Dietary Diversity, Nutritional Knowledge and Nutritional Status of In-school Adolescents in Makurdi, Local Government Area, Benue State

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ABSTRACT

Background: *The burden of malnutrition among adolescents continues to rise all over the world.*
Objective: *This study assessed the dietary diversity, nutritional knowledge, and nutritional status of in-school Adolescents in Makurdi, Benue State.*
Methodology: *This cross-sectional study employed a multi-stage sampling technique to select 200 adolescents (boys and girls) between the ages of 10- 19 years in selected secondary schools in Makurdi, Benue State. A structured interviewer-administered questionnaire was used to collect data on socio-demographics, nutritional knowledge, and dietary diversity. Anthropometric measurements such as weight and height were taken. Weight was measured using a digital weight scale, while height measurements were obtained by the use of a stadiometer. Data were cleaned, coded in Microsoft Excel, and analysed using SPSS version 25. Body mass index for age Z-score (BMIAZ) and height-for-age (HAZ) Z-scores were generated using the WHO AnthroPlus software.*
Results: *Out of 200 adolescents, more than half (59.5%) were females, and the majority (72%) were predominantly Tiv. 64% had good nutritional knowledge, and more than half (65.5%) had high dietary diversity. The major food groups consumed were grains, roots/tubers, pulses, nuts/seed, milk/milk products, meats/poultry/fish, vegetables, and fruits. About 67% had normal BMI-for-age, 33% were overweight or obese, 22.5% were stunted, and 12.5% were underweight. There was no association between nutritional knowledge and nutritional status; BMIAZ (p=0.757), HAZ (p=0.056). There was no significant association between dietary diversity and nutritional status; BMIAZ (P=0.951), HAZ (p=0.280).*
Conclusion: *Adolescents exhibited high dietary diversity, good nutrition knowledge, and a high prevalence of overweight/obesity. School-based nutrition education is recommended to improve adolescent nutrition.*

Keywords: Adolescents, Dietary diversity, Nutritional knowledge, Nutritional status, Malnutrition

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INTRODUCTION

Adolescence is a transitional phase from childhood to adulthood, and as defined by the World Health Organization, adolescents are a group of persons between the ages of 10 and 19 years [1, 2]. Adolescents make up about one-fifth of the total world's population and 25% of Nigeria's population [3]. Currently, the world faces a triple burden of malnutrition characterized by undernutrition (stunted growth), overweight, and micronutrient deficiencies occurring simultaneously in an individual [4, 5]. Globally, malnutrition affects approximately 31.1% of adolescent boys and 8% of adolescent girls (49 million), with 1 in every 4

adolescent girls being anaemic, and the prevalence increases by 84.6% among pregnant adolescents. Also, 31.1% of 1 in 4 middle and late female adolescents are stunted, while almost 1 in 7 adolescents are overweight or obese [6, 7, 8]. In Africa, the burden of malnutrition among adolescents is particularly pronounced, with a substantial proportion (10%) of adolescents experiencing both undernutrition and overnutrition [9, 10]. The malnutrition prevalence in southern Nigeria showed that 7.3% were underweight, 22.0% were overweight, 49.3% were obese, 5.7% were mildly stunted, and 1.5% were severely stunted [11, 12]. In Northern Nigeria (Kano), Malnutrition accounts for an overall 60.6% underweight, with a higher prevalence among boys (63.0%) than girls (58.7%), 41.6% for stunting, and 9.6% overweight [13, 14].

The adolescent stage is a crucial period when good nutrition and optimal diet quality are required to establish healthy dietary behaviours [15]. Despite this, malnutrition prevalence amongst adolescents continues to increase, thereby posing a significant public health challenge. Adolescents lack adequate nutrition knowledge to decide on healthy food choices, and their diet quality is poor [16, 17]. Their diet is mostly monotonous, characterized by starchy staple foods, high intakes of fast foods (consisting mainly of fat and sugar), and very low intakes of fruits and vegetables [18, 11]. Other factors such as unavailability, unaffordability, false perception of healthy foods, and socioeconomic boundaries further worsen the situation [19].

Poor diet quality is one of the largest contributors to the global burden of non-communicable diseases and is considered a key modifiable risk factor for chronic diseases [20]. It could result in several detrimental health problems such as micronutrient deficiencies, heart diseases, and osteoporosis in old age [21]. In girls, it can result in an intergenerational cycle of malnutrition, as it can affect their health and that of their children later in life [22, 23]. It can also impair learning and academic achievement [24].

Adolescent nutrition has been largely neglected in policy and research, as many of the existing nutrition programs tend to focus on infants, young children, and pregnant women [25]. The few available studies focused solely on adolescent girls [26, 27, 23], leaving a significant gap in addressing the needs of boys. Therefore, this study assessed the diet diversity, nutritional knowledge, and status of in-school adolescents in Makurdi, Benue State.

METHODS

Study Design

The study employed a cross-sectional design that spanned from January to May 2025.

Study Area and Setting

The study was conducted in Makurdi Local Government Area, the capital city of Benue State, Nigeria. Makurdi is an urban and peri-urban settlement located along the River Benue and serves as an administrative, educational, and commercial hub within the state. Padopas Day Secondary School and Government Day Secondary School in Makurdi Local Government Area were used.

Study Target and Population

The study consisted of adolescents aged 10-19 years enrolled in Government Day Secondary School and Padopas Secondary School

Sample Size and Technique

The sample size was determined using Fischer's (1991) formula [28] with Z=1.96, a malnutrition prevalence of 13.8%, and a 5% margin of error. The calculated minimum sample size was 183, and after the addition of 10% non-response/attrition, a final sample size of 200 adolescents was derived. A multi-stage sampling technique was used to select participants. Makurdi Local Government Area was purposively selected, and two (2) council wards were selected from the council wards in Makurdi using a simple random sampling technique. Within the selected council wards, two communities were chosen randomly. Two public junior and senior secondary schools were then selected from the list of registered secondary schools within the selected communities obtained from the Benue State Ministry of Education. Six (6) classes (JSS-SSS3) were selected purposively, and 33-34 eligible adolescents in each class who met the inclusion criteria were randomly chosen from the class registers until the required sample size was achieved.

Inclusion Criteria

Adolescents (boys and girls) aged 10-19 years of age, in JSS1-SS3, who have been in the selected schools for at least one year, with informed assent or parental consent, and are physically and mentally fit were included in the study

Exclusion Criteria

Adolescents with medical conditions or chronic illness and those without parental consent or assent forms were excluded

Ethical Consideration

Ethical approval with reference number (NTD/REF04/01) was obtained from the Benue State Ministry of Education. Parental consent and adolescent assent were obtained. The nature of the study was explained to the study participants, and they were assured of the confidentiality of their data. Confidentiality of data was maintained by assigning identification codes to questionnaires instead of participants' names and reporting results in aggregate forms without revealing individual identities. Participants were also allowed to withdraw from the study at any point

Data Collection Procedure

Data were collected between March and October 2025 using an interviewer-administered questionnaire. The questionnaire consisted of questions on socio-demographic characteristics, dietary diversity, and nutritional knowledge. Two (2) research assistants (Nutritionists and Dietitians) were recruited due to their expertise in nutrition assessments, dietary data collection, anthropometric measurements, and their ability to ensure accurate and standardized administration of study instruments

Dietary Diversity

Dietary Diversity Score was assessed using the FAO Individual Dietary Diversity Score (IDDS) questionnaire. A total of nine (9) food groups were considered: (1) grains, roots, and tubers, (2) pulses, (3) nuts/seeds, (4) dairy, (5) meat and fish, (6) eggs, (7) dark green leafy vegetables, (8) other vitamins A fruits and vegetables, and (9) organ meat. Commonly consumed foods in the locality were incorporated into each food group. For each food group, a response category was "Yes" if at least one food item in the group was consumed and "No'' if it was not consumed in the last 24 hours prior to the study. A response of " Yes " was awarded 1 point, and a response of ''no'' was awarded 0 points. Finally, the results were summed and classified into low dietary diversity scores (DDS) if food items consumed were <5 and high dietary diversity scores if they were ≥ 5 [30].

Nutritional Knowledge (NK)

It was assessed based on FAO guidelines for assessing nutrition-related knowledge, attitude and practices using a modified 10-question questionnaire. Each question was answered with either 'yes or no'. Each question with a ''yes'' response scored 1 point, and a 'No' response scored 0 points. Based on the overall NK score, participants were classified into three levels of NK: poor NK (≤5 points), average NK (6–7 points), and good NK (≥8 points) [18]

Anthropometric Measurement

Body weight was measured using a calibrated digital weighing scale placed on a firm, level surface. Before each measurement, the scale was checked and set to zero. Participants were asked to remove their shoes, heavy clothing, and any items from their pockets to minimize measurement error. They were instructed to stand upright in the center of the scale platform with their feet slightly apart, arms hanging freely at their sides, and body weight evenly distributed on both feet while looking straight ahead. The reading was taken only after the display stabilized and was recorded to the nearest 0.1 kg. To ensure accuracy, the scale was recalibrated periodically throughout the data collection process [29].

Height was measured using a portable stadiometer placed on a flat, stable surface. Participants were asked to remove their shoes, hats, and any hair accessories that could interfere with the measurement. They stood erect on the stadiometer platform with their heels together, legs straight, arms relaxed at their sides, and shoulders level. The heels, buttocks, shoulder blades, and the back of the head were positioned against the vertical board where possible, while the head was aligned in the Frankfurt plane (the lower margin of the eye socket in line with the upper margin of the ear canal). The movable headpiece was gently lowered until it touched the crown of the head, compressing the hair slightly. Height was recorded to the nearest 0.1 cm [30]. Nutritional status was established using height-for-age Z-scores (Stunting <−2) and Body mass index for age BMIAZ (thinness <-2.0, overweight >1.0, and obesity >2.0) [33].

Data Analysis

Data were analyzed using SPSS version 25. Anthropometric data were analysed using W.H.O AnthroPlus software (version 1.0.4), and descriptive statistics were used to present analysed data, while Chi-square tests established associations between nutrition knowledge, diet diversity and nutritional status. Significance was set at $p < 0.05$.

RESULT

Socio-Demographic Characteristics of Adolescents

Nearly half (49.0%) of the respondents (49.0%) were aged between 18-19 years, 40.0% were within 14-17 years, and 11.0% were aged 10-13 years. More females (59.5%) participated in the

study compared with males (40.5%). The majority (72.0%) of the adolescents were Tiv, followed by Idoma (18.0%), Igbo (4.0%), Igede (3.5%), Hausa (1.5%), and Yoruba (1.0%). More than a quarter of their mothers (37.5%) had attained secondary and post-secondary education (35.0%), while 15% and 12% had no formal education or only primary education (Table 1)

Table 1: Socio-Demographic Characteristics of Adolescents

Variables	Frequency (200)	Percentage (100)
Age (years)		
10-13	22	11.0
14 - 17	80	40.0
18 - 19	98	49.0
Gender		
Male	81	40.5
Female	119	59.5
Ethnicity		
Tiv	144	72.0
Idoma	36	18.0
Igede	7	3.5
Yoruba	2	1.0
Igbo	8	4.0
Hausa	3	1.5
Educational level of mother		
None	31	15.5
Primary	24	12.0
Secondary	75	37.5
Post-Secondary	70	35.0
Educational level of father		
None	28	14.0
Primary	23	11.5
Secondary	58	70.7
Post-Secondary	91	45.4
Occupation of mother		
None	23	11.5
Business/trading	122	61.0
Civil servant	18	9.0
Teacher	10	5.0
Artisan	4	2.0
Farmer	23	11.5
Occupation of father		
None	21	10.5
Business/trading	80	40.0
Civil servant	53	26.5
Teacher	12	6.0
Artisan	6	3.0
Farmer	28	14

Dietary Diversity of Adolescents

Grains were the most commonly consumed food group (80.5%), while 19.5% weren't consumed. Consumption of white roots, tubers, and plantain was reported by 60.5%, and 55.5% consumed pulses (beans, lentils, legumes). Nuts and seeds were consumed by 58.0% of adolescents, while 54.0% consumed milk and milk products. About 69.5% consumed meat, poultry, and fish; 66.0% consumed dark green leafy vegetables; 53.0% consumed other vitamin A-rich fruits and vegetables; and 59.5% consumed other fruits, as seen in Table 2. The dietary diversity score revealed that 65.5% had high dietary diversity while 34.5% had low dietary diversity, as reflected in Figure 1.

Table 2: Dietary Diversity of the Adolescents

Variables	Frequency (200)	Percentage (%)
Grains		
Yes	161	80.5
No	39	19.5
White roots, tubers and plantain		
Yes	121	60.5
No	79	39.5
Pulses		
Yes	111	55.5
No	89	44.5
Nuts and seeds		
Yes	116	58.0
No	58	42.0
Milk and milk products		
Yes	108	54.0
No	92	46.0
Meat, poultry and fish		
Yes	139	69.5
No	61	30.5
Eggs		
Yes	96	48.0
No	104	52.0
Dark green leafy vegetable		
Yes	132	66.0
No	68	34.0
Other vitamin A-rich fruits and vegetables		
Yes	106	53.0
No	94	47.0
Other fruits		
Yes	113	59.5
No	87	43.5

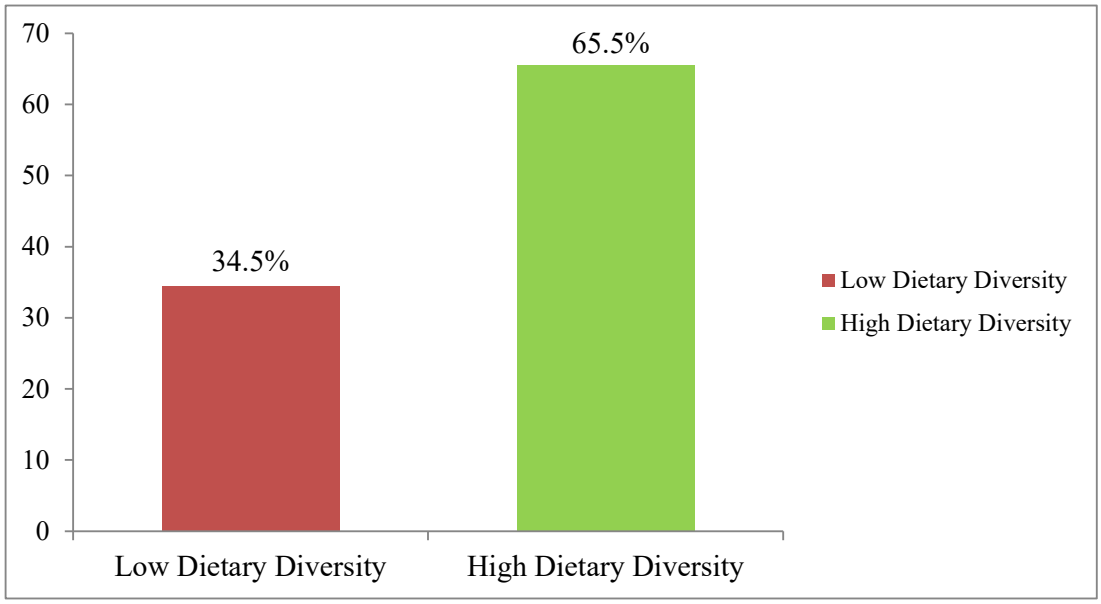

Figure 1: Dietary Diversity of Adolescents

Nutritional Knowledge of Adolescents

Most adolescents (92.0%) correctly understood that a balanced diet contains all nutrients needed by the body in adequate proportions and were also aware of food groups that provide energy to the body (92.0%). Most adolescents (89.5%) rec-

ognized that eating breakfast provides energy, while 4.5% believed breakfast was not necessary and 6.0% did not know its importance. Knowledge of protein function was high, with 91.5% correctly identifying growth and repair as its major function, whereas 4.0% associated it with vision and 4.5% with digestion. The nutritional knowledge score revealed that 64% of adolescents had good nutrition knowledge, 24% average, and 12% poor, as shown in Figure 2.

Table 3: Nutritional Knowledge of the Adolescents

Variables	Frequency (200)	Percentage (%)
A balanced diet contains all the nutrients needed by the body in adequate proportion		
Yes	184	92.0
No	16	8.0
Awareness of food groups that provide the body with energy		
Yes	184	92.0
No	16	8.0
Iron is essential for the prevention of anemia		
Yes	138	62
No	69	31.0
Nutrient deficiency could arise as a result of inadequate food intake		
Yes	172	86.0
No	28	14.0
Frequency consumption of fruits and vegetables		
Daily	125	62.5
2-3 times/week	39	19.5
Rarely	11	5.5
I don't know	25	12.5
Vitamin essential for strong bones		
Vitamin C	102	51
Vitamin D	32	16
Calcium	48	24
I don't know	18	9.0
Importance of eating breakfast		
Energy	179	89.5
Not necessary	9	4.5
I don't know	19	6.0
Function of protein in the body		
Growth and repair	183	91.5
Vision	8	4.0
Digestion	9	4.5
It is beneficial to consume different foods		
Yes	153	76.5
No	47	23.5
Digestion		
Inadequate food intake have an effect on the body		
Yes	125	62.5
No	75	37.5

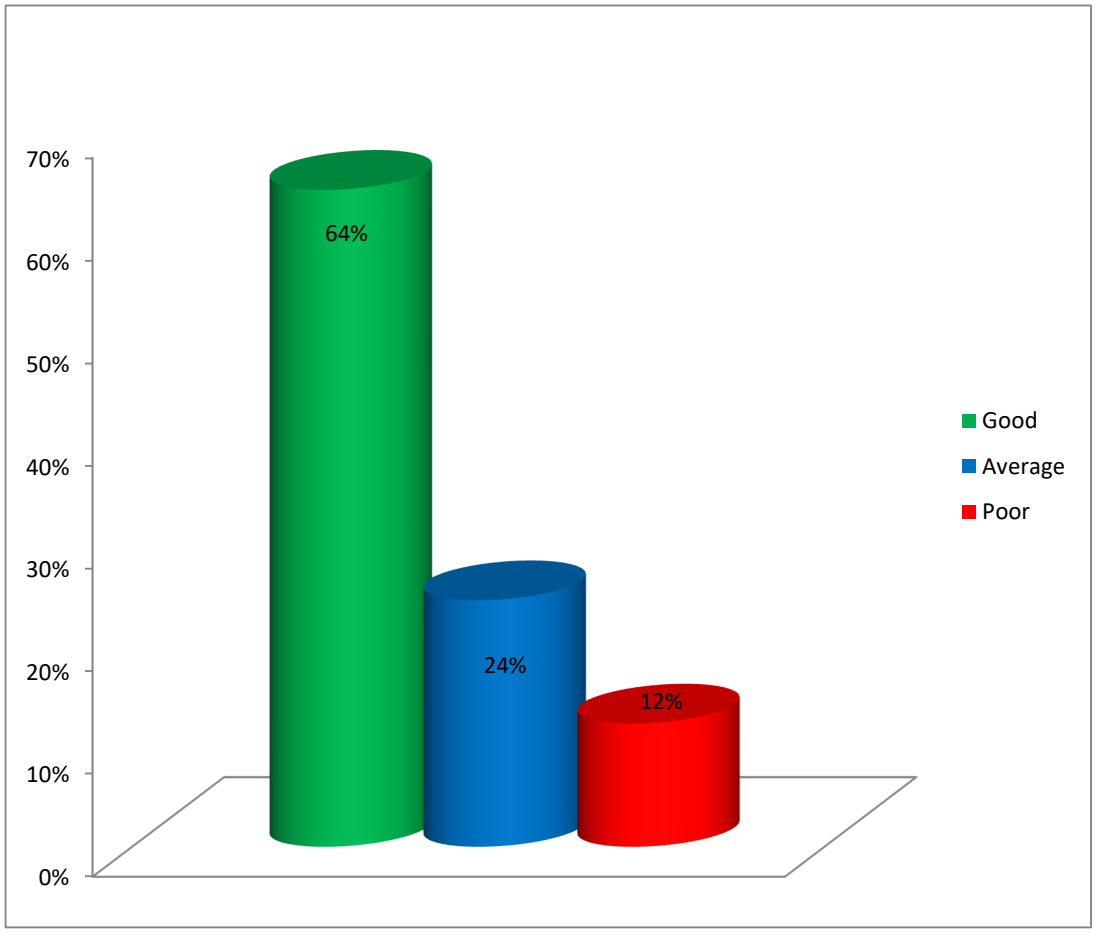

Figure 2: Nutritional Knowledge of Adolescents

Nutritional Status of Adolescents

For BMIAZ, 67% of adolescents fell within the normal range while 25% were overweight and 8% obese, with no cases of thinness recorded. Similarly, height-for-age z-scores revealed that 77.5% of respondents were of normal stature, whereas 14.5% and 8% exhibited moderate and severe stunting, respectively, as shown in Table 4.

Table 4: Nutritional Status of Adolescents

Nutritional Status	Frequency (200)	Percentage (100)
BMIAZ		
Thinness (< -3SD and <-2SD)	0	0.0
Normal (> -2SD and <+1SD)	134	67.0
Overweight(> +1SD and +2SD)	50	25.0
Obesity (>+2SD)	16	8.0
HAZ		
Severe stunting (<-3SD)	16	8.0
Moderate stunting (> -3SD and < -2SD)	29	14.5
Not stunted (> -2SD)	155	77.5

Association between Nutritional Knowledge, Dietary Diversity and Nutritional Status of Adolescents

The majority (43.0%) of respondents with good nutritional knowledge were nourished, followed by overweight (15.5%) and obese (5.5%). Among adolescents with average nutritional knowledge, 21.0% were nourished, 7.5% were overweight, and 2.5% were obese. Only 3.0% of respondents with poor nutritional knowledge were nourished,

2.0% were overweight, while none were obese. The association between nutritional knowledge and BMIAZ was not statistically significant (p = 0.757). For HAZ, adolescents with good nutritional knowledge had the highest proportion (51.5%) of not being stunted, followed by moderate stunting (8.5%) and severe stunting (4.0%). The association between nutritional knowledge and HAZ was not significant (p = 0.056). Furthermore, the majority (43.5%) of adolescents with high dietary diversity had normal nutritional status. Among adolescents with low dietary diversity, 23.5% had normal nutritional status. The association between dietary diversity and BMIAZ was not statistically significant (p = 0.951). Most adolescents (53.0%) with high dietary diversity were not stunted, compared to 24.5% with low dietary diversity. The association between dietary diversity and HAZ was also not statistically significant (p = 0.280), as seen in Table 5.

Table 5: Association between Nutritional Knowledge, Dietary Diversity and Nutritional Status of Adolescents

Variables	Nutritional knowledge			χ^2	p-value
	Good N (%)	Average N (%)	Poor N (%)		
BMIAZ				**1.883**	**0.757**
Thinness (<-3SD and <-2SD)	0(0.0)	0(0.0)	0(0.0)		
Normal (>-2SD and <+1SD)	86(43.0)	42(21.0)	6(3.0)		
Overweight (>+1SD and +2SD)	31(15.5)	15(7.5)	4(2.0)		
Obesity (>+2SD)	11(5.5)	5(2.5)	0(0.0)		
HAZ				**9.193**	**0.056**
Severe stunting (<-3SD)	8(4.0)	6(3.0)	2(1.0)		
Moderate stunting (>-3SD and <-2SD)	17(8.5)	8(4.0)	4(2.0)		
Not stunted (>-2SD)	103(51.5)	48(24.0)	4(2.0)		
Dietary diversity				**1.365**	**0.505**
High	41(20.5)	25(12.5)	3(1.5)		
Low	87(43.5)	37(18.5)	7(3.5)		

DISCUSSION

The study assessed the diet diversity, nutritional knowledge, and status of in-school adolescents in Makurdi, Benue State. A good proportion of adolescents involved in the study were between ages 17-19 years, with a higher proportion being females. This finding aligns with similar studies in the U.K [34] and in Ethiopia [35]. Female participation in school-based nutrition surveys tends to be higher due to their greater availability and compliance during data collection. The predominance of the Tiv ethnic group mirrors the population distribution in Makurdi and its environs, where agriculture and small-scale trading are the main occupations.

Findings from this study indicate that a majority of the adolescents maintained a reasonably adequate diet variety, suggesting that most have access to sufficient meals and are likely meeting part of their nutritional requirements. High diversity among most participants may also reflect positive dietary habits, improved household food security, or heightened nutrition awareness, especially among those who have received formal nutrition education in this study. This finding is higher than the 56.7% adequate dietary diversity in Ethiopia among adolescents [12]. However, the 34.5% with inadequate dietary diversity represent a significant proportion at risk of nutrient deficiencies and poor growth outcomes. The prevalence of inadequate dietary diversity is lower than the 53.5% inadequate dietary diversity in Nigeria, 84.7% in Ghana [36], and 52.6% in Kathmandu Valley [16].

Nutritional knowledge score in this study suggests that a majority of the respondents possess a commendable level of understanding regarding nutrition and dietary principles. The high proportion of good knowledge implies effective exposure to nutrition-related information, possibly through formal education, media, and health campaigns. Such awareness can positively influence dietary behaviours, food selection, and overall nutritional well-being. The findings are higher than those of [37], who reported a 54.6% level of nutritional knowledge among high school students in the province of Ontario, Canada, and [27], who documented 57.5% nutritional knowledge among adolescents in Abeokuta, Nigeria. However, the percentage with average knowledge represents a substantial segment that may not consistently translate nutritional awareness into practice. This group may benefit from reinforcement through continuous education and behaviour change communication strategies to improve comprehension and practical application of nutritional principles. The adolescent with poor knowledge reflects a vulnerable subset at risk of making inappropriate dietary choices. Although small, this group's presence underscores the need for tar-

geted intervention, particularly through tailored nutrition education programs addressing identified gaps in understanding.

Adolescents are nutritionally vulnerable, especially to malnutrition because of their increased nutritional needs, eating patterns, lifestyles, and susceptibility to environmental influence [38, 39]. The finding that two-thirds of adolescents had normal BMIAZ is encouraging, suggesting that a majority fall within healthy growth parameters. However, the coexistence of stunting, underweight, overweight, and obesity in this adolescent population poses substantial implications for both short- and long-term health outcomes. The notable proportion of overweight and obese adolescents (33% combined across indicators) could be linked to increased consumption of energy-dense foods, sedentary lifestyles, and reduced physical activity, which raises concerns about emerging non-communicable diseases (NCDs) such as type 2 diabetes, hypertension, dyslipidemia, and cardiovascular disorders [2]. The finding is higher compared to the 20.4% stated in a study in Lagos, Nigeria [40]. Conversely, no case of thinness was recorded based on BMIAZ, suggesting that acute malnutrition is minimal within this population, which could be attributed to the adequate consumption of various food groups as reflected in the dietary diversity score in this study. Nonetheless, stunting affected 22.5% of the adolescents (8% severe, 14.5% moderate), implying chronic exposure to nutritional deficiencies during early childhood or prolonged inadequate dietary intake. Stunting reflects cumulative nutritional deprivation and recurrent infections, both of which compromise physical growth and cognitive performance [41]. This prevalence of stunting (22.5%) in this study is higher than the 11.8% stated in Zanzibar [42] and 9.8% in Uyo, Akwa Ibom State [43].

Furthermore, the study found no significant association between nutritional knowledge and nutritional status ($p>0.05$). This suggests that while adolescents may possess theoretical understanding of good nutrition, behavioural factors, peer influence, taste preferences, and food availability might overshadow knowledge in determining actual food choices [44]. This finding corroborates the report of an Indonesian study on the Associations between nutrition knowledge, protein-energy intake, and nutritional status of adolescents [45], as weak correlations were found between nutrition knowledge and BMI among adolescents, reinforcing the argument that improving knowledge alone is insufficient without supportive environmental and behavioural interventions. Another study that aligns with our result is in Ibadan [11]. Furthermore, no statistically significant association was found between dietary diversity and nutritional status ($p>0.05$). This observation may reflect the complexity of adolescent nutrition, where body weight outcomes are shaped by multiple interacting factors beyond food variety. Energy balance, sedentary behaviour, physical activity, access to ultra-processed foods, household socioeconomic status, and adolescent growth spurts may exert stronger influence on BMI than dietary diversity alone [46]. The absence of a significant association is consistent with findings from previous studies which reported that dietary diversity improves nutrient intake but does not consistently predict anthropometric outcomes among adolescents [47]. The findings of HAZ are biologically plausible because HAZ reflects accumulated nutritional and health experiences over a prolonged period rather than recent dietary intake. The finding agrees with previous evidence indicating that stunting is a chronic condition that often persists despite improvements in current dietary practices [13, 48].

CONCLUSION

The study revealed that adolescents demonstrated high dietary diversity and a relatively high level of nutritional knowledge. The high nutritional knowledge could be due to increased exposure to nutrition information, which translated to better dietary behaviours and may have contributed to the favourable dietary diversity. However, despite these positive indicators, the study identified a high burden of overweight and obesity. The consequences of this burden are deleterious, as it can increase the risk of non-communicable diseases, psychological and emotional consequences, etc. There was no significant association between nutritional knowledge and nutritional status. Also, dietary diversity was not significantly associated with nutritional status. School-based nutrition education programmes should be strengthened to move beyond knowledge dissemination and focus on practical behaviour change strategies. Regular physical activity should be encouraged, and parents/caregivers should be engaged in nutrition interventions to reinforce healthy dietary and lifestyle practices at the household level.

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AUTHOR'S CONTRIBUTION

Gwadza Msendoo Patience: Conceptualization, data curation, analysis and interpretation, project administration, writing (Original draft, review and editing)

Dada Israel Olanrele: Conceptualization, supervision, validation, writing (review and editing)

Talabi Yetunde Justina: Supervision, Review and editing

Onyekweli-Ugeh Chioma Nonyelum: Review and editing

Adedayo Oyeyemi Elizabeth: Review and editing

DISCLOSURE AND CONFLICT OF INTEREST

The authors declare no conflicts of interest

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