

DETERMINANTS OF UNDERNUTRITION AMONG UNDER-FIVE CHILDREN IN RURAL COMMUNITY OF NORTHWESTERN NIGERIA

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ABSTRACT

Introduction: Nigeria has one of Africa's highest rates of undernutrition and the situation is particularly worst in northwestern Nigeria. This study aimed to determine the prevalence and determinants of undernutrition in Bagwai LGA, Kano, northwestern Nigeria. **Methodology:** This was a cross-sectional study of 358 children aged 6 - 59 months; a semi-structured questionnaire was used to collect data. Chi-square test was used to assess the association between the outcome and the respondent's characteristics while binary logistic regression model was employed to estimate the adjusted odds of malnutrition. **Results:** A total of 358 children were involved in this study with a mean age of 26.2(\pm 15) months. Up to 24.3% of the children were underweight and the prevalence of stunting was found to be 62% with 22.9% moderately stunted and 39.1% severely stunted; stunting was higher in males (66.3%) compared to females (56.9%). Underweight was also higher in males (28.0%) than females (20.0%). Wasting was also seen more in males (6.8%) compared to 2.4% in females. Underweight and stunting were mostly common within the age group 24-35months while wasting was found to be most prevalent in children aged 12-23 months. The odds of stunting was 5 times higher (OR=5.36, 95% CI=2.42 -11.89, $p<0.001$) in children aged 24-35 months and 3.5times higher (OR=3.55, 95% CI=6.83-7.47, $p<0.001$) in children aged 36-47months compared to children aged 6-11 months. The odd of stunting is almost 11 times higher in children whose mothers have no formal education (OR=10.92, 95% CI=3.37 - 35.36, $p<0.001$) compared to those who had tertiary education and the odds of stunting in male children is almost 2 times that of females (OR=1.72, 95% CI=1.12 - 2.64, $p=0.014$). **Conclusion:** These findings emphasize the multidimensional nature of undernutrition, involving both biological and socio-environmental determinants. Efforts to reduce stunting should prioritize improving access to female education, enhancing sanitation facilities, and addressing gender disparities in child health outcomes, as envisioned in global sustainable development goals. Furthermore, early interventions targeting older age groups and promoting proper nutrition and hygiene practices are essential to prevent stunting and its long-term impacts on child health and development.

Keywords: Determinants, undernutrition, stunting, wasting, underweight, children, Kano

Cite this article: Warshu SH, Braji AI, Haruna IU, Jalo RI, *et al.* Determinants of undernutrition among under-five children in rural community of northwestern Nigeria. *Yob Med J.* 2025; 1(1):20-36

Received: 03-Feb-2024

Accepted: 18-Mar-2025

Published:12-Apr-2025

INTRODUCTION

The World Health Organization has classified malnutrition as the biggest threat to public health worldwide.¹ Malnutrition is a pathological state caused by a relative or absolute shortage or excess of one or more necessary nutrients/energy in a given individual or population.^{2,3} The term malnutrition addresses broad groups of conditions: undernutrition, which includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age); micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and overweight, obesity and diet-related noncommunicable diseases (such as heart disease, stroke, diabetes and some cancers).³ Globally, in 2022, 148 million children under 5 were estimated to be stunted (too short for age), 45 million were estimated to be wasted (too thin for height), and 37 million were overweight or living with obesity.³ Stunting is the devastating result of poor nutrition in-utero and early childhood. Children suffering from stunting may never attain their full potential and their brains may never develop to their full cognitive potential.⁴ These children begin their lives at a marked disadvantage with consequences continuing into adulthood: they face learning difficulties in school, earn less as adults, and face barriers to participation in their communities. Stunting has been declining steadily over the last decade, with 148.1 million, or 22.3 per cent of children under age 5 worldwide affected in 2022. Nearly all children affected lived in Asia (52 per cent of the global burden) and Africa (43 per cent of the global burden).⁴

Child wasting is the life-threatening result of poor nutrient intake and/or recurrent illnesses. Children suffering from wasting have weakened immunity, are susceptible to long-term developmental delays and face an increased risk of death, particularly when wasting is severe. Children suffering from severe wasting require early detection and timely treatment and care to survive. In 2022, an estimated 45 million children under 5 (6.8 per cent) were affected by wasting,

of which 13.7 million (2.1 per cent) were suffering from severe wasting.⁴ More than three quarters of all children with severe wasting live in Asia and another 22 per cent live in Africa.⁴

In recent times, sub-Saharan Africa (SSA) has had so much to grapple with in terms of the undernutrition. Within the SSA region, sub-regional variations in malnutrition are reported in the literature. According to Akombi *et al*, East and West Africa bear the greatest burden of malnutrition in the SSA region.⁵ The Nigerian Demographic and Health Survey (NDHS 2023) reported that 40% of children aged 6-59 months were stunted, 8% were wasted and 27% were underweight.⁶ These indices are even higher than that reported in the NDHS 2018, showing that the problem of undernourishment among under five-year children still remains a considerable challenge in Nigeria. The existing literature suggests malnutrition is still a big problem in Nigeria and needs further investigation.⁷⁻¹³ This study therefore set out to investigate the prevalence and determinants of malnutrition in rural community of Bagwai LGA in northwestern Nigeria. Further, previous research shows that maternal education,^{7,8} maternal nutrition⁹⁻¹², maternal low body mass index (BMI) ($<18.5 \text{ kg/m}^2$), maternal anemia (hemoglobin $<12 \text{ g/dL}$)¹³ child's birth order and birth weight^{8,14}, maternal age, residence,¹⁵ antenatal care (ANC), child's sex,^{7,14} stool disposal system,¹² short period of breastfeeding¹⁶ and household income level¹⁷ are the main determinants of anthropometric failures (stunting, wasting, and underweight) among children.

All forms of malnutrition are preventable; to prevent malnutrition before it starts, children and their families need access to nutritious diets, essential services and positive practices to set them on the path to survive and thrive.⁴ Interventions to prevent malnutrition range from promoting breastfeeding to food supplementation schemes, whereas micronutrient deficiencies would best be addressed through food-based strategies. These strategies include dietary diversification through home gardens and small-scale livestock to minimize the burden on public

health.^{4,18} The Sustainable Development Goals (SDG) agenda represent a shared framework for promoting sustainable development through international collaboration. SDG 2 aims to end hunger, achieve food security and improved nutrition and promote sustainable agriculture.¹⁹ Even though there has been some progress towards the goal of ending all forms of malnutrition, with improvements in the global prevalence of stunting and wasting among children under five years of age, the world is not on track to achieving any of the seven global nutrition targets by 2030.²⁰ Nigeria ranks 160 out of 165 countries in terms of its progress towards achieving the SDGs while with regards to achieving SDG 2, Nigeria has progressed only minimally in lowering the prevalence of wasting and stunting among children under the age of five years.²⁰ Considering this background, it is evident that malnutrition remains a persisting problem in the country. This study therefore aims to assess the prevalence and determinants of undernutrition among under-five children in rural Bagwai, Kano, Nigeria.

METHODOLOGY

Study area and study design

The study area was Bagwai LGA Northwestern Nigeria while the study was a cross-sectional in design. Bagwai Local Government, named after Bagwai Town, is part of the Kano Emirate. Historically, Bagwai is bordered to the north by the Watari River (before 1976), to the southeast by the Yalawai River, and to the west by the Rafinkankanu Fadama, a tributary of the Watari River. The town is home to three major tribes: Hausawa, Fulani and the Kanuri.

Sample size determination

Using the formula for single proportion and prevalence of stunting of 40% (NDHS 2023), the minimum sample size of 369 was obtained.⁶

Sampling method

A cluster sampling method was used to select study subjects. Three political wards in Bagwai local government areas (LGAs) were selected and

all eligible children were studied until the required sample size was reached.

Study population

The inclusion criteria were children aged 6–59 months living with their parents in Bagwai LGA. Children with any known chronic debilitating illness that can affect growth such as sickle cell anemia, HIV infection, chronic kidney disease and congenital heart defects were excluded.

Data collection method

The data used for this study were collected using a semi-structured pre-tested questionnaire by trained enumerators which include nurses working in the rural community. Information was collected on children's, mother's, households and community-based characteristics.

Weight was measured in kilogram using a scale attached to a stadiometer to the nearest 0.1kg. Children who could not stand were held by the mother. Height was measured using the height meter attached to the stadiometer. For children under 24 months, recumbent length was measured in centimeters using a measuring tape while they were placed on a table.

Data management and analysis

Data collected was checked in the field for consistency and completeness. It was then coded and entered into a Microsoft Excel spreadsheet for cleaning and exported to SPSS version 25.0 for data analysis.²¹ Nutritional indices were assessed using the WHO ANTHRO software.²² Frequency and percentage were used to summarize categorical variables such as the nutritional status, age category and socio-economic status while means and standard deviations were used to summarize continuous variables such as weight for height and height for age z-scores. The associations between nutritional status and categorical variables (age category and socio-economic status) were determined using chi square. Determinants of childhood undernutrition were assessed using logistic regression analysis. All reported p-values <0.05 were considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Health Research Ethics Committee of the Kano State Ministry of Health (Reference – SHREC/2023/5097). Informed consent was obtained from each caregiver; this was duly signed or thumb-printed by all respondents.

RESULTS

A total of 358 children (97% response rate) were involved in this study with a mean age of 26.2(\pm 15) months, they were mostly within the age range of 36-47(24.6%) and 24-35(23.2%); more than half were males (53.1%). The caregivers had a mean age of 30.5(\pm 7.5) years and were mostly (41.9%) within the age range of 20-39years. Most of the mothers had secondary level of education (53.6%) and they were mostly petty traders (78.2%). The fathers were mostly farmers (39.1%) followed by traders (36.3%) (Table 1).

Majority (84.1%) of the children were born at home. Almost all (99.2%) the children had been breastfed with a third (39.5%) still being breast fed. Two thirds of the children were first breast fed within the first hour of birth. More than half of the children had been given pre-lacteal feeds and majority (97.2%) had been given colostrum. Age at introduction of complementary feeds was at < 6 months for almost 87.4% of the children and majority (87.4%) of the children are breastfed for 18months and beyond. (Table 1) Almost 81% of the children had a BCG scar and 67.4% had been given vitamin A supplementation. They were mostly partially immunized, almost 53.4% of the children had fever, 38.3% had cough and almost 28.2% had diarrhea in the last 2 weeks preceding the interview.

Prevalence of undernutrition

This study showed that 24.3% were underweight with 17% moderately underweight and 7.3 % severely underweight. The prevalence of stunting was found to be 62% with 22.9% moderately stunted and 39.1% severely stunted. The study also showed that 4.8% of the children were wasted with 2.8% moderately wasted and 2.0%

severely wasted (Figure 1). Stunting was higher in males (66.3%) compared to females (56.9%). Underweight was also higher in males (28.0%) than females (20.0%) while wasting was also seen more in males (6.8%) compared to 2.4% in female.

Underweight was mostly common within the age group 24-35months with 27.7% and 10.8% moderately and severely underweight, respectively (Figure 3). Stunting was commonest within the age group 24-35month with 22.9 and 59% moderately and severely stunted, respectively. Wasting was also found to be most prevalent in children aged 12-23 months with 2.6% and 7.8% moderately and severely wasted, respectively.

Determinants of underweight

Bivariate analysis showed that mother's educational level ($p=0.016$), sex of the child ($p=0.025$), age of child 24-35month ($p<0.001$) and facility sanitation ($p=0.010$) were factors significantly associated with being underweight among children. Binary Logistic regression showed that the odds of underweight among children aged 24-35month was 4 times higher (OR=4.39, 95% CI = 1.68 - 11.50, $p=0.003$) compared to children aged 6-11months. Odds of underweight was almost 10 times higher (OR = 10.045, 95% CI = 1.26 - 79.95, $p=0.029$) in women with primary education compared to women with tertiary education (Table 2). Compared to the female child, the male child is almost two times (OR:1.767, CI:1.073,2.911, $p=0.025$) more likely to be underweight. Children living in households with unimproved sanitation are 2 times more likely to be underweight than those in houses with improved sanitation (OR=2.30, 95% CI=1.21 - 4.39, $p=0.063$). The odds of underweight amongst those that had diarrhea in the last 2 weeks and those that did not was almost the same (OR=1.11, 95% CI=0.66 - 1.89, $p=0.69$) (Table 2).

Determinants of stunting and wasting

Factors found to be associated with stunting included age of child ($p<0.001$), mothers' educational level ($p<0.001$) and sex of the child ($p=0.013$). The odds of stunting was 5 times

higher (OR = 5.36, 95% CI=2.42-11.89, $p<0.001$) in children aged 24-35month and 3.5times higher (OR=3.55, 95% CI= 6.83-7.47, $p=0.001$) in children aged 36-47month compared to children aged 6-11 months. The odd of stunting is almost 11 times higher in children whose mothers have no formal education (OR=10.92, 95% CI=3.37-5.36, $p<0.001$) compared to those who have

tertiary education. The odds of stunting in male children is almost 2 times that of females (OR=1.72, 95% CI=1.12-2.64, $p=0.014$) (Table 3). Wasting was found to be significantly associated with sex of the child; male children were 4 times more likely to be wasted than the female children (OR=4.23, 95% CI=1.19-14.96, $p=0.03$) (Table 4).

Table 1: Sociodemographic characteristics of children in Bagwai

VARIABLE	FREQUENCY	PERCENTAGE
Age of caregiver (years)		
<20	8	2.2
20-29	150	41.9
30-39	134	37.4
40-49	66	18.4
Age of children (months)		
6-11	48	13.4
12-23	78	21.8
24-35	83	23.2
36-47	88	24.6
48-59	61	17.0
Sex of child		
Male	193	53.9
Female	165	46.1
Educational level of caregiver		
No formal education	78	21.8
Primary	70	19.6
Secondary	192	53.6
Tertiary	18	5.0
Occupation of caregiver		
Farming	22	6.1
Seamstress	45	12.6
Petty trader	280	78.2
Civil servant	11	3.1
Occupation of father		
Farming	140	39.1
Trader	130	36.3
Artisan	18	5.0
Civil servant	70	19.6
Place of birth		
Home	301	84.1
PHC	30	8.4
General hospital	24	6.7
Private Hospital	3	0.8
Ever breastfed		
Yes	355	99.2
No	3	0.8
Time of initiation of breast feeding		
Within 1hr	225	62.8
Between 1hr and 24hrs	197	30.1
>24hrs	25	6.0
Colostrum given		
Yes	345	97.2
No	10	2.8
Pre-lacteal feed		
Yes	196	55.2
No	159	44.8

Age at introduction of complementary feeds		
<6months	313	87.4
Six months & above	45	12.6
Currently breastfed	140	39.4
Breastfeeding child for 18months and beyond	196	92.0

Child still being breastfed	153	39.5
Facility sanitation		
Unimproved	267	74.6
Improved	91	25.4
BCG scar		
Yes	289	80.7
No	16	4.5
Immunisation status of children 1yr & above		
Fully immunised	6	2.1
Partially immunised	198	67.1
Not immunised	91	30.8
Vitamin A supplementation		
Yes	211	67.4
No	102	32.6
Fever in the last 2 weeks		
Yes	191	53.4
No	167	46.6
Cough in the last 2 weeks		
Yes	137	38.3
No	221	61.7
Diarrhoea in the last 2 weeks		
Yes	101	28.2
No	257	71.8

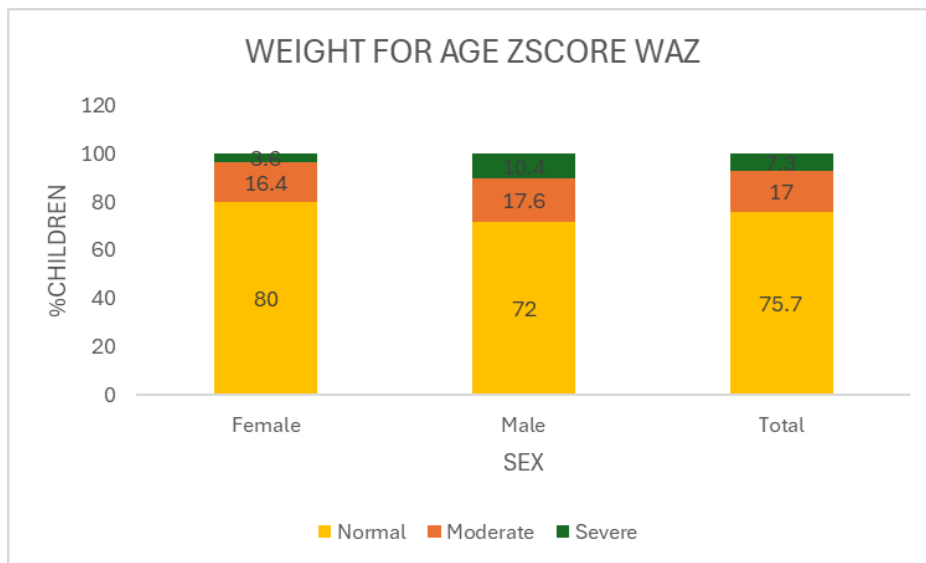
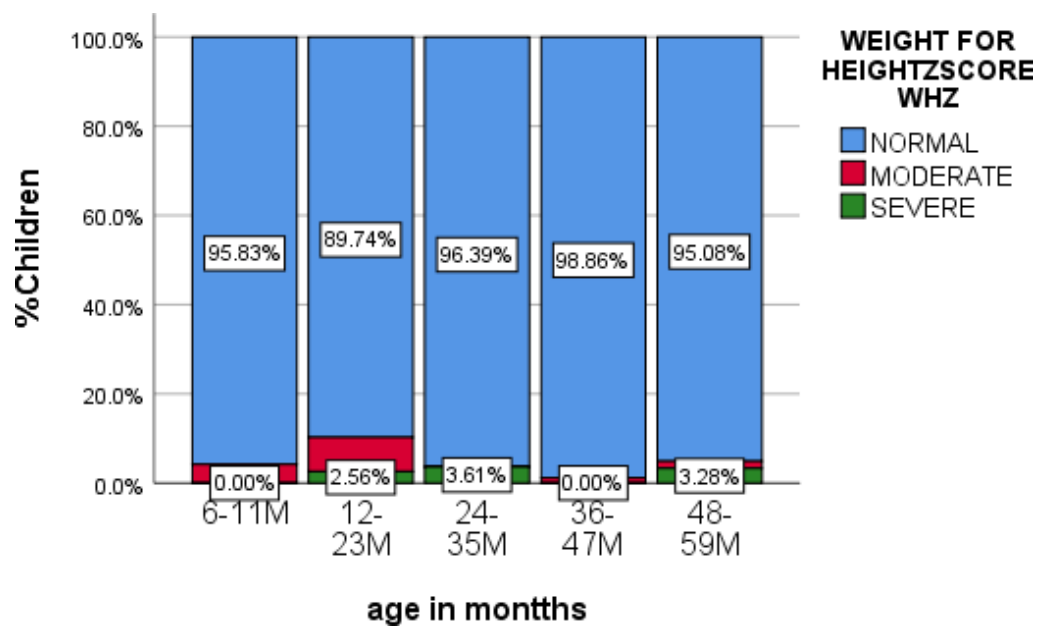
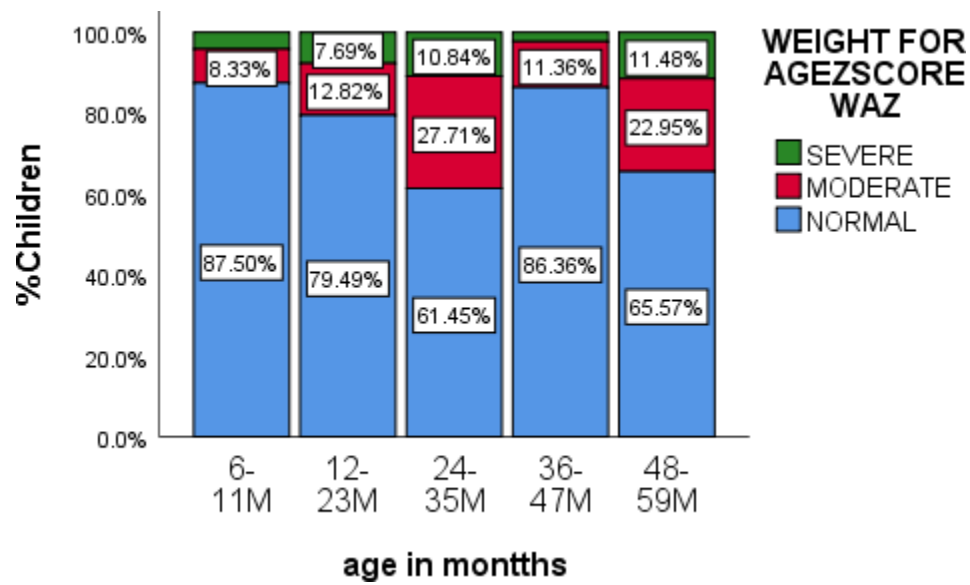




Figure 1: Nutritional status of children by sex



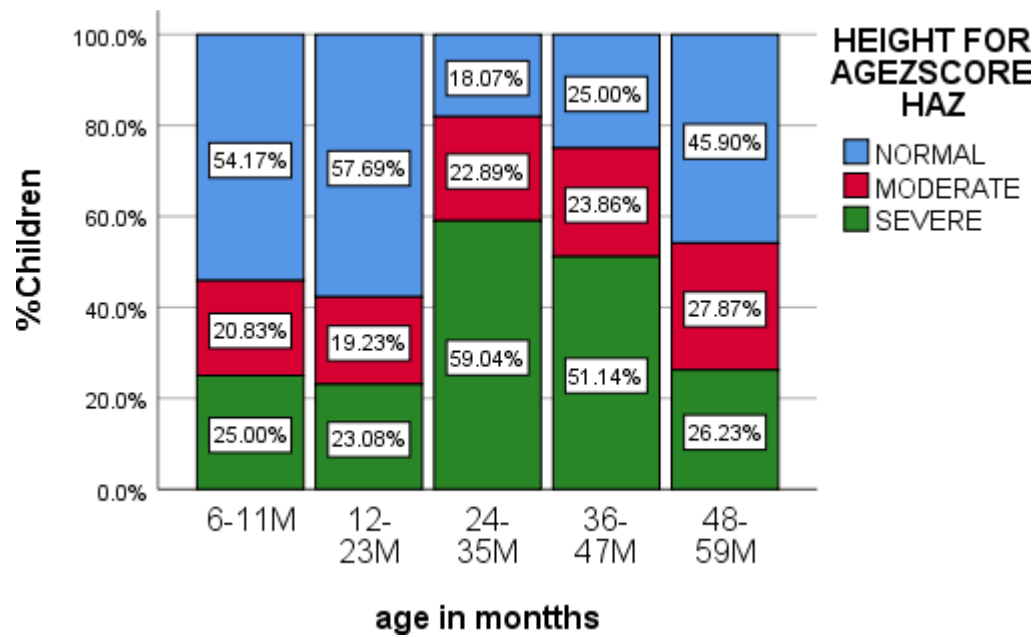


Figure 2: Nutritional status of children by age group

Table 2: Determinants of underweight among children in Bagwai

Variable	Well nourished	Underweight	χ^2 test	Binary logistic model OR (95%CI)	
			P - value		P - value
Age of child (months)			0.000		
6-11	42(87.5)	6(12.5)		Reference	
12-23	62(79.5)	16(20.5)		1.806(0.654,4.993)	0.254
24-35	51(61.4)	32(38.6)		4.392(1.677,11.504)	0.003
36-47	76(86.4)	12(13.6)		1.105(0.387,3.158)	0.852
48-59	40(65.6)	21(34.4)		3.675(1.345,10.043)	0.011
Age of caregiver (years)			0.380		
<20	7(87.5)	1(12.5)			
20-29	107(71.3)	43(28.7)			
30-39	103(76.9)	31(23.1)			
40-49	54(81.8)	12(18.2)			
2.945	0.400				
Sex of child			0.025		
Female	134(81.2)	31(18.8)		reference	
Male	137(71.0)	56(29.0)		1.767(1.073,2.911)	0.025
Educational level of mother			0.016		
No formal	60(76.9)	98(23.1)		5.100(0.04,1.004)	0.126
Primary	48(62.9)	26(37.1)		10.045(1.262,79.947)	0.029
Secondary	150(78.1)	42(21.9)		4.760(0.615,36.813)	0.135
Tertiary	17(94.4)	1(5.6)		REFERENCE	
Occupation of caregiver					
Farming	18(81.8)	4(18.2)	0.206		
Artisan	31(68.9)	14(31.1)			
Petty traders	216(77.1)	64(22.9)			
Civil servant	6(54.5)	5(45.5)			
Fathers' occupation			0.099		
Farming	112(80)	28(20.0)			
Artisan	101(77.7)	29(22.3)			
Petty traders	12(66.7)	6(33.3)			
Civil servant	46(65.7)	24(34.3)			

Colostrum			0.287		
Yes	260(75.4)	85(24.6)			
No	9(90.0)	1(10.0)			
Pre-lacteal feed			0.897		
Yes	148(75.5)	48(24.5)			
No	121(76.1)	38(23.9)			
Age at introduction of complementary feed			0.275		
<6months	234(74.8)	79(25.2)			
6months and above	37(82.2)	8(17.8)			
Immunization status			0.448		
Fully immunized	7(77.8)	2(22.2)			
Partially immunized	181(77.7)	52(22.3)			
Not immunized	83(71.6)	33(28.4)			
Vitamin A			0.111		
Yes	152(72.6)	59(28.0)			
No	82(80.4)	20(19.6)			
Cough in the last 2 weeks			0.665		
Yes	102(74.5)	35(25.5)			
No	169(76.5)	52(23.5)			
Diarrhea in the last 2 weeks			0.021		
Yes	68(67.3)	33(32.7)		1.114(0.655,1.894)	0.690
No	203(79.0)	54(21.0)		REFERENCE	
Fever in the last 2 weeks			0.168		
Yes	139(72.8)	52(27.2)			
No	132(79.0)	35(21.0)			
Sanitation facility			0.010		
Unimproved	193(72.3)	74(27.7)		REFERENCE	
Improved	78(85.7)	13(14.3)		2.301(1,206,4.387)	0.011

Table 3: Determinants of stunting among children in Bagwai

Variable	Well nourished	Stunting	χ^2 test	Binary logistic model	
			P-value	OR (95% CI)	P-value
Age of child (months)			0.000		
6-11	26(54.2)	22(45.8)		REFERENCE	
12-23	45(57.7)	33(42.3)		0.867(0.420,1.788)	0.698
24-35	15(18.1)	68(81.9)		5.358(2.415,11.886)	<0.001
36-47	22(25)	66(75.0)		3.545(1.683,7.469)	0.001
48-59	28(45.9)	33(54.1)		1.393(0.652,2.975)	0.392
Age of caregiver (years)			0.541		
<20	5(62.5)	3(37.5)			
20-29	57(38.0)	93(62.0)			
30-39	49(36.6)	85(63.4)			
40-49	25(37.9)	41(62.1)			
2.139	0.544				
Sex of child			0.013		
Female	74(44.8)	91(55.2)		REFERENCE	
Male	62(32.1)	131(67.9)		1.718(1,117,2,643)	0.014
Educational level of mother					
No formal	15(19.2)	63(80.8)		10.920(3.372,35.364)	<0.001
Primary	16(22.9)	54(77.1)		8.775(2.716,28.347)	<0.001
Secondary	92(47.9)	100(52.1)		2.826(0.970,8.235)	0.057
Tertiary	13(72.2)	5(27.8)		REFERENCE	
Mothers' occupation			0.397		
Farming	8(36.4)	14(63.6)			
Artisan	12(26.7)	33 (73.3)			
Petty traders	112(40.0)	168(60.0)			
Civil servant	4(36.4)	7(63.6)			
Fathers occupation			0.232		
Farming	50(35.7)	90(64.3)			
Artisan	7(38.9)	11(61.1)			
Petty traders	57((43.8)	73(56.2)			

Civil servant	22(31.4)	48(68.6)			
Colostrum			0.596		
Yes	132(38.3)	213(61.7)			
No	3(30.0)	7(70.0)			
Pre-lacteal feed			0.437		
Yes	71(36.3)	125(63.8)			
No	64(40.3)	95(59.7)			
Age at introduction of complementary feed			0.918		
<6months	298(95.2)	15(4.8)			
6months and above	43(95.6)	2(4.4)			
Immunization status			0.456		
Fully immunized	3(33.3)	6(66.7)			
Partially immunized	94(40.3)	139(59.7)			
Not immunized	39(33.6)	77(66.4)			
Vitamin A			0.700		
Yes	78(37.4)	133(63.0)			
No	40(39.2)	62(60.8)			
Cough in the last 2 weeks			0.119		
Yes	59(43.1)	78(56.9)			
No	77(34.8)	144(65.2)			0.078
Diarrhea in the last 2 weeks			0.224		
Yes	27(26.7)	74(73.3)			
No	109(42.4)	148(57.6)			
Fever in the last 2 weeks			0.320		
Yes	68(35.6)	123(64.4)			
No	68(40.7)	99(59.3)			
Sanitation facility			0.670		
Unimproved	105(38.6)	167(61.4)			
Improved	31(36.0)	55(64.0)			

Table 4: Determinants of wasting among children in Bagwai

Variable	Well nourished	Wasting	χ^2 test P- value	Binary logistic model OR (95% CI)	P-value
Age of child (months)			0.090		
6-11	46(95.8)	2(4.2)			
12-23	70(89.7)	8(10.3)			
24-35	80(96.4)	3(3.6)			
36-47	87(98.9)	1(1.1)			
48-59	58(95.1)	3(4.9)			
Age of caregiver (years)			0.799		
<20	8(100)	0(0)			
20-29	142(94.7)	8(5.3)			
30-39	127(94.8)	7(5.2)			
40-49	64(97.0)	2(3.0)			
Sex of child			0.016	4.223(1.192,14.963)	0.026
Female	162(98.2)	3(1.8)			
Male	179(92.7)	14(7.3)			
Educational level of mother			0.953		
No formal	74(94.9)	4(5.1)			
Primary	66(94.3)	4(5.7)			
Secondary	184(95.8)	8(4.2)			
Tertiary	17(94.4)	1(5.6)			
Mothers' occupation					
Farming	21(95.5)	1(4.5)	0.811		
Artisan	42(93.3)	3(6.7)			
Petty traders	268(95.7)	12(4.3)			
Civil servant	10(90.9)	1(9.1)			
Fathers Occupation			0.442		
Farming	132(94.3)	8(5.7)			
Artisan	125(96.2)	5(3.8)			
Petty traders	16(88.9)	2(11.1)			
Civil servant	68(97.1)	2(2.9)			

Colostrum			0.472		
Yes	328(95.1)	17(4.9)			
No	10(100)	0(0.0)			
Pre-lacteal feed					
Yes	202(95.3)	10(4.7)	0.183		
No	161(92)	14(8)			
Age at introduction of complementary feed			0.918		
<6months	298(95.2)	15(4.8)			
6months and above	43(95.6)	2(4.4)			
Immunization status					
Fully immunized	9(100)	0(0)	0.540		
Partially immunized	237(94.4)	14(5.6)			
Not immunized	121(92.4)	10(7.6)			
Vitamin A			0.286		
Yes	199(94.3)	12(5.7)			
No	99(97.1)	3(2.9)			
Cough in the last 2 weeks					
Yes	130(94.9)	7(5.1)	0.800		
No	211(95.7)	10(4.5)			
Diarrhea in the last 2 weeks			0.506		
Yes	95(94.1)	6(5.9)			
No	246(95.7)	11(4.3)			
Fever in the last 2 weeks			0.972		
Yes	182(95.3)	9(4.7)			
No	159(95.2)	8(4.8)			
Sanitation facility			0.961		
Unimproved	259(95.2)	13(4.8)			
Improved	82(95.3)	4(4.7)			

DISCUSSION

The study assessed the prevalence and determinants of undernutrition in children under the age of five years in Bagwai community. It showed the prevalence of underweight was 24.5%, stunting 62% and wasting 4.8%. The proportion of children who are stunted is much higher than the 37% national average reported by the Nigerian Demographic and Health survey (2023), with the prevalence reaching 53.2% in the northwest region.⁶ The figures for underweight and wasting are slightly higher than the national figures of 27% and 7% respectively. A systematic review to determine the prevalence and determinants of malnutrition in Nigeria revealed that the highest prevalence of underweight, wasting and stunting were 43.3%, 29.3% and 41%, respectively.²³ While another review that explored the disparities of malnutrition in Nigeria and potential problems revealed that stunting remained alarmingly high ranging from 7.2% (Osun, Southwest) to 61% (Kaduna, North Central), while wasting varied from 1% (Ibadan, Southwest) to 29% (FCT Abuja, Central) and underweight from 5.9% (Osun, Southwest) to

42.6% (Kano, Northwest) respectively.²⁴ A study in Ghana to determine the contributing factors of malnutrition also showed that 35.9% of children under 5 years were underweight, 13.9% stunted and 33.9% wasted, indicating that the prevalence of stunting in this study is alarmingly high, and wasting is the least prevalent indicator in all the studies.¹⁸ Similar to this study, a study in rural farmland in Ogun state found a prevalence of stunting, underweight and wasting of 70%, 24%, and 8%, respectively.²⁵ Another study in Kebbi also showed that stunting was high (60%) indicating that childhood stunting is a key issue in northern Nigeria that warrant special public health and community-wide attention.²⁶ Children affected by stunting can suffer severe irreversible physical and cognitive damage that accompanies stunted growth. The devastating consequences of stunting can last a lifetime and even affect the next generation.⁴

Undernutrition prevalence also varies with children's age, the current study shows that both stunting and underweight were mostly common within the age group 24-35months while wasting was found to be most prevalent in children aged

12-23 months. Similar to our findings, Obasohan *et al*²⁷ also observed that the odds of children aged 24–35 months developing malnutrition were two times the odds of children 6–11 months of age. Similarly, Amoah *et al*¹⁸ also observed that the likelihood of being underweight among children aged 24-35 months was nearly two times higher than children under 24 months. Similar conclusions were reached in previous studies that reported an increase in the age of the children has a harmful effect on poor nourishment for the children.²⁸⁻⁴⁰ The possible explanation for this difference is that as the child grows older, less attention is paid to their nutritional requirement and overall welfare compared with the youngest child.

Stunting and underweight were commoner in males compared to females; wasting was also commoner in males compared to males. This is similar to other studies where malnutrition was commoner in the male children than females.^{27,41} The current study found that compared to the female child, the male child is almost two times more likely to be underweight and also the odds of stunting in male children is almost two times that of females. In the fixed effect analysis, the study found that female children have considerably decreased odds of being poorly nourished than their male counterparts.²⁷ The same findings were reported in previous studies on malnutrition.^{26,27,42-54} Contrary to these findings, Amoah *et al*¹⁸ observed that the female child was 8 times more likely to be underweight compared to their male counterpart and was consistent with other findings.⁵²

A high level of education of mothers also guarantees better female independence and in turn affects decisions that border on health, and consequently improvement of child nutritional status.⁵ Mothers with high level of education tends to utilize health care facilities better with the high implementation of improved medical practices. The current survey revealed that the odds of underweight was almost 10 times higher in women with primary education compared to women with tertiary education. This position is consistent with other studies who posited that child malnutrition and mother's education are indirectly correlated as well as studies that

substantiated the result on maternal education.^{7,42,52,54}

Several studies have shown an independent association between the incidence of common illnesses such as diarrhea, cough and cold and the development of malnutrition. Acute infections can lead to weight loss and being underweight can suppress immunity, increasing the risk of infections resulting in a vicious cycle of disease and poor nutrition.^{47,55-61} However, this study showed that odds of underweight amongst those that had diarrhea in the last 2 weeks and those that did not was almost the same. This is contrary to other studies that found children who had diarrhea two weeks before the survey were more likely to be poorly nourished than children who did not have the illnesses.^{27,29,30}

The current survey showed that children living in households with unimproved sanitation are two times more likely to be underweight than those in households with improved sanitation. This finding is consistent with a case-control study in Pakistan, which showed significant association between pour/pit/open sewer and malnutrition.⁶¹ Children with access to ventilated improved pit latrines (VIPs) or flush toilets had a decreased risk of malnutrition. Unhygienic conditions such as open defecation and pour or pit latrine are associated with malnutrition according to many studies conducted in rural settings.⁶²

This study highlights the critical factors contributing to the high prevalence of malnutrition, particularly stunting, in Northern Nigeria. Male children, older age groups (24-35 months), low maternal education and poor sanitation facilities were identified as significant predictors of stunting. Comprehensive community-based strategies integrating these factors will be critical in combatting the high rates of stunting and fostering healthier, more resilient children. However, this study is limited by its cross-sectional design. There is potential for recall bias in the self-reported data, as well as the possibility of measurement errors.

CONCLUSION

These findings emphasize the multidimensional nature of undernutrition, involving both

biological and socio-environmental determinants. Efforts to reduce stunting should prioritize improving access to female education, enhancing sanitation facilities, and addressing gender disparities in child health outcomes, as envisioned in global sustainable development goals. Furthermore, early interventions targeting older age groups and promoting proper nutrition and hygiene practices are essential to prevent stunting and its long-term impacts on child health and development.

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