. A significant public health issue is anaemia, particularly in low- and middle-income nations, where it affects mainly women of reproductive age and children under five years. Physical and cognitive development, work productivity, maternal and child health, and survival can all be affected negatively by anaemia.

Anaemia, a disorder that affects people in both the developed and developing worlds and is characterised by a decrease in the volume of red blood cells (RBC), is a public health concern. It has detrimental effects on social and economic advancement in addition to health. Even though anaemia is common and may not always cause symptoms, it is a sign of poor nutrition and general health. The tragic significant effects of awful anaemia on the mortality and morbidity of expectant mothers and their children have been extensively studied for a long time. However, its effects on children's mental and physical development as well as adults′ productivity at work, including weariness, diminished work capacity, diminished ability to carry out daily tasks, and diminished cognitive function, are of serious concern, particularly in developing nations. There are several conditions that can cause anaemia, but the most common one is iron deficiency anaemia, which accounts for roughly 50% of all cases of anaemia. According to Olivia et al. (2019), the causes of anaemia vary depending on the population group and the location, with local conditions playing a role. Additional factors contributing to anaemia include deficiencies in micronutrients such as riboflavin, folate, vitamin A, vitamin B, and chronic infections like malaria, helminth infections, tuberculosis, HIV, and cancer, as well as acquired or inherited disorders affecting haemoglobin, red blood cell survival, or the production of red blood cells. According to the WHO global anaemia estimates for 2019, Nigeria had a prevalence of anaemia of 39.4% (95% UI: 35.8%, 43.0%) among women of reproductive age, 42.7% (95% UI: 40.2%, 45.2%) among pregnant women and 67.6% (95% UI: 64.3%, 70.8%) among children aged 6-59 months [2]. These figures indicate that anaemia is a severe public health problem in Nigeria, affecting more than half of the population in these groups.

Several studies have investigated the prevalence and determinants of anaemia in different regions and subgroups of Nigeria, using different methods and criteria. Some of the common factors associated with anaemia in Nigeria are:

- Socio-economic status: Low income, education, occupation and living standards are associated with higher risk of anaemia, due to poor dietary intake, hygiene and access to health care.
- Demographic factors: Age, sex, marital status and parity are also related to anaemia prevalence. Generally, younger children, females, unmarried women and multiparous women are more likely to be anaemic than their counterparts.

- Nutritional status: Approximately half of all cases of anaemia globally are caused by iron deficiency. Other micronutrient deficiencies, such as folate, vitamin B12 and vitamin A, can also contribute to anaemia. Malnutrition, obesity and dietary diversity are also important factors influencing anaemia risk.
- Infections: Malaria, intestinal parasites, HIV/AIDS and other infectious diseases can cause or exacerbate anaemia by affecting red blood cell production or survival, increasing blood loss or reducing iron absorption. Nigeria has a high burden of these infections, especially malaria, which is endemic in most parts of the country.
- Genetic disorders: Hemoglobinopathies, such as sickle cell disease and thalassemia, are inherited conditions that affect the structure or function of hemoglobin, leading to hemolytic anaemia or impaired oxygen delivery. Nigeria has one of the highest frequencies of sickle cell trait in the world, affecting about 20-30% of the population.

The study of Ndukwu & Dienye (2012) assessed the widespread high prevalence of anaemia in pregnancy, particularly in developing nations like Nigeria. Nigerian local prevalence data varies from 35.3% in Lagos to 72.0% in Kano State. In Nigeria, the most prevalent causes are preventable and include nutritional deficits in iron and folate, parasite illnesses like malaria and hookworm, hemoglobinopathies, and most recently human immunodeficiency virus infection.

Oliver et al, (2019) examined Anaemia among men in India: a nationally representative cross-sectional study. This cross-sectional study assesses the population-based research on anaemia in India, which has primarily concentrated on women and children. Despite the negative effects of anaemia on health, well-being, and economic productivity, men with anaemia have received far less attention. In their effort to determine whether anaemia reduction efforts for men should be combined with those already being made for women, this study set out to determine the national prevalence of anaemia among men in India, how the prevalence of anaemia in men varies across India among states and districts and by sociodemographic characteristics, and whether the geographical and sociodemographic variation in the prevalence of anaemia among men is similar to that among women. The results and findings indicate that anaemia is a serious public health concern among Indian men. Given the similarities in the patterns of geographic and sociodemographic variation in anaemia between men and women, future efforts to reduce anaemia in males may focus on the same population segments as those targeted in current efforts to reduce anaemia in women.

Kebede et al. BMC Pediatrics (2021) gave a global approximation of anaemia affects 1.62 billion people worldwide, with 36.4 to 61.9% of children under five suffering from the disease in sub-Saharan Africa. Comparably, it is regarded as a significant public health issue in Sub-Saharan Africa, where 83.5 million children were afflicted and 67% of them had anaemia. Different environments have different risk factors for anaemia, such as intestinal worms, malaria, HIV infection, malnutrition, haematological cancers, and long-term illnesses like sickle cell disease.

Despite numerous studies on prevalence of anaemia in other populations, such as adolescents, men, and the elderly, are scarce. These data primarily concern the impact of anaemia on morbidity and mortality in children, pregnant women, and non-pregnant women. Research indicates that anaemia is most common in low socioeconomic groups and that the prevalence of anaemia and a nation's overall economic status are strongly correlated. Therefore, this study aimed to ascertain the prevalence of anaemia among people of various socioeconomic levels in Nigeria, as well as the associated factors. In addition, since there is a dearth of data on anaemia in populations other than children and pregnant women in Nigeria, the study will ascertain the prevalence of anaemia in these populations.

2. Research and Methods

The data used for this study was obtained from Demographic and Health Survey (DHS) for 2021 Malaria Indicator Survey (MIS). This cross-sectional data set, which is nationally representative, was gathered through in-person interviews with women between the ages of 15 and 29. These are the extensive surveys carried out in Nigeria as part of the Demographic and Health Survey (DHS), which is an initiative of the National Population Commission of Nigeria and ICF International, USA. The 2021 MIS datasets contained the dependent and independent variables used in this investigation. Using Stata software (Stata version 14), the relevant variables were kept and the irrelevant ones were eliminated. The dependent variable in this study refers to the prevalence of anaemia with associate socioeconomic and demographic factors in Nigeria. These are the potential factors that may influence the status of the children aged 6-59 months, such as age, sex, mother's anaemia status, wealth index, education level, and region, place of residence, and dietary intake or hemoglobin level, which is often used to measure anaemia. The socioeconomic and demographic factors that could be associated with prevalence of anaemia in Nigeria could include income, education level, geographical location, and access to healthcare. The independent variable of prevalence of anaemia with associated socioeconomic and demographic factors in Nigeria is the anaemia status of the children aged 6-59 months. This variable measured by the hemoglobin level of the children, which is classified into three categories: normal, mild, and moderate/severe. The dependent variable are the potential factors that may influence the anaemia status of the children, such as age, sex, mother's anaemia status, wealth index, education level, and dietary intake.

2.1. Logistics Regression

With the use of a logistic function that represents the cumulative logistics distribution, logistic regression estimates probabilities and analyses how one or more independent variables and the categorical dependent variable are related. One or more predictor variables, which can be continuous or categorical data, are used in logistic regression. Logistic regression, in contrast to standard linear regression, is utilised to forecast binary outcomes of the dependent variable, treating it as the result of a Bernoulli experiment, as opposed to a continuous outcome. The two types of logistic regression models are binary logistic regression and multinomial logistic regression. Each type differs from the other in execution and theory. This study employed both binary logistic and multinomial logistic regression.

Binary logistic regression is typically used when the dependent variable is dichotomous and the independent variables are either continuous or categorical. A binary logistic regression model forecasts the correlation between the independent and binary dependent variables. The regression types such as success/failure, 0/1, and true/false can produce various outputs. The model for binary logistic regression is given as (1)

$$\mathrm{Logit}(P) = \mathrm{In}\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k \tag{1}$$

Multinomial logistic regression can be used when the department variable is not dichotomous and consists of more than two categories. In a multinomial regression type, a categorical dependent variable has two or more discrete results. According to this, there are more than two possible outcomes for this kind of regression. This is represented by (2)

$$\mathrm{Logit}(P) = \mathrm{In}\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_l + \ldots + \beta_k X_k \tag{2}$$

Or

$$p = \frac{e(\beta 0 + \beta 1X1 + \cdots + \beta kXk)}{1 + e(\beta 0 + \beta 1X1 + \cdots + \beta kXk)}$$

Where:

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- P is the probability that a case is in a particular category,
- β_0 is the y-intercept (constant term),
- β_1 is the regression coefficient,
- X_i is a predictor variables.

The assumptions of the Logistics Regression Model are:

i. It is a binary or dichotomous response/dependent variable: In logistics regression, the first premise is that response variables can only have two possible outcomes: male or female and pass/fail.
ii. Minimal or non-existent Predictor/explanatory variable multicollinearity: The predictor variables, sometimes referred to as the independent variables, should be independent of one another based on this premise.
iii. Log odds, or methods of expressing probabilities, have a linear relationship with independent variables. Probabilities and log odds are two separate things. The success rate divided by all potential outcomes is known as probability, odds, on the other hand, represent the success to failure ratio.
iv. Prefers Large Sample Size: When a larger sample size of the data is taken into consideration, logistics regression analysis produces results that are dependable, strong, and valid.

2.2. Chi-Square

The chi-square test is a statistical tool used to assess if two categorical variables significantly correlate with one another.

The test consists of comparing the anticipated frequencies which are determined on the supposition that there is no correlation between the variables with the observed frequencies of each category in a contingency table. The sum of the square differences between the expected and observed frequencies, divided by the expected frequencies, yields the test statistic.

The chi-square test statistic is given as (3)

$$\chi^2 = \sum (\mathrm{O_i} - \mathrm{E_i})^2/\mathrm{E_i} \tag{3}$$

Where:

- χ^2 = chi-square test statistic
- O_i = observed frequency in category i

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- E_i = expected frequency in category i

The test's degrees of freedom are determined as (r-1) (c-1), where c is the number of columns and r is the number of rows in the contingency table.

3. Data Analysis and Results Discussion

This section presents the result of the analysis carried out from the 2021 MIS dataset on some factors related to prevalence of anaemia. The chi-square test was used to examine the association between some factors that relate to anaemia in under-five children. Finally, multivariate logistic regression was used to model the effect of some factors on anaemia in under-five children.

3.1. Descriptive Analysis of Data

The table 3.1 shows the frequency and percentage distribution of various variables. A total of 10,714 number of under-five children were extracted from the survey. Those who are anaemic are 7,255 (67.72%) while 3,459 (32.28%) are not anaemic.

Variables	Frequency	Percentage (%)
Region		
North Central	2,092	19.53
North East	2,048	19.12
North West	2,939	27.43
South East	1,151	10.74
South South	1,441	13.45
South West	1,043	9.7
Malaria		
Negative	6,607	61.67
Positive	4,107	38.33
Gender		
Female	5,215	48.67
Male	5,499	51.33
Use Mosquito Nets		
No	4,025	37.57
Yes	6,689	62.43
Place of Residence		
Urban	3,109	29.02
Rural	7,605	70.98
Wealth Index		
Poorest	2,200	20.53
Poorer	2,120	19.79
Middle Class	2,272	21.21
Richer	2,184	20.38
Richest	1,938	18.09

Variables	Frequency	Percentage (%)
Anaemia Level		
Anaemic	3,459	32.28
Not Anaemic	7,255	67.72
Mother's Education		
No education	3,883	42.59
Primary	1,354	14.85
Secondary	2,936	32.20
Higher	945	10.36

Table 3.1. Frequency Distribution of study population

From the Table 3.1, information extracted come from different regions in the country, most of the respondents are from the North West (27.43%), 19.53% are from North Central while 19.12% are from North East. The South West having the smallest number of respondents (9.73%). In terms of malaria status, a 38.33% of the children were tested positive for malaria. The distribution of gender is roughly the same but with a slight difference in the percentage of females (48.67%) and males (51.33%). A higher percentage of individuals used mosquito nets (62.43%) compared to those who are not using it (37.57%). Majority of the women with their children reside in rural areas as a place of residence (70.98%) compared to those in the urban area (29.02%).There is a difference in the distribution of wealth index; a higher percentage of children belonging to the middle class (21.21%), and poorest(20.53%) categories compared to those that are rich. A higher percentage of under-five children's mothers have no education (42.59%), followed by secondary level (32.20%) compared to those with higher education (10.36%). The overall pattern suggests that there are differences in the distribution of the variables.

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3.2. Association between Anaemia in Children Under-5 years of age in Nigeria and Socio-Economic and demographic factors using Chi Square Analysis

Hypothesis of the Study

H_0: There are no significant assosiation between the variables

H_1: There are significant association between the variables

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Variables	Frequency		Chi-square	P-value
	Anaemic	Not Anaemic		
Malaria				
No Yes	3,405 3,850	702 2,757	703.109	<0.001
Gender				
Female Male	3,464 3,791	1,751 1,708	7.751	0.005
Use Mosquito Nets				
No Yes	2,620 4,635	1,405 2,054	20.273	<0.001
Place of Residence				
Urban Rural	1,891 5,364	1,218 2,241	95.158	<0.001
Wealth index				
Poorest Poorer Middle class Richer Richest	1,724 1,582 1,523 1,368 1,058	476 538 749 816 880	339.276	<0.001
Mother's Education				
No Education Primary	2,931 948	952 406	280.449	<0.001

Variables	Frequency		Chi-square	P-value
	Anaemic	Not Anaemic		
Secondary	1,847	1,089		
Higher	471	474		
Region				
North Central	1,261	831	205.494	<0.001
North East	1,479	569		
North West	2,220	719		
South East	765	386		
South South	920	521		
South West	610	433		

Table 3.2. Association between anaemia and socioeconomic and demographic variables and its prevalence

P < 0.05; Significant

Table 3.2 shows the relationship between the covariates and the prevalence of anaemia. A total of 10,714 children were observed in the survey and tested. The frequency of under-five children with malaria tested positive of anaemia is 3,850 increased with an increase in malaria (p<0.001) and the anaemia is most prevalent among male children (p<0.005) compared to female. A great number of under-five children who tested positive of Anaemia reside in rural areas as a place of residence (p<0.001), therefore we can say there's a significant relationship between anaemia prevalence with place of residence and the male children are more prone to Anaemia compare to female children with a significant association.

Anaemia prevalence reduces with increase in wealth index (P<0.001), that is the children who belonged to the richest wealth index had a lesser percentage of Anaemia positives (p<0.001) compared to those in the poorest wealth index (p<0.001). Malaria was also more prevalent with under-five children that are using mosquitos net (p<0.001). Anaemia is associated with the presence of malaria parasite and is a significant factor. Under-five children with Anaemia showed a higher frequency of malaria than those who were not

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anaemic ($p<0.001$). Northern region has a higher number of children who are anaemic compare to Southern region.

Based on the p-values, all variables are significantly associated with anaemic status of under-five children.

3.3. Binary Logistic Regression of Anaemia in Children Under-5 years of age in Nigeria

The table 3.3 shows the odds ratio, coefficient, p-value and the confidence interval of the binary logistic regression model.

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Characteristics	Multivariate Analysis			
	Coefficient	Odds Ratio	95% Cl	P-value
Region				
North Central	-0.134	0.874	0.738, 1.036	0.121
North East	0.189	1.209	1.002, 1.458	0.048
North West	0.247	1.280	1.071, 1.529	0.007
South East	0.438	1.550	1.283, 1.872	0.000
South South	0.264	1.302	1.091, 1.553	0.003
South West (ref)				
Gender				
Female(ref)				
Male	0.117	1.124	1.031, 1.226	0.008
Use Mosquito Net				
No(ref)				
Yes	0.032	1.032	0.940, 1.133	0.507
Residence				
Urban(ref)				
Rural	0.024	1.024	0.923, 1.137	0.652
Wealth index				
Poorest	0.606	1.833	1.522, 2.207	0.000
Poorer	0.434	1.544	1.295, 1.842	0.000
Middle class	0.231	1.259	1.083, 1.465	0.003
Richer	0.128	1.137	0.991. 1.304	0.067
Richest (ref)				
Mother's Education				
No education	0.210	1.233	1.081, 1.407	0.002

Characteristics	Multivariate Analysis			
	Coefficient	Odds Ratio	95% Cl	P-value
Primary	0.193	1.213	1.039, 1.416	0.015
Secondary	0.115	1.121	0.995, 1.264	0.060
Higher(ref)				
Child's Age	-0.031	0.970	0.967, 0.973	0.000
Malaria				
Negative				
Positive (ref)	-1.276	0.279	0.252, 0.309	0.000

Table 3.3. Odds Ratio of Under-five Anaemia in relation to socioeconomic risk factors

The table shows the adjusted odds ratio for the effects of some factors on the prevalence of Anaemia in children under-five years of age. The characteristics being considered include, gender of the child, mosquito net usage, place of residence, wealth index, mother's education, Child's age, and Geopolitical zone. The result consist of the estimated odds ratio (OR) for logit model. The P-values were included to validate whether or not each predictor variable in the model is significant. The influence of each covariates in the model is determined by its odds ratio for adjusted model.

From the result, under-five children who were male (OR = 1.124, 95%CI 1.031-1.226, p=0.008) have a significant higher risk of having anaemia compared to female. Also, Under-five children living in a rural area (OR = 1.024, 95%CI 0.923-1.137) have the higher risk of having anaemia compared to those in urban areas. Under-five children with negative malaria rapid test are less likely to have anaemia compare to those who are tested positive.

Based on the education of the mothers, the children of mother's with no education, primary and secondary education, have 1.2 times higher risk of having anaemia (p<0.001) compare to mothers with higher levels of education. In addition, under-five children from North East, North West, South East, and South-South geopolitical zones respectively have an increased odds (1.209, 1.280, 1.550, 1.302) of having anaemia compared to children from South West while North Central have lower risk. Under-five children that use mosquito nets (OR = 1.032, 95%CI 0.940-1.133) also have an increased odd. Considering the household wealth index, under-five children from a poorest, poorer, and middle class, family have significant increased odd of having anaemia compared to under-five children from richer and richest family. For a unit increase in child's age, there is a significant decrease of Anaemia.

After adjusting for the other characteristics of the respondents, having a mother from rural area who has no education, primary or secondary education with poorest, poorer, middle household wealth index having male child with positive malaria rapid test were more likely to be tested positive for anaemia.

4. Conclusion

Results showed that there is a significant association between prevalence of anaemia and gender, malaria rapid test, place of residence, Wealth index, usage of mosquito nets, and Mother's education. Majority of women from rural area who have no education, primary or secondary education with poorest, poorer, middle household wealth index, their children are more prone to anaemia especially those that are male. Higher number of under-five children in the northern region had anaemia compared to those in southern region.

The results of the study also revealed that factors, such as child's age, gender, place of residence, wealth index, mother's education, malaria rapid test, and geopolitical zone, contribute significantly to the anaemia prevalence among under-five children. Therefore, based on the analysis carried out, anaemia prevalence is higher in the northern region of Nigeria than the southern region, with the northern region having a higher percentage of anaemia for under-five children. Additionally, children who are anaemic were found to have tested positive for malaria compared to those who were not anaemic. Mother's education and gender of the under-five children were also found to have a significant contribution with anaemia prevalence. However, use of mosquito nets were not statistically significant. The results also show that increase in child's age significantly decreases anaemia in children. Hence, the results suggest that intervention efforts should target rural areas and mothers with lower levels of education and wealth to reduce the incidence of anaemia.

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Declarations

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