

Nutritional Status of Adolescents in Public and Private Secondary Schools in Asaba, Delta State, Nigeria

ABSTRACT

This study aimed to compare the nutritional status of adolescents in private and public secondary schools in Asaba, Delta State. A cross-sectional analytical design was conducted among 282 adolescents from private day, private boarding and public secondary schools, selected by multistage sampling technique. Anthropometrics measures and socio-demographic characteristics data were collected using pretested questionnaire. Using WHO-reference-2007, height, BMI and weight-for-age were measured for stunting, wasting and underweight respectively and BMI-for-age for overweight and obesity. The collected data were entered in to Microsoft Excel and exported to SPSS for further statistical analysis. Chi-square test at 95% confidence interval (CI) was used to quantify independent variables of nutritional indices. The mean age of the students in public, private day, and private boarding schools were 14.28 ± 2.79 , 13.54 ± 2.24 , and 14.04 ± 2.53 years, respectively. The prevalence of stunting, thinness, underweight, normal weight and overweight among public school participants was 31, 35, 29, 71, 0% respectively; that of private day school participants was 34, 45, 29, 63, 9%, respectively whereas that of private boarding school participants was 39, 47, 23, 61, 16%, respectively. These differences in the underweight and obesity were statistically significant ($p < 0.05$). Statistical analyses revealed significant associations ($p < 0.05$) between socioeconomic levels and underweight, highlighting the vulnerability of adolescents from lower socio-economic backgrounds. The influence of poverty on stunting was particularly pronounced within private boarding schools. The result also showed that there was no significant association between thinness, stunting, underweight and eating patterns among adolescents in all school types, however, significant association were observed for overweight. Thus, nutrition interventions to improve nutritional status of the adolescents through providing comprehensive nutritional assessment and counseling services at community, school, and health facility levels, and creating household's income-generating activities are recommended before they reach conception to break the intergenerational cycle effect of malnutrition.

Keywords: Nutritional status; Adolescent; Schools; Malnutrition

INTRODUCTION

An adolescent is a young person who is typically between the ages of 10 and 19 years old. An adolescent is also a person who is in the stage of development between childhood and adulthood. This stage typically begins with the onset of puberty, which marks the physical and hormonal changes that occur during this period. Adolescence is that period of life in which an adolescent learns healthy eating pattern which in future leads to healthy nutritional status of an adolescent. An estimated 20% of the total world population are adolescents and 22% of the population in Nigeria according to the 2006 census report [1]. Adolescents are viewed as a group of people who are at risk of nutritional deficiencies. This is because they are inclined to unhealthy and nutritionally deficient choices, lack of physical activity, and mental stress, which have an impact on their behavior and way of life. Consequently,

nutrition plays a vital role in the growth and development of adolescents, during which the establishment of healthy dietary habits and lifestyle practices is of significant importance.

Quality education plays a crucial function in the advancement of the economy, society, and politics. Presently, simply enrolling adolescents in educational institutions is insufficient, the government must guarantee that adolescents achieve fundamental proficiency and abilities required for individual welfare. Educational institutions play a significant role in shaping the child's consciousness and character. Nutrition is also an essential aspect of human well-being, existence, and cognitive growth throughout the complete lifespan [2]. As well, malnutrition is considered a pressing problem that affects the ability of children to learn and could make them perform at a lower level in school [3].

Malnutrition is still prevalent globally with the coexistence of both overnutrition and undernutrition in developed countries affecting people of all ages [4, 5]. Adolescents are a vulnerable group for malnutrition and its consequences due to rapid growth and development and changes in dietary habits that may have influenced their nutrient intake [6]. Malnutrition in adolescents occurs in different forms, particularly undernutrition including underweight for age, too short for age (stunted), too thin relative to height (wasted), and functionally deficient in vitamins and minerals [7]. Globally, over 340 million children and adolescents aged 5-19 years are overweight and obese [8]. Obesity among children and adolescents is about one out of 10 [1]. Adolescents are at an increased risk for under nutrition in low- and middle-income countries such as Nigeria because of poverty and inadequate food intake.

Adolescents have become more vulnerable to malnutrition due to insufficient attention from health programs and nutrition interventions. Despite being the last chance to prevent undernutrition and break the cycle of malnutrition, they are often considered low-risk for poor health and receive little attention. Nutrition interventions have mainly focused on infants and pregnant/lactating women, leaving out adolescents who have additional nutrient demands for growth and development. This has led to a lack of information on adolescent nutrition, making it difficult for officials to develop appropriate strategies. Lack of physical activity and consuming calorie-rich junk food has also caused obesity and other metabolic disorders among adolescents, which has negatively impacted their nutritional status in Nigeria. At the same time, an increasing occurrence of obesity and the chronic diseases associated with it is being witnessed in developed nations among adolescents. In certain developing countries, half of all children and adolescents are unable to reach their full genetic growth potential

because of insufficient nutrition, frequent illnesses, and lack of access to healthcare [9]. In developing countries, adolescents experience a dual burden of malnutrition.

The prevalence and pattern of various types of malnutrition such as wasting, stunting, overweight and obesity vary within regions in Nigeria. Abdulkarim *et al.* [10] reported overall prevalence of wasting, stunting, overweight and obesity among school going adolescents, 10–19 years studying in various schools in Abuja Municipal area to be 1.7%, 11.3%, 13.2% and 1.7%, respectively. On the other hand, Kola-Raji *et al.* [1] reported prevalence of stunting, underweight, normal weight, overweight and obesity among adolescents in private school in Ibadan to be 2.5%, 39.3%, 51.9%, 8.0% and 0.8% respectively, whereas that of public-school adolescents was 8.4%, 37.1%, 60.1%, 2.4% and 0.0%. Berhe *et al.* [11] reported the pooled prevalence of stunting and underweight to be 20.7% and 27.5% respectively. The consequences of undernutrition in adolescents include delayed growth, intellectual development, and increased risk of various health problems. Research has shown that factors such as rural/urban differences, socioeconomic status, lifestyle habits, and physical activity levels are associated with malnutrition in adolescents [12].

In many developing nations, efforts to improve nutrition have primarily concentrated on children and women, disregarding adolescents. Meeting the nutritional requirements of adolescents may be a crucial move towards ending the cycle of malnutrition, long-term illnesses, and destitution that passes from one generation to another. Conversely, investigations into the causal factors of malnutrition among adolescents have been conducted in various regions, including Ibadan [1], Abuja [10], Aba [13], Kano [14] and Umahia [15]. However, it is noteworthy that no analogous studies have been undertaken in Asaba, Delta State. It is important to address the nutritional needs of adolescents as it can accelerate economic development. The objective of this study was to assess the nutritional status of adolescents in public and private secondary schools in Asaba, Delta State.

METHODOLOGY

Research design: The study adopted a cross sectional analytical design.

Area of the Study: The study was conducted in Asaba, which is the capital city of Delta State in Nigeria. Asaba is situated on the western bank of the Niger River, with an estimated population of 407,126 people. It spans an area of approximately 762 square kilometers (294 sq. miles) in the northern region of Delta State, located between latitude 06o141-6o151N and

longitude 06°40'E-6°45'E in West Africa. The city is bounded on the east and northeast by the river Niger and on the west by the rolling slopes of the Asaba plateau.

Study Population: The study population comprised of adolescents in private and public Secondary Schools in Asaba that are registered under the ministry of basic and secondary education.

Inclusion criteria included:

- i. All private and public secondary schools operating in Asaba.
- ii. Adolescents within a specific age range, such as 10-19 years old.
- iii. All adolescent boys and girls attending private and public secondary schools in Asaba.

Exclusion criteria included:

- i. Adolescents who are seriously ill.
- ii. Schools not registered by the state ministry of education
- iii. Adolescents who are unwilling for anthropometric measurements.
- iv. Adolescents whose parents refused to give their consent.

Sample and Sampling Technique

Sample Size: The minimum sample size was determined using the formula for comparative designs below [16].

$$N = \frac{[Z_{\alpha} + Z_{\beta}]^2 2p(1-p)}{d^2}$$

Where N= Minimum sample size for each group

Z_{α} = Percentage point of normal distribution corresponding to the two (two sided) significance level. In this case, significance level is 5%, Z_{α} = 1.96

Z_{β} = Power of the test, which is conventionally 80%, Z_{β} = 0.84

p= Population proportion estimated to adolescent malnutrition from previous study which is 26.7% or 0.267 [1].

1-p= the variance of the proportions= 1-0.267= 0.733

d= the minimum difference to be detected by the study (20%) = 0.2

Substituting in the formula therefore:

$$N = \frac{[1.96 + 0.84]^2 2 * 0.267 * 0.733}{0.2^2} = \frac{2.972}{0.04} = 74$$

10% was added to take care of Attrition = 74+8= 82

Furthermore, to enhance the precision of research findings, the researcher decided to augment the sample by including an extra 12 adolescents. It is widely recognized that increasing the

sample size improves the accuracy of research findings, a principle supported by established research methodologies.

Sample size = Public school (94) + Private day (94) + Private boarding (94) =282 adolescents.

Sampling Technique

A multistage sampling method was employed in this study.

Stage one: Selection of Secondary Schools: A Comprehensive list of schools registered in the ministry of basic and secondary education was obtained. The list contains a total number of seventy-day secondary schools. This comprise of 13 public schools and 57 private schools. A simple random sampling technique was used. Five schools were selected from the public and fourteen from the private secondary schools (seven day and seven boarding schools, respectively) using balloting method.

Stage Two: Selection of Class arm to be studied

A minimum of 13 students from each private schools and 20 students from public schools were selected from each school. From each of the six classes in each secondary school, simple random sampling technique by balloting was used to select a class arm of students for the study.

Stage Three: Selection of students

A systematic sampling technique was used, four students were required from each selected class arm from the public and private schools. A class list containing the names of every student in the selected class arm was obtained. This formed the sampling frame.

Data Collection Instrument: The study instrument was a semi-structured questionnaire, weighing scale and stadiometer. The instrument was titled “nutritional status of adolescents in private and public secondary schools in Asaba, Delta State”. The instrument was developed to cover three (3) sections. Section A: Socio-demographic characteristics; Section B: anthropometric measures and Section C: Factors affecting adolescents’ nutritional status.

Scoring and Interpretation of Variables/Outcome Measures

- a) **Nutritional Status:** This was obtained using the Body Mass Index (BMI), a measure of body fat based on a person's weight and height. A BMI score of less than 18.5 indicates underweight, 18.5-24.9 indicates normal weight, 25-29.9 indicates overweight, and over 30 indicates obesity.

- b) Prevalence of malnutrition:** The prevalence of stunting, wasting and underweight was calculated by dividing the number of children with stunted growth, wasting, underweight, overweight and obesity by the total number of children in the population being assessed.
- c) Types of Malnutrition:** A weight-for-height score below -2 standard deviations (-2SD) from the reference median indicates moderate underweight, while a score below -3SD indicates severe underweight. A weight-for-height score below -2 standard deviations (-2SD) from the reference median indicates moderate wasting, while a score below -3SD indicates severe wasting. A height-for-age score below -2 standard deviations (-2SD) from the reference median indicates moderate stunting, while a score below -3SD indicates severe stunting. A weight-for-height score above +1 standard deviation (+1SD) from the reference median indicates overweight, while a score above +2SD indicates obesity [17].
- d) Factors associated with the nutritional status:** Poverty levels of the adolescents was measured by wealth status comprising of dwelling characteristics such as floor material, source of drinking water, type of house, and toilet facilities. Nutritional knowledge of the adolescents was assessed using objective structured questions on nutrition. The questions assessed their knowledge on nutrition terms of good health, water intake, diet and disease. For a score-based indicator of knowledge, each respondent was given a score based on the number of correct responses provided and ranked from 0-15 points.
- For item 1, 5, 6, 7, 8, 11, 14 and 15 each response was scored as follows: “Yes” = 1 point “No” = 0 point. This mean that the sequencing of these items is related to food that the adolescent should eat and be recommended to do. For item 2, 3, 4, 9, 10, 12 and 13 each response was scored as follows: “Yes” = 0 point “No” = 1 point. This mean that the sequencing of these items is related to understanding about nutrition that the adolescents should not eat and not be recommended to do. The criterion of knowledge level was based on the percentage of knowledge score and classified into three groups following Bloom’s criteria [18].
- Score 0-8 (<60%) = Poor knowledge
 - Score 9-12 (60-80%= Moderate knowledge
 - Score 13-15 (<80%) = Good knowledge

Reliability of the Instrument: The reliability of the instrument was established using Cronbach Alpha method. A trial test was performed and scores were subjected to Cronbach Alpha statistical reliability test to determine the reliability index of the instrument. The result of the analysis of 0.75 indicated that the instrument was reliable.

Data Collection and Administration: The researcher obtained a letter of introduction from the Head of Department, Community Medicine and Primary Health to the selected schools. Then the researcher also wrote a letter seeking for permission from Delta state ministry of basic and secondary education to carry out the research in the selected schools. The researcher administered the questionnaires to the respondents in their class rooms.

Data Analysis: After data collection, data was thoroughly screened, reviewed, compiled and checked for its completeness, consistency and accuracy by the researcher and the data analysis was done as per the objectives of the study. Editing, classifying, coding and entry of data was done using Microsoft Excel and analysis carried out using Statistical Product Service Solution (SPSS) version 23.0. Descriptive analysis such as frequencies, percentage and means were calculated. Categorical variables were presented as frequency and percentages. Association between categorical variables like nutritional status, types of malnutrition and prevalence of malnutrition was determined using Chi-square test of association. Level of significance was determined at p value =0.05.

RESULTS

Demographic Characteristics of the Adolescents

The demographic characteristics of the adolescents are presented in Table 1. A total of 282 adolescents took part in the study. The mean age \pm standard deviation (SD) of the study participants in public, private day, and private boarding schools were 14.28 \pm 2.79, 13.54 \pm 2.24, and 14.04 \pm 2.53 years, respectively. Regarding gender distribution, slightly less than two-fifths, 108 (38.30%), of the participants were males, while the majority, 174 (61.70%), were females. In terms of academic levels, the majority were in JSS3 (72 or 25.53%) and SS1 (73 or 25.89%), followed by 31 (10.99%) in JSS1, 44 (15.60%) in JSS2, 33 (11.70%) in SS2, and 29 (10.28%) in SS3. Regarding religious affiliation, the majority, 226 (80.14%), identified as Christians, 41 (14.54%) as Muslims, and 15 (5.32%) belonged to other religions.

Table 1. Demographic and socioeconomic-related characteristics of school's adolescents in Asaba, Delta State ($n = 282$)

Variables	Public		Private Day		Private Boarding	
	N (94)	%	N (94)	%	N (94)	%
Age						
10 -13	35	37.23	42	44.68	45	47.87
14 – 16	40	42.55	37	39.36	32	34.04
17 – 19	19	20.21	15	15.96	17	18.09
Mean \pm SD	14.28 \pm 2.79		13.54 \pm 2.24		14.04 \pm 2.53 \pm 2.53	
Sex						
Male	33	35.11	33	35.11	42	44.68
Female	61	64.89	61	64.89	52	55.32
Class						
JSS1	12	12.77	10	10.64	9	9.57
JSS2	9	9.57	16	17.02	19	20.21
JSS3	33	35.11	11	11.70	28	29.79
SS1	19	20.21	36	38.30	18	19.15
SS2	11	11.70	11	11.70	11	11.70
SS3	10	10.64	10	10.64	9	9.57
Religion						
Christian	94	100.00	71	75.53	61	64.89
Islam	-	-	23	24.47	18	19.15
Others	-	-	-	-	15	15.96

Prevalence and types of malnutrition among adolescents in Asaba, Delta State

Table 2 shows the prevalence and types of malnutrition among adolescents in Asaba, Delta State. The prevalence of thinness ($BAZ < -2$ SD) among students in public, private day, and private boarding schools was 35%, 45%, and 47%, respectively ($p > 0.05$). Regarding stunting ($HAZ < -2$ SD), the overall prevalence rates were 31%, 34%, and 39% for public, private day, and private boarding schools, respectively ($p > 0.05$). Concerning overweight, the prevalence was 8% in private day schools and 16% in private boarding schools, with no overweight recorded in public schools ($p < 0.000$). Notably, obesity was not observed in any of the adolescents across all school types. The prevalence of severe thinness ($BAZ < -3$ SD) was 2% for both public and private day schools, with none recorded for private boarding schools. The prevalence of severe stunting was 3% and was only observed in public schools ($p < 0.000$). In terms of the nutritional status of the adolescents according to the body mass index (BMI), 29% of adolescents from public and private day schools were underweight, respectively, while 23% of adolescents from private boarding schools were underweight ($p = 0.030$).

Table 2. Anthropometric status of study participants of school adolescents in Asaba, Delta State (N = 282)

Variables	Categories	Public		Private Day		Private Boarding		p-value
		N (94)	%	N (94)	%	N (94)	%	
Height for age (Stunting)	Severe stunting	3	3	-	-	-	-	0.000
	Moderate stunting	26	28	32	34	37	39	0.640
	Not stunted	65	69	62	66	57	61	0.984
BMI (kg/m ²)	Underweight (<18.5 kg/m ²)	27	29	27	29	22	23	0.030
	Normal weight (>18.5 kg/m ²)	67	71	59	63	57	61	0.823
	Overweight (>25 kg/m ²)	-	-	8	9	15	16	0.000
	Obesity (>30 kg/m ²)	-	-	-	-	-	-	-
Weight for age (thinness)	Severely thin	2	2	2	2	-	-	0.000
	Moderately thin	31	33	40	43	44	47	0.367
	Normal	61	65	52	55	50	53	0.849

Factors associated with thinness, stunting, underweight and overweight of adolescents

Factors associated with stunting among school adolescents' in Asaba, Delta State

The findings extracted from Tables 3 and 4 offer valuable insights into the factors associated to stunting among school adolescents in Asaba, Delta State. The study examined a range of factors across different types of schools: public, private day, and private boarding. Regarding poverty levels, the chi-square (χ^2) value was found to be 0.203, 1.144 and 7.372 for public, private day and private boarding schools, respectively and p-value=0.203, 0.564 and 0.025 which showed no significant association between stunting and poverty levels among adolescents in public and private day schools. However, a significant association between high poverty levels and stunting was observed in private boarding schools ($p=0.025$). Socioeconomic levels also emerged as significant factors, with low socioeconomic levels being connected to stunting in private day schools ($p=0.004$). In terms of nutritional knowledge, the chi-square (χ^2) value was found to be 3.933, 2.011 and 2.051 for public, private day and private boarding schools, respectively and p-value=0.140, 0.366 and 0.359 which showed no significant association between stunting and poverty levels among adolescents in all school types. Similarly, eating patterns did not reveal significant associations with stunting in public and private day schools. Nonetheless, a significant association was noted in private boarding schools ($p=0.067$).

Table 3. Factors associated with stunting among school adolescents' in Asaba, Delta State

Factors	Public		Private Day		Private Boarding	
	Yes	No	Yes	No	Yes	No
Poverty levels						
High	2 (2.13%)	6(6.38%)	17(18.09%)	33(35.11%)	10(10.64%)	4(4.26)
Medium	23(24.47%)	49(52.13%)	13(13.83%)	21(22.34%)	2(2.13%)	6(6.38%)
Low	4(4.26%)	10(10.64%)	2(2.13%)	8(8.51%)	25(26.60%)	47(50.00%)
Socioeconomic levels						
High	-	-	6(6.38%)	33(35.11%)	17(18.09%)	33(35.11%)
Medium	16(17.02%)	38(40.43%)	22(23.40%)	22(23.40%)	10(10.64%)	12(12.77%)
Low	13(3.19%)	27(28.72%)	4(4.26%)	7(7.45%)	10(10.64%)	12(12.77%)
Nutritional knowledge						
High	7(7.45%)	22(23.40%)	5(5.32%)	7(7.45%)	2(2.13%)	7(7.45%)
Moderate	15(15.96%)	37(39.36%)	25(12.77%)	45(47.87%)	25(26.60%)	31(32.98%)
Low	7(7.45%)	6(6.38%)	2(2.13%)	10(10.64%)	10(10.64%)	19(20.21%)
Eating pattern						
Excellent	-	2(2.13%)	7(7.45%)	10(10.64%)	12(12.77%)	12(12.77%)
Fair	27(28.72%)	63(67.02%)	17(18.09%)	41(43.62%)	18(19.15%)	28(29.79%)
Poor	2(2.13%)	-	8(8.51%)	11(11.70%)	7(7.45%)	17(18.08%)

Table 4. Chi-square tests for the association with between poverty levels, socioeconomic status, nutritional knowledge, eating pattern and stunting among school adolescents' in Asaba, Delta State

Factors	Public		Private day		Private boarding	
	χ^2	p-value	χ^2	p-value	χ^2	p-value
Poverty levels	0.203	0.904	1.144	0.564	7.372	0.025
Socioeconomic status	0.089	0.766	11.063	0.040	1.287	0.526
Nutritional knowledge	3.933	0.140	2.011	0.366	2.051	0.359
Eating pattern	5.406	0.067	1.514	0.469	2.184	0.336

Factors associated with Thinness among school adolescents' in Asaba, Delta State

The findings, as presented in Table 4, illuminate the factors connected with thinness among school adolescents in Asaba, Delta State. The study investigated various factors across three types of schools: public, private day, and private boarding. Regarding poverty levels, the chi-square (χ^2) value was found to be 3.624, 2.165 and 11.042 for public, private day and private boarding schools, respectively and p-value=0.163, 0.339 and 0.040 which showed no significant association between thinness and poverty levels among adolescents in public and private day schools. However, within private boarding schools, a significant association between high poverty levels and thinness was observed ($p=0.004$). Socioeconomic levels also demonstrated a significant association with thinness, as low socioeconomic levels were correlated with thinness in public schools ($p=0.066$). In terms of nutritional knowledge, no significant associations were found across the school types. The chi-square (χ^2) value was found to be 0.913, 4.261 and 2.240 for public, private day and private boarding schools, respectively and p-value=0.633, 0.119 and 0.326 which showed no significant association between thinness and nutritional knowledge among adolescents in all school types. Regarding eating pattern, the chi-square (χ^2) value was found to be 4.796, 4.976 and 0.913 for public, private day and private boarding schools, respectively and p-value=0.091, 0.083 and 0.634 which showed no significant association between thinness and eating patterns among adolescents in all school types.

Table 5. Factors associated with thinness among school adolescents' in Asaba, Delta State

Factors	Public		Private Day		Private Boarding	
	Yes	No	Yes	No	Yes	No
Poverty levels						
High	4(4.26%)	4(4.26%)	23(24.47%)	27(12.77%)	12(12.77%)	2(2.13%)
Medium	27(28.72%)	45(47.87%)	12(12.77%)	22(23.40%)	4(4.26%)	4(4.26%)
Low	2(2.13%)	12(12.77%)	6(6.38%)	4(4.26%)	27(12.77%)	45(47.87%)
Socioeconomic levels						
High	-	-	27(28.72%)	12(12.77%)	23(24.47%)	27(28.72%)
Medium	15(15.96%)	39(41.49%)	21(22.34%)	23(24.47%)	8(8.51%)	14(14.89%)
Low	18(19.15%)	22(23.40%)	5(5.32%)	6(6.38%)	12(12.77%)	10(10.64%)
Nutritional knowledge						
High	9(9.56%)	20(21.28%)	5(5.32%)	7(7.45%)	5(5.32%)	4(4.26%)
Moderate	18(19.15%)	34(36.17%)	34(36.17%)	34(36.17%)	28(29.79%)	28(29.79%)
Low	6(6.38%)	7(7.45%)	2(2.13%)	10(10.64%)	10(10.64%)	19(20.21%)
Eating pattern						
Excellent	-	2(2.13%)	8(8.51%)	9(9.56%)	12(12.77%)	12(12.77%)
Fair	31(32.98%)	59(62.77%)	29(30.85%)	29(30.85%)	22(23.40%)	24(25.53%)
Poor	2(2.13%)	-	4(4.26%)	15(15.96%)	9(9.56%)	15(15.96%)

Table 6. Chi-square tests for the association with between poverty levels, socioeconomic status, nutritional knowledge, eating pattern and thinness among school adolescents' in Asaba, Delta State

Factors	Public		Private day		Private boarding	
	χ^2	p-value	χ^2	p-value	χ^2	p-value
Poverty levels	3.624	0.163	2.165	0.339	11.042	0.040
Socioeconomic status	2.992	0.084	4.492	0.106	1.468	0.480
Nutritional knowledge	0.913	0.633	4.261	0.119	2.240	0.326
Eating pattern	4.796	0.091	4.976	0.083	0.913	0.634

Factors associated with Underweight among school adolescents' in Asaba, Delta State

Tables 7 and 8 shows the factors associated with adolescent underweight in Asaba, Delta State. Regarding poverty levels, the chi-square (χ^2) value was found to be 9.104, 8.322 and 7.724 for public, private day and private boarding schools, respectively and p-value=0.001, 0.004 and 0.023 which showed a significant association between underweight and poverty levels among adolescents in all school types. Furthermore, a significant association was established between socioeconomic levels and underweight in all schools. The chi-square (χ^2) value was found to be 9.451, 6.941 and 10.431 for public, private day and private boarding schools, respectively and p-value=0.001, 0.032 and 0.001. In terms of nutritional knowledge, no significant associations were found across the school types. The chi-square (χ^2) value was found to be 1.731, 2.043 and 2.211 for public, private day and private boarding schools, respectively and p-value=0.167, 0.302 and 0.302. On the other hand, a significant statistical association was observed pertaining to eating patterns and underweight across public ($p=0.020$), private day ($p=0.050$), and private boarding ($p<0.001$) schools.

Table 7. Factors associated with underweight among school adolescents' in Asaba, Delta State

Factors	Public		Private day		Private Boarding	
	Yes	No	Yes	No	Yes	No
Poverty levels						
High	2(2.13%)	18(19.15%)	13(13.83%)	40(42.55%)	6(6.38%)	16(17.02%)
Medium	27(28.72%)	47(50.00%)	6(6.38%)	17(18.09%)	-	-
Low	-	-	4(4.26%)	14(14.89%)	16(17.02%)	56(59.57%)
Socioeconomic levels						
High	-	-	6(6.38%)	19(20.21%)	12(12.77%)	51(54.26%)
Medium	19(20.21%)	36(38.30%)	15(15.96%)	42(44.68%)	6(6.38%)	12(12.77%)
Low	10(10.64%)	29(30.85%)	2(2.13%)	10(10.64%)	4(4.26%)	9(9.57%)
Nutritional knowledge						
High	11(11.70%)	21(22.34%)	5(5.32%)	16(17.02%)	-	-
Moderate	12(12.77%)	29(30.85%)	14(14.89%)	46(48.94%)	14(14.89%)	53(56.38%)
Low	6(6.38%)	15(15.96%)	4(4.26%)	9(9.57%)	8(8.51%)	19(20.21%)
Eating pattern						
Excellent	-	-	4(4.26%)	11(11.70%)	4(4.26%)	14(14.89%)
Fair	27(28.72%)	52(55.32%)	15(15.96%)	47(50.00%)	14(14.89%)	45(47.87%)
Poor	2(2.13%)	13(13.83%)	4(4.26%)	13(13.83%)	4(4.26%)	13(13.83%)

Table 8. Chi-square tests for the association with between poverty levels, socioeconomic status, nutritional knowledge, eating pattern and underweight among school adolescents' in Asaba, Delta State

Factors	Public		Private day		Private boarding	
	χ^2	p-value	χ^2	p-value	χ^2	p-value
Poverty levels	9.104	0.001	8.322	0.004	7.724	0.023
Socioeconomic status	9.451	0.001	6.941	0.032	10.431	0.001
Nutritional knowledge	1.731	0.167	2.043	0.302	2.211	0.302
Eating pattern	6.348	0.020	4.976	0.050	9.631	0.001

Factors associated with overweight among school adolescents' in Asaba, Delta State

Tables 9 shows the factors associated with adolescent overweight in Asaba, Delta State. Regarding poverty levels, the chi-square (χ^2) value was found to be 10.233 and 9.213 for private day and private boarding schools, respectively and p-value=0.001 and 0.003 which showed that there was an association between poverty levels and the occurrence of overweight. A significant association was also identified between socioeconomic levels and overweight within private day ($p=0.023$) and private boarding ($p<0.001$) schools. Adolescents stemming from lower socioeconomic backgrounds exhibited higher odds of being overweight in comparison to those with higher and medium socioeconomic backgrounds.

Furthermore, the study highlights a statistically significant association between nutritional knowledge and overweight within private day ($p=0.004$) and private boarding ($p=0.020$) schools. Adolescents possessing poor nutritional knowledge demonstrated greater odds of being overweight when compared to those with limited nutritional knowledge, as opposed to individuals with moderate and high nutritional knowledge. Regarding eating patterns, the chi-square (χ^2) value was found to be 8.011 and 9.305 for private day and private boarding schools, respectively and p-value=0.005 and 0.002 which showed that there was an association between eating patterns and the occurrence of overweight. Adolescents with inadequate eating patterns were more prone to experiencing overweight compared to their peers with fair and moderate eating patterns.

Table 9. Factors associated with overweight among school adolescents' in Asaba, Delta State

Factors	Public		Private Day		Private Boarding					
	Yes	No	Yes	No	χ^2	P-value	Yes	No	χ^2	P-value
High	-	-	4	45	10.233	0.001	-	-	9.213	0.003
Medium	-	-	4	41			2	22		
Low	-	-	-	-			13	57		
Socioeconomic levels					9.102	0.023			11.212	0.001
High	-	-	4	35			11	54		
Medium	-	-	2	22			2	12		
Low	-	-	2	29			2	13		
Nutritional knowledge					9.751	0.004			10.543	0.020
High	-	-	-	-			-	-		
Moderate	-	-	4	44			8	42		
Low	-	-	4	42			7	37		
Eating pattern					8.011	0.005			9.305	0.002
Excellent	-	-	-	-			2	21		
Fair	-	-	6	51			10	33		
Poor	-	-	2	35			3	25		

DISCUSSIONS

From the results of this study, the percentage of stunting in public schools, private boarding and private day were found to be 31%, 32% and 37%, respectively. The percentage of stunting was higher in the private boarding schools and lower in the public schools, however, no significant ($p>0.05$) relationship existed. The overall average percentage of stunting across all participants was reported as 34.8%. This prevalence of stunting is slightly lower than that reported by Esimai and Ojofeitimi [19] among the adolescents in Port Harcourt (36.3%). This prevalence is higher than that of Nwoke *et al.* [13], who reported stunting prevalence of 7% and 25% among adolescent boys in private and public schools, respectively in Aba, Abia State. This stark contrast highlights the considerable disparities in adolescent nutritional status even within the same country. This could be attributed to regional variations in socio-economic conditions, dietary patterns, cultural practices, and healthcare access, reaffirming the need for targeted interventions tailored to specific contexts. The higher prevalence of stunting in private boarding schools suggests chronic under-nutrition, which might result in slowing the metabolic process of maturation [20]. This could be due to the living environment which could influence dietary habits. Adolescents living away from home might have fewer opportunities to make healthy food choices due to limited control over their diets.

Lack of parental oversight on dietary choices could lead to less balanced diets and potentially contribute to stunting.

The prevalence of thinness in public schools, private boarding schools, and private day schools was identified as 35%, 43%, and 47%, respectively. Similarly, the occurrence of thinness was greater in private boarding schools and lower in public schools; however, no statistically significant relationship was observed ($p > 0.05$). Factors such as limited physical activity, sedentary behaviours, and sleep patterns in boarding schools might influence metabolic rates and energy expenditure, potentially leading to thinness. The overall average percentage of thinness across all participants was documented as 42.2%. This prevalence is comparatively lower when contrasted with the findings of Ejike *et al.* [15] reporting 24.2% prevalence among adolescent boys in the eastern region of Nigeria. Furthermore, the prevalence reported here falls below the rate of 60.6% reported by Mijinyawa *et al.* [14] for adolescents in Kano. This substantial difference emphasizes the diverse nutritional challenges faced by adolescents across different regions within the same country. Socio-economic factors, cultural practices, and regional disparities likely contribute to these variations in prevalence rates.

The occurrence of being underweight in public schools, private boarding schools, and private day schools was identified as 29%, 29%, and 23%, respectively. The prevalence of underweight was higher in private day and public schools, and lower in private boarding schools ($p < 0.030$). The overall average percentage of overweight among all participants was recorded as 28.7%. This prevalence is comparatively lower when contrasted with the prevalence of 39.3% reported by Kaji-Raji *et al.* [1] in both private and public boarding secondary schools in Ibadan. However, it is slightly higher than the prevalence of 21% reported by Nwoke *et al.* (2017) for adolescents in Aba, Abia State. The findings of this study also diverge from those of Kaji-Raji *et al.* [1], who reported a higher prevalence of underweight in public schools than in private schools. This discrepancy was attributed to inadequate social and healthcare services within the country. Several factors could potentially contribute to the observed higher prevalence of underweight among adolescents in public schools compared to their counterparts in private boarding schools, as revealed by this study. These factors encompass socio-economic conditions, access to nutrition, healthcare disparities, and environmental influences.

In the study, it was found that 71% of adolescents in public schools had a normal weight, while the figures for private day and boarding schools were 63% and 61%, respectively.

These percentages exceeded the prevalence reported by Kola-Raji et al. [1], indicating a higher prevalence of normal weight among adolescents in this study. Notably, none of the adolescents in public schools were found to be overweight, with factors such as diverse socio-economic demographics and limited discretionary income potentially contributing to this trend. However, private boarding schools displayed a higher prevalence of overweight at 9%, while private day schools recorded 16%. This significant difference ($p < 0.001$) in prevalence can be attributed to the controlled environment of boarding schools, impacting dietary choices, access to physical activity, and exposure to various lifestyle factors. Private boarding schools typically cater to more affluent students, potentially leading to increased consumption of energy-dense, nutrient-poor foods and sedentary behaviors. The overall average percentage of overweight among all participants was 8.2%, which is relatively lower when compared to other studies, such as the 13.2% reported by Abdulkarim et al. [10] among adolescents in the Abuja Municipal area. These variations may be due to regional disparities in dietary habits, lifestyle, and socio-economic conditions. A similar study conducted by Musa et al. [21] in Benue found a prevalence of overweight at 9.7%, consistent with this study's findings. Although none of the adolescents were classified as obese, the study highlights the importance of considering the potential long-term health implications of overweight among adolescents.

The study highlights significant findings on poverty and stunting. It reveals that high poverty levels do not significantly associate with stunting across all school types, suggesting variations in the influence of poverty on stunting in different schools. Notably, a significant link between high poverty and stunting is observed in private boarding schools, emphasizing a more pronounced impact in this setting. Low socioeconomic levels are linked to stunting in private day schools, aligning with the findings of Jonah et al. [22] findings. However, Santosa et al. [23] reported inconclusive results regarding family socioeconomic and stunting. These disparities may be due to location, cultural practices, economic conditions, and healthcare systems, highlighting the role of socioeconomic factors in stunting, particularly in private day schools. This underlines the need for targeted interventions to address socioeconomic disparities among adolescents. Regarding nutritional knowledge, no significant differences are found across school types, suggesting consistent nutritional awareness, possibly reflecting the education system's effectiveness in imparting such knowledge to students. While high poverty levels did not show significant associations with thinness across all school types, a distinctive outcome emerged in private boarding schools. There, a significant link between

high poverty levels and thinness was observed, suggesting varying influences of poverty on thinness across different school settings, with private boarding schools showing heightened vulnerability. Socioeconomic levels also demonstrated trends related to thinness, with a significant association seen in public schools, potentially contributing to thinness among students. Notably, although the association did not reach statistical significance, exploring nutritional knowledge revealed a potential subtle connection with thinness, specifically in private day schools. Similarly, eating patterns and their association with thinness yielded significant insights, with a notable association identified in public schools, suggesting a role in thinness among these students.

The impact of poverty levels on underweight prevalence yielded noteworthy results, with significant associations observed across all school types. Adolescents from lower poverty levels demonstrated increased vulnerability to underweight compared to those from higher or medium poverty levels, emphasizing the influence of socioeconomic disparities on underweight prevalence regardless of school type. Similarly, lower socioeconomic backgrounds were linked to a heightened likelihood of underweight among school adolescents, in line with findings from Farooq et al. [24] and Galgamuwa et al. [25], emphasizing the importance of addressing socioeconomic inequalities in combating underweight across diverse educational settings. However, no significant association was found between nutritional knowledge and underweight, despite adolescents' generally satisfactory nutritional knowledge and predominantly normal nutritional status. This suggests that sound nutritional knowledge does not consistently translate into nutritious dietary choices, as habits and purchasing power also play a role. The study of Veronika et al. [26] also found no significant association between nutrition knowledge and nutritional status, highlighting the indirect impact of knowledge on nutritional intake compared to its more direct influence on status. Additionally, adolescents with suboptimal eating patterns were at a heightened risk of underweight compared to those with fair or moderate eating patterns, underscoring the role of dietary habits in shaping underweight prevalence across different school environments.

The study's findings on poverty levels and their impact on overweight reveal significant statistical associations, particularly within private day and private boarding schools. These associations indicate that adolescents from lower poverty levels are more susceptible to overweight compared to their peers from higher or medium poverty levels, emphasizing the importance of addressing economic disparities when combating overweight in these school

environments. Similarly, the study underscores the substantial influence of socioeconomic levels on the likelihood of overweight within private day and private boarding schools, with a statistically significant connection indicating that adolescents from lower socioeconomic backgrounds face elevated odds of being overweight compared to those with higher or medium socioeconomic backgrounds. These results align with the findings of Hoebel et al. [27], highlighting the global health challenge of overweight in adolescence and the well-established relationship between overweight and socioeconomic status. The study also elucidates the role of nutritional knowledge in relation to overweight, revealing a statistically significant association within private day and private boarding schools. This association emphasizes that adolescents with poor nutritional knowledge are more prone to being overweight compared to those with limited, moderate, or high nutritional knowledge. These findings support the idea that improving dietary knowledge among children and adolescents, as demonstrated by Wang et al. [33], can decrease the risk of overweight and obesity, emphasizing the importance of promoting nutritional education as a strategy to mitigate overweight risks in these school settings. Furthermore, the study emphasizes the significance of dietary habits in relation to overweight, with statistically significant associations in private day and private boarding schools. These associations reveal that adolescents with inadequate eating patterns face a higher susceptibility to overweight compared to those with fair or moderate eating patterns, aligning with the findings of Mu et al. [37]. These results underscore the role of dietary habits in contributing to overweight among students in these schools.

CONCLUSION

This study revealed varying prevalence rates among adolescents, including 42.2% for thinness, 34.8% for stunting, 28.7% for underweight, and 8.2% for overweight. Across school types, public schools had a stunting prevalence of 31%, private day schools exhibited 32%, and private boarding schools showed the highest at 37%. Overweight was absent in public schools, while private day schools reported 16% and private boarding schools 9%. For thinness, public schools had 35%, private day schools had 43%, and private boarding schools had the highest at 47%. Similarly, underweight prevalence was 29% in public schools, 23% in private day schools, and 29% in private boarding schools. Significant differences were observed in overweight and underweight among school types, while no associations were found for stunting and thinness. This study underscores the significance of thinness and stunting as public health concerns according to WHO criteria. It highlights the complex

relationship between poverty and stunting, particularly in private boarding schools. Socio-economic factors impact thinness, revealing vulnerabilities among adolescents from lower socio-economic backgrounds to underweight. Nutritional knowledge significantly influences overweight within private day and boarding schools, emphasizing its role. The study emphasizes the potential impact of nutritional knowledge on these conditions and the importance of eating patterns in underweight vulnerability. To address these concerns, collaboration with educational boards and health authorities is crucial for introducing structured physical activity sessions and engaging extracurricular activities in schools. This approach encourages regular exercise, helps maintain healthy body weights, and reduces the risk of obesity among adolescents in the study area.

Ethical Approval and Consent: Ethical approval for the study was obtained from the Human Research Ethics committee of Nnamdi Azikiwe University Awka. Informed consent was obtained freely without coercion from respondents and assuring them of respect for the confidentiality of the data obtained from them. The objective of the study was thoroughly explained to them and that they were free to opt-out of the study any time they wished to do so.

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