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Review Article

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Maternal Risk Factors Associated with Anaemia Among Children in Nigeria: A Cross-Sectional Study

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ABSTRACT

Background: Anemia in children under five remains a significant public health concern in Nigeria. This study aimed to investigate the association between maternal, socioeconomic, and child-related factors and anemia prevalence in this population.

Methods: We conducted a cross-sectional analysis using data from the 2018 Nigeria Demographic and Health Survey (NDHS), encompassing 10,431 children under five. Multivariate logistic regression was employed to assess the relationship between childhood anemia and maternal education, age, body mass index (BMI), employment status, household wealth, child age, gender, stunting, wasting, and residence type. Collinearity diagnostics were performed prior to model construction.

Results: Higher maternal education (above secondary school) was significantly associated with lower odds of childhood anemia (OR = 0.55, $p < 0.001$). Increased maternal BMI (overweight and obese) also significantly reduced the odds of anemia compared to underweight ($p < 0.001$). Children from wealthier households exhibited lower anemia prevalence ($p < 0.001$). Female children had lower odds of anemia compared to males ($p < 0.05$). Child age 2-5 years was associated with significantly reduced odds of anemia compared to 6 months-1 year ($p < 0.001$). Stunting significantly increased the odds of anemia ($p < 0.001$). Maternal age was not significantly associated with anemia after adjusting for child age and gender. Residence type and child wasting were not significantly associated with anemia. No significant collinearity was detected among the independent variables.

Conclusion: Maternal Maternal education, BMI, household wealth, child age, gender, and stunting are significant determinants of anemia in Nigerian children under five. Interventions targeting these factors, particularly focusing on improving maternal education and nutrition, and addressing socioeconomic disparities, are crucial for reducing childhood anemia in Nigeria

Keywords: Anaemia, Children, Maternal Risk Factors, Maternal education, Maternal Age

Introduction

Anaemia among children remains a significant public health concern in Nigeria, contributing to high rates of morbidity, impaired cognitive development, and increased vulnerability to infectious diseases [1]. The condition is often multifactorial, but maternal characteristics play a critical role in determining children's susceptibility. For example, a nationally representative cross-sectional analysis found that children whose mothers were anaemic had a substantially higher probability of being anaemic themselves, and that low maternal education, young maternal age, low maternal body-mass index, and socioeconomic deprivation were all independently associated with childhood anaemia [2,3]. Maternal parity (having had many children) and maternal unemployment or informal employment have also been linked with increased anaemia risk among offspring [4]. In addition, poor dietary diversity and a high burden of infections among children have been repeatedly identified as

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proximate pathways through which maternal risk factors exert their influence [5]. In a study in Osun State, for example, malaria positivity in young children was strongly correlated with lower haemoglobin, reinforcing the interaction between maternal care, environmental exposures, and child health outcomes [6].

Iron deficiency has been reported to be the leading cause of anemia [7]. Anemia is associated with poor cognitive and motor development and work capacity. It is a condition marked by low hemoglobin levels in the blood (< 11g/dl). In low-resource settings, anemia is considered a public health concern affecting young children. In developing countries, 46 and 66% of children under five are impacted by anemia [8]. Data from the World Bank and the World Health Organization (WHO) show that Sub-Saharan African countries (SSA) and South Asia have the highest burden of anemia [8,9]. The determinants of anemia are very complex, some of which are social, environmental, and health factors. Among these, low birth weight, socioeconomic status, low maternal education status, inadequate breastfeeding, poor access to proper sanitary services, insufficient nutrient intake, and specific micronutrient deficiencies such as iron, folate, vitamin B12 are significant contributors to anemia in children. Additionally, infectious diseases such as HIV/AIDS, malaria, and tuberculosis are other common risk factors for anemia [10,11].

In Nigeria, the prevalence of iron deficiency anemia (IDA) among preschool children is estimated to be around 69% [7]. Furthermore, a report by the Nigeria 2018 Demographic and Health Survey (NDHS) shows that 68% of children under five had Anemia, with 27% mildly anemic, 38% moderately anemic, and 3% severely anemic. The prevalence of severe anemia among children living in the Northwest and Northeastern parts of Nigeria (4% each) tends to be high compared to the Southwest (<1%). Additionally, anemia's prevalence seemed to decrease with increasing mother's educational level and household wealth [12].

Evidence has shown that the complexity of the risk factors related to anemia encompasses several social, economic, environmental, and health aspects. Social factors such as maternal educational level are highly associated with children's health status [13]. Higher maternal education levels have shown increased knowledge about health and nutrition at the household level, which may also influence the micronutrient requirements of children. Moreover, maternal employment could be highly associated with the child's health, as income is known to be an independent factor associated with several issues such as poverty. Regarding health, income could be a tool to access nutritious food or health services. When it comes to geographical zones or types of residence, the accessibility to health facilities plays a considerable role in the health status of the nearby population [14]. Understanding these maternal risk factors is essential for designing effective interventions in Nigeria's challenging healthcare and socio-economic context. This study aims to examine the association between maternal risk factors and anemia among children under five in Nigeria. Some well-known risk factors described in the reviewed literature include maternal education, age, body mass index (BMI), type of residence, employment status, health-seeking behaviors, and household wealth status. In this study, we limited our scope to only assessing the association between risk factors at the mother's level and anemia in children under 4 years of age. The dependent variable was anemia status, while the unit of analysis was anemia among children under five in Nigeria. Based on this backdrop, the question below guided this study;

1. What are the significant mother-related risk factors associated with anemia among children under five years of age in Nigeria?'

Methodology

Data Analysis

The 2018 Nigeria Demographic and Health Survey (DHS) childhood questionnaire dataset was obtained and exported into STATA format for analysis. An initial review of the dataset identified 50 variables relevant to maternal and child health, as well as environmental and geographic factors, validated against existing literature [15]. Due to practical constraints, the analysis was restricted to 13 variables encompassing maternal, household, and child-related factors. The final dataset comprised 10,431 observations, representing children under five years of age tested for anemia.

Data Preparation

Missing values were assessed across all selected variables, with less than 3% missing data observed. Values coded as 9998 (indicating missingness) were recoded as such, and no imputation was performed. Variables were retained if they aligned with the research objectives and were adequately structured; otherwise, recoding was applied as follows:

- Wealth (v190): Originally categorized into five quintiles ("Poorest," "Poorer," "Middle," "Richer," "Richest"), this variable was recoded into three levels: "Poor" (merging "Poorest" and "Poorer"), "Medium," and "Rich" (merging "Richer" and "Richest"). The recoded variable was labeled "Wealth."
- Body Mass Index (BMI) (v445): This discrete variable, ranging from 1273 (12.73 kg/m²) to 5864 (58.64 kg/m²), was recoded into four categories: "Underweight" (<18.50 kg/m²), "Normal" (18.50–24.90 kg/m²), "Overweight" (25.00–29.90 kg/m²), and "Obese" (≥30.00 kg/m²). The recoded variable was labeled "BMIWomen."
- Anemia (hw57): Originally classified as "Mild," "Moderate," "Severe," or "Not Anemic," this variable was recoded into a binary format: "Yes" (encompassing mild, moderate, and severe anemia) and "No" (not anemic). The recoded variable was labeled "Anemia."
- Child Nutritional Indicators: Height-for-age Z-scores (hw5, stunting), weight-for-height Z-scores (hw11, wasting), and weight-for-age Z-scores (hw8, underweight) were recoded from discrete values into binary categories based on WHO standards. For stunting (hw5), values <–2.00 SD were classified as "Stunted," and values ≥–2.00 SD as "Not Stunted" (excluding values ≥9998). Similar thresholds were applied to wasting and underweight.

Further details on recoded variables are provided in Table 1.

Analytical Approach

The primary dependent variable was anemia status ("Anemia"). The key independent variable of interest was maternal educational attainment (v149). Additional independent variables included maternal factors (age, smoking status, BMI, employment, marital status), household factors (wealth, residence type [rural/urban]), and child-related factors (age, gender, stunting, wasting). Variable selection was guided by the research questions and time constraints of the study.

Univariate Analysis

The analysis commenced with the generation of frequency distributions and summary statistics for the following variables: anemia status ("Anemia"), maternal educational attainment (v149), maternal age (v013), maternal BMI ("BMIWomen"), household wealth ("Wealth"), smoking status (v463a), residence type (v025), marital status (v501), employment status (v714), child stunting (hw5), child wasting (hw11), child age (b8), and child gender (b4). These were computed using STATA's tabulation and summary commands. Data visualization techniques, such as pie charts, were employed to explore variable distributions (see Figure 1 for an example).

Key findings from the univariate analysis are summarized in Table 1. Approximately 87.9% of children were aged between 1 and <5 years, with a mean age of 2.17 years. Additionally, 68% of children were classified as anemic, as illustrated in Figure 1.

Table 1: Frequency of age groups among children under 5 years

Variable		Frequency	Percentage %	Mean ± SD
The current age of the child (b8) in years	0	1,263	12.08	2.17±1.32
	1	2,482	23.74	
	2	2,217	21.21	
	3	2,275	21.76	
	4	2,219	21.22	

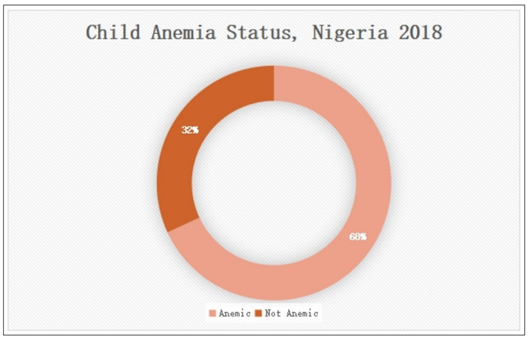

Figure 1: Percentage of anemic under-five children in Nigeria

The univariate analysis revealed that approximately 38% of women had no formal education, while only 9% had attained a higher education level (beyond secondary school) (Table 2). Most of the women (92%) were married, and 70% were employed. Regarding body mass index (BMI), 59.9% of women fell within the normal range, while less than 1% reported smoking cigarettes. Age distribution indicated that 27.9% of women were aged 25–29 years, representing the largest age group (Table 2). Household wealth distribution showed that 40% of households were classified as poor and 37% as rich. Among child-related nutritional outcomes, 32.8% of children exhibited stunting (low height-for-age), and 6% were wasted (low weight-for-height).

Table 2: Frequency Table of the Variables

Variable	Number	Percentage
Anemia		
Yes	7,003	68.7%
No	3,179	31.2%
Educational attainment (V149)		
No education	4,007	38.4%
Incomplete primary	493	4.73%
Complete primary	1,268	12.16%
Incomplete Secondary	1,311	12.57%
Complete secondary	2,412	23.12%
Higher	940	9.01%
Wealth (v190)		
Poor	4,176	40.03%
Medium	2,294	21.99%
Rich	3,961	37.97%
Type of area of residence (V025)		
Urban	4,617	44.15%
Rural	5,841	55.85%
Current marital status (V501)		
Never in union	177.9	1.70%
Married	9,658	92.35%
Living with partner	334.8	3.20%
Widowed	121.9	1.17%
Divorced	65.35	0.62%
No longer living together	99.5	0.95%
Sex of child (b4)		
Male	5,356	51.22%
Female	5,101	48.78%
Respondent currently working (v714)		
Yes	7,386	70.63%
No	3,071	29.37%
BMI Women		
Underweight	987.6	9.44%
Normal	6,272	59.98%
Overweight	1,997	19.10%
Obese	1,200	11.47%
Smokes cigarettes (v463a)		
No	10,435	99.78%
Yes	23.02	0.22%
Stunting		
Not stunted	6,749	64.54%
Stunted	3,431	32.81%
Wasting		
Not wasted	9,517	93.80%
Wasted	629	6.20%
Age in 5 years group (V013)		
15-19	333.7	3.19%

20-24	1,788	17.10%
25-29	2,927	27.99%
30-34	2,490	23.81%
35-39	1,906	18.23%
40-44	734.9	7.03%
45-49	275.6	2.64%

Bivariate Analysis

Bivariate analysis was performed to examine the relationships between the dependent variable, anemia status ("Anemia"), and the primary independent variable, maternal educational attainment (v149), alongside other independent variables. This was achieved through the construction of two-way frequency tables and the application of chi-square tests. Statistical significance was determined using a threshold of p < 0.05.

child anemia status	educational attainment 0. no edu	1. incomp	2. Comple	3. incomp	4. comple	5. higher	Total
No	941 29.60	132 4.15	370 11.64	391 12.30	881 27.71	464 14.60	3,179 100.00
Yes	2,955 42.20	351 5.01	880 12.57	895 12.78	1,477 21.09	445 6.35	7,003 100.00
Total	3,896 38.26	483 4.74	1,250 12.28	1,286 12.63	2,358 23.16	909 8.93	10,182 100.00

Pearson chi2(5) = 303.7436 Pr = 0.000
Cramér's V = 0.1727

Figure 2: Child anemia status by education attainment among women

The bivariate analysis demonstrated a clear inverse relationship between maternal education and childhood anemia. Specifically, 42% of children born to uneducated women were anemic, compared to 29% who were not. In contrast, among mothers with higher education, only 6.3% of children were anemic, while 14% were not. The association between education and anemia was moderate (Cramer's V = 0.17, Figure 2). Further analysis of maternal risk factors showed that age, employment status, and BMI were significantly associated with childhood anemia (p < 0.05), with Cramer's V values indicating weak to moderate associations. Marital status and cigarette smoking did not exhibit significant associations and were subsequently excluded from multivariate analysis. Regarding child-related factors, stunting, wasting, age, and gender were all significantly associated with anemia. Age and stunting showed the strongest associations (Cramer's V = 0.17 and 0.12, respectively), while wasting and gender exhibited weaker associations. Wealth and residence type also demonstrated moderate associations with childhood anemia (Table 3).

Table 3: Bivariate analysis of the independent variables

Independent variable	Cramer's V test	P value
Maternally related variables		
Educational attainment (V149)	0.1727***	0.000*
Current marital status (V501)	0.0105**	0.951
Age in 5 years group (V013)	0.0715**	0.000*
Smokes cigarettes (v463a)	0.0022**	0.828
Respondent currently working (v714)	-0.0393**	0.000*
BMI Women	0.1151***	0.000*
Child related variables		
Wasting	0.0553**	0.000*
Stunting	0.1218***	0.000*
Sex of child (b4)	-0.0383**	0.000*
The current age of the child (b8) in years	0.1747***	0.000*
Household SES variable		
Wealth	0.1656***	0.000*
Geographical variable		
Type of area of residence (V025)	0.1116***	0.000*

***P value significant <0.05 **Cramer's V<0.1; ***0.1>Cramer's V<0.3;**

Collinearity testing revealed no significant issues among the variables. Therefore, all significant variables identified in Table 3 were included in the regression model.

Anemia
v714 1.0000
v149 0.1778 1.0000
wealthinde~t 0.1175 0.6264 1.0000
v025 -0.0828 -0.4029 -0.5060 1.0000
BMIWomen 0.0811 0.2839 0.3075 -0.1922 1.0000
v013 0.1774 -0.0205 0.0598 -0.0657 0.1620 1.0000
b4 -0.0071 0.0009 -0.0097 0.0216 0.0040 0.0006
b8 0.0538 -0.0336 0.0028 0.0018 0.0500 0.1704
Stunting -0.0780 -0.3309 -0.2969 0.1824 -0.1818 -0.0237
Wasting -0.0269 -0.0775 -0.0703 0.0416 -0.1012 -0.0308
Anemia v714 v149 wealth~t v025 BMIWomen v013
1.0000
-0.0393
-0.1589
-0.1652
0.1116
-0.1147
-0.0602
-0.0383
-0.1706
0.1218
0.0553
b4 b8 Stunting Wasting
b4
b8 1.0000
Stunting 0.0616 1.0000
Wasting -0.1312 0.0325 1.0000 1.0000 0.0088 -0.0337 -0.0452

Figure 3: Collinearity test

We performed a multivariate logistic regression analysis. Independent variables selected based on prior bivariate analyses represented maternal, socioeconomic, child, and geographical factors. A hierarchical modeling approach was employed. Model 1 examined the association of maternal education alone with childhood anemia. Subsequent models incrementally added maternal age, body mass index (BMI), and employment status (Model 2); household wealth (Model 3); child age and gender (Model 4); child stunting and wasting (Model 5); and type of residence (Model 6). The final model (Model 6, Table 4) incorporated all significant predictors: maternal education, BMI, household wealth, child age, child gender, and stunting (Figure 4). Prior to regression modeling, collinearity diagnostics were performed, revealing no significant collinearity among the independent variables. Consequently, Akaike Information Criterion (AIC) testing was not conducted. The results presented herein are derived from this final multivariate logistic regression model.

Table 4: Logistic regression modeling results related to anemia among children under 5 in Nigeria

Incomplete	0.72(0.001) *	0.74(0.004)*	0.96(0.72)	0.92(0.46)	0.99(0.91)	1.00(0.97)
Secondary	0.54(0.000)**	0.59(0.00)**	0.81(0.03)*	0.77(0.01)*	0.84(0.69)	0.85(0.09)
Complete secondary Higher	0.33(0.000)**	0.38(0.00)**	0.54(0.00)**	0.50(0.00)**	0.55(0.00)**	0.55(0.00)**
Age in 5 years group (V013)						
20-24		0.83(0.32)	0.85(0.37)	1.00(0.98)	0.97(0.88)	0.95(0.79)
25-29		0.76(0.145)	0.80(0.25)	1.03(0.81)	0.99(0.97)	0.99(0.99)
30-34		0.69(0.05)	0.74(0.12)	0.99(0.97)	0.94(0.64)	0.95(0.80)
35-39		0.70(0.07)	0.75(0.15)	1.00(0.95)	0.97(0.90)	0.98(0.93)
40-44		0.64(0.03)*	0.69(0.08)	0.96(0.87)	0.92(0.72)	0.93(0.74)
45-49		0.54(0.009)*	0.57(0.01)*	0.81(0.38)	0.77(0.27)	0.78(0.30)
Respondent currently working (v714)						
Yes		1.00 (0.90)	1.00(0.90)	1.02(0.67)	1.03(0.55)	1.03(0.55)
BMI value (BMIWomen)						
Normal		0.80(0.01)*	0.81(0.03)*	0.85(0.08)	0.88(0.19)	0.88(0.20)
Overweight		0.64(0.00)**	0.69(0.002)*	0.72(0.00)**	0.78(0.032)*	0.78(0.03)*
Obese		0.59(0.00)**	0.65(0.001)*	0.69(0.005)*	0.74(0.025)**	0.74(0.02)*
Wasting (for children)						
Wasted					1.20(0.17)	1.20(0.17)
Stunting (for children)						
Stunted					1.44(0.00)**	1.44(0.00)**

Table 5: Multivariate Logistic Regression Models Examining the Association Between Maternal Educational Attainment and Childhood Anaemia in Nigeria

	Model 1 OR (p- value)	Model 2 OR (p- value)	Model 3 OR (p- value)	Model 4 OR (p- value)	Model 5 OR (p- value)	Model OR (p- value)
Educational attainment (V149)						
Incomplete primary	0.81 (0.18)	0.84(0.27)	0.95(0.76)	0.97(0.90)	0.97(0.70)	0.97(0.89)
Complete primary	0.83(0.07)	0.89(0.27)	1.08(0.47)	1.05(0.62)	1.10(0.35)	1.11(0.31)

Table 5 above presents the results of a series of logistic regression models examining the association between maternal educational attainment and the likelihood of childhood anaemia in Nigeria. Across six models, odds ratios (ORs) with corresponding p-values are reported for two categories of maternal education: incomplete primary and complete primary education, using mothers with no formal education as the reference group.

In Model 1, both incomplete and complete primary education are associated with slightly lower odds of childhood anaemia (OR = 0.81, p = 0.18; OR = 0.83, p = 0.07), though neither association reaches conventional levels of statistical significance. As additional covariates are introduced in subsequent models (Models 2–5), the direction of the association shifts. For incomplete primary education, the odds ratios trend toward 1.0 across the models, indicating a diminishing protective effect, with non-significant findings in all cases. For complete primary education, the odds ratios gradually move above 1.0 (e.g., OR = 1.11, p = 0.31 in the final model), suggesting that, after adjusting for other factors, completing primary education may no longer be protective against childhood anaemia.

Table 6: Multivariate Logistic Regression Models of Child's Age, Sex, Wealth, and Area of Residence in Relation to Childhood Anaemia in Nigeria

The current age of the child (b8) in years				
1		1.02 (0.83)	0.94(0.60)	0.94(0.61)
2		0.56(0.00)**	0.52(0.00)**	0.52(0.00)**
3		0.44(0.00)**	0.41(0.00)**	0.41(0.00)**
4		0.34(0.00)**	0.32(0.00)**	0.32(0.00)**
Sex of child (b4)				
Female		0.86(0.007)	0.88(0.02)	0.88(0.02)
Wealth				
Medium	0.62(0.00)**	0.61(0.00)**	0.62(0.00)**	0.63(0.00)**
Rich	0.57(0.00)**	0.56(0.00)**	0.58(0.00)**	0.60(0.00)**
Type of area of residence (V025)				
Rural				1.07(0.30)

Significance: * p<0.05 **p<0.001 OR: odds ratio

results on Table 6 above show that the current age of the child is strongly associated with anaemia risk. Compared to children aged one year, the odds of anaemia decline progressively with age. For instance, children aged two years have a significantly lower risk (OR ≈ 0.52, $p < 0.001$), which further decreases among those aged three (OR ≈ 0.41, $p < 0.001$) and four years (OR ≈ 0.32, $p < 0.001$). This suggests that anaemia is more prevalent in infancy and early toddlerhood, likely due to high nutritional demands, rapid growth, and greater vulnerability to infections during these early years.

The sex of the child is also significant, with females showing lower odds of anaemia compared to males (OR ≈ 0.86–0.88, $p < 0.05$). This aligns with evidence suggesting that boys may have higher vulnerability to early childhood illnesses and nutritional deficiencies.

Regarding household factors, wealth status is a strong predictor. Children from medium and rich households have consistently reduced odds of anaemia compared to those from poor households (ORs ranging from 0.56 to 0.63, $p < 0.001$). This highlights the protective role of household socio-economic resources, likely through improved nutrition, healthcare access, and living conditions.

Finally, the type of residence (rural vs. urban) does not show a statistically significant association with anaemia (OR = 1.07, p = 0.30), suggesting that place of residence alone may not directly influence anaemia risk once other factors are controlled for.

Survey: Logistic Number of strata Number of PSUs	regression = 74 = 1,376	Number of obs = 10,085 Population size = 10,121.523 Design df = 1,302 F(16, 1287) = 30.70 Prob > F = 0.0000				
Anemia	**Odds ratio**	**Linearized std. err.**	**T**	**P>|t|**	**[95% conf.**	**interval]**
v149						
1. incomplete primary	.9793037	.1595725	-0.13	0.898	.71136	1.348172
2. complete primary	1.112425	.1192486	0.99	0.320	.9014462	1.372783
3. incomplete secondary	1.009412	.1070469	0.09	0.930	.8198142	1.242857
4. complete secondary	.8544713	.0814545	-1.65	0.099	.7087273	1.030186
5. higher	.5577593	.0666035	-4.89	0.000	.4412738	.7049942
BMIWomen						
Normal	.8737724	.0834542	-1.41	0.158	.7244763	1.053834
Overweight	.7680761	.0880196	-2.30	0.021	.6134341	.961702
Obese	.7305931	.0941571	-2.44	0.015	.5673781	.9407593
Wealthindexcat						
Medium	.6279979	.054934	-5.32	0.000	.528969	.7455662
Rich	.5827502	.054986	-5.72	0.000	.4842746	.7012505
b4						
2. female	.8820537	.0474885	-2.33	0.020	.7936425	.980314
b8						
1	.9555937	.1017459	-0.43	0.670	.7754576	1.177575
2	.5262773	.0531275	-6.36	0.000	.431724	.6415389
3	.4153385	.0429428	-8.50	0.000	.3390881	.5087352
4	.325397	.0338217	-10.80	0.000	.2653734	.3989971
Stunting						
Stunted	1.440072	.0975491	5.38	0.000	1.260872	1.644741
_cons	6.770582	.9120689	14.20	0.000	5.198206	8.818577

Figure 4: Final model with the significant independent variables associated with Anemia among children under five in Nigeria

All regression models demonstrated statistical significance ($p < 0.05$). Model 1, examining maternal education alone, revealed that children of highly educated mothers (above secondary school) had significantly lower odds of anemia (OR = 0.67, $p < 0.001$) compared to children of uneducated mothers (Table 4). The 95% confidence interval (CI) for this association did not include 1, indicating a significant association. Model 2, incorporating maternal age, BMI, and employment status, confirmed that high maternal education remained significantly associated with reduced childhood anemia. Additionally, maternal age 40-49 years (OR [reference:

15-19 years], $p < 0.05$) and normal, overweight, or obese BMI (OR [reference: underweight], $p < 0.05$) were associated with lower odds of anemia. Employment status did not demonstrate a significant association.

In Model 3, which added household wealth, children from wealthy families had significantly lower odds of anemia (OR = 0.57, $p < 0.001$) compared to those from poor families, adjusting for maternal factors. Model 4 included child age and gender, resulting in the loss of significance for maternal age. Child gender was significant, with girls having lower odds of anemia than boys (OR, $p < 0.05$). Child age 2-5 years was associated with significantly lower odds of anemia compared to 6 months-1 year ($p < 0.001$). Model 5, including child stunting and wasting, showed that stunting was significantly associated with higher odds of anemia (OR, $p < 0.001$), while wasting was not significantly associated. Model 6, the final model, incorporated residence type, which did not exhibit a significant association with childhood anemia.

Across all models, maternal education (high education) and BMI consistently demonstrated strong associations with childhood anemia. Specifically, highly educated mothers had 45% lower odds of having an anemic child (OR = 0.55, $p < 0.001$). Overweight and obese mothers had 24% and 27% lower odds of having an anemic child, respectively, compared to underweight mothers ($p < 0.001$). Children from medium and rich households had 38% and 42% lower odds of anemia, respectively, compared to those from poor households ($p < 0.001$). Girls had 12% lower odds of anemia than boys ($p < 0.05$). Children aged 2-5 years had significantly lower odds of anemia compared to 6 months-1 year ($p < 0.001$). Stunted children had 44% higher odds of anemia ($p < 0.001$). These results are summarized in Figure 6.

Discussion

This study investigated the association between maternal, socioeconomic, and child-related factors and anemia in Nigerian children under five. Finding revealed that higher maternal education and increased maternal BMI were significantly associated with lower odds of childhood anemia. After adjusting for child age and gender, maternal age was no longer significantly associated with anemia. Conversely, household wealth, female child gender, and child age 2-5 years were associated with reduced odds of anemia, while stunting significantly increased the odds.

Our findings are consistent with previous research [16] which reported associations between older maternal age, higher maternal BMI, and greater wealth with higher hemoglobin levels in children across sub-Saharan Africa. While maternal education was not included in their analysis, our study extends these findings by demonstrating its significant protective effect against childhood anemia. Similarly, research in Angola [17] and Lesotho [18] found a significant association between stunting and childhood anemia aligning with our results of higher odds of anemia. The observed gender disparity, with female children exhibiting lower odds of anemia, is supported by a study in Tanzania [19]. The same study [19] also agrees with our finding that older children (2-5 years) have lower odds of anemia compared to younger infants (6 months-1 year).

The robust association between higher maternal education and lower childhood anemia underscores the importance of investing in women's education as a strategy to improve child health outcomes. The protective effect of higher maternal BMI, particularly overweight and obesity, may reflect improved nutritional status and access to resources. However, this finding warrants further investigation to understand the potential underlying mechanisms and implications for public health interventions. The significant impact of household wealth highlights the socioeconomic determinants of childhood anemia, emphasizing the need for poverty reduction strategies. The observed associations with child age, gender, and stunting reinforce the complex interplay of factors contributing to anemia in this population.

Policy Implication of the Study

First, the significant association between maternal education and reduced childhood anaemia highlights the importance of strengthening policies that promote female education beyond secondary school. Investing in women's education not only improves their knowledge and practices regarding nutrition, healthcare, and childcare, but also creates a generational impact on child health outcomes. Thus, policies aimed at expanding access to quality education for girls and women in Nigeria can play a pivotal role in reducing anaemia prevalence among children.

Second, the findings suggest that maternal nutritional status is a crucial determinant of childhood anaemia. Children of mothers with higher body mass index (BMI) were less likely to be anaemic, indicating that improving maternal nutrition and reducing undernutrition among women of reproductive age should be a key priority. Public health policies should therefore emphasize maternal dietary support, nutrition education, and access to affordable, diverse foods, particularly during preconception and pregnancy, to break the intergenerational cycle of malnutrition and anaemia.

Third, the strong association between household wealth and child anaemia demonstrates that socioeconomic inequalities are central drivers of poor health outcomes. Poverty reduction strategies, such as social safety nets, conditional cash transfers, and food supplementation programs for vulnerable households, are critical in addressing anaemia among children. By reducing financial barriers to healthcare and nutritious foods, these policies can mitigate the impact of poverty on child health.

Additionally, the findings that younger children (particularly those under two years) are more vulnerable to anaemia underline the need for age-specific interventions. Strengthening infant and young child feeding (IYCF) policies, promoting exclusive breastfeeding, and ensuring timely introduction of iron-rich complementary foods can protect children during this critical growth stage. Special attention should also be given to monitoring and addressing stunting, which significantly increases anaemia risk, through integrated programs that combine nutrition, sanitation, and maternal healthcare.

Finally, the evidence that child sex, residence type, and wasting were not significant determinants suggests that interventions should prioritize universal approaches rather than residence-specific or gender-targeted policies. However, continuous nationwide surveillance and context-specific program adaptations remain essential to ensure inclusivity and effectiveness.

Conclusion

This study examined the maternal, socioeconomic, and child-related factors associated with anaemia among children under five in Nigeria, using nationally representative data from the 2018 Nigeria Demographic and Health Survey. The findings reveal that childhood anaemia is influenced by a complex interplay of maternal characteristics, household socioeconomic conditions, and child health and demographic variables. Notably, maternal education, maternal body mass index, and household wealth emerged as strong protective factors, while stunting significantly increased the odds of anaemia. These results underscore the importance of both maternal and structural determinants in shaping child health outcomes in Nigeria.

The study further highlights that children between six months and two years remain the most vulnerable group, reinforcing the need for early-life interventions that promote adequate nutrition and proper feeding practices during critical developmental stages. Female children were found to have a lower risk of anaemia compared to males, although sex differences in anaemia may also reflect biological and behavioral factors that require further exploration. In contrast, maternal age, child wasting, and area of residence did not significantly predict anaemia after adjusting for other variables, suggesting that individual and household-level determinants carry more weight than broader demographic factors.

Overall, these findings emphasize that reducing childhood anaemia in Nigeria requires integrated interventions that improve maternal education and nutrition, address poverty-related disparities, and prevent stunting among children. Policies and programs must prioritize maternal and child health holistically, recognizing the intergenerational linkages between maternal wellbeing and child outcomes. By tackling both immediate nutritional deficiencies and long-term socioeconomic inequities, Nigeria can make meaningful progress toward lowering the burden of childhood anaemia and advancing child survival and development goals.

This study is subject to several limitations. Notably, the analysis did not incorporate key health-related variables, such as malaria prevalence and helminth infections, due to data limitations within the Nigeria Demographic and Health Survey (NDHS). The absence of these factors may introduce confounding and potentially bias the observed associations between maternal variables and childhood anemia. Furthermore, the categorization of maternal age into seven strata, without further refinement, may have reduced the statistical power of the regression analysis. While maternal education was a primary focus, the study was unable to include other potentially relevant maternal factors, such as parity and maternal health service utilization, due to data incompleteness within the NDHS child health questionnaire.

Despite these limitations, the study makes an important contribution by identifying maternal education, maternal nutritional status, household wealth, and child-related characteristics as significant determinants of anaemia among children under five in Nigeria. By drawing on a large, nationally representative dataset, the findings provide valuable insights into the multifaceted drivers of childhood anaemia and underscore the need for integrated interventions that target maternal and household-level factors. These contributions are critical for informing health policies and guiding future research aimed at reducing the burden of childhood anaemia in Nigeria.

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