Prevalence, Knowledge, and Factors Affecting In-School Adolescent Obesity: Comparative Study of Urban and Rural Settings in Delta State

Jarikre O.E.[1,4], Ofili C.C.[1], Otutu M.O.[1], Esegbue P.R.C.[1], *Peter M.B.[2,3], Okafor T.P.[1]

[1]*Department of Public and Community Health, Novena University Ogume, Delta State, Nigeria*
[2]*Department of Human Nutrition and Dietetics, Ambrose Alli University Ekpoma, Nigeria*
[3]*Department of Dietetics, Irrua Specialist Teaching Hospital Irrua, Edo State Nigeria.*
[4]*Department of Community Medicine, Delta University Teaching Hospital, Oghara, Delta State, Nigeria.*

***Corresponding author:** peter.babangida20@aauekpoma.edu.ng **Phone number:** 08068088402

ABSTRACT

Background: *Adolescent obesity is an emerging public health issue in Nigeria, driven by urbanization, sedentary lifestyles, and socio-economic inequalities.*

Objective: *To compare obesity prevalence, knowledge of related comorbidities, and risk factors among in-school adolescents in urban and rural areas of Delta State.*

Methodology: *A comparative cross-sectional study was conducted among 954 adolescents (670 urban, 284 rural), selected through multistage sampling across 36 schools. Data on socio-demographics, behavioral risks, and knowledge of obesity-related comorbidities were collected using structured questionnaires. Body mass index (BMI)-for-age was determined using WHO standards. Data analysis utilized Chi-square and logistic regression in SPSS version 26.0, at $p < 0.05$ significance.*

Results: *Obesity prevalence was significantly higher among urban adolescents (14.7%) than their rural counterparts (4.3%) ($p < 0.05$), while rural adolescents exhibited a higher prevalence of underweight (38.7% vs. 14.9%). Urban adolescents reported significantly greater engagement in sedentary behaviors, including higher screen time and increased fast-food consumption. Knowledge of comorbidities was better among urban students (60.7% vs. 53.2%); however, only 6.9% of all respondents had good overall knowledge of obesity causes and prevention. Financial constraints emerged as the strongest predictor of obesity (OR = 1.384; 95% CI: 1.178–1.626; $p < 0.05$), followed by poor diet, reduced physical activity, and private school attendance.*

Conclusion: *Significant urban-rural differences exist in adolescent nutritional status and health knowledge. School-based and community-focused interventions addressing both under- and over-nutrition are crucial to mitigate these disparities and improve overall adolescent health outcomes.*

Keywords: *Adolescents, Comorbidities, In-School, Obesity, Urban-Rural Disparities*

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INTRODUCTION

Adolescent obesity has emerged as a critical global public health challenge, with a disproportionate rise now occurring in low- and middle-income countries (LMICs), including Nigeria, where undernutrition and overnutrition increasingly coexist within the same populations. This epidemiological transition reflects rapid urbanization, shifts in dietary patterns, and declining physical activity, which collectively redefine nutrition-related health risks among adolescents. Global surveillance data demonstrate that overweight and obesity among children and adolescents aged 5–19 years increased more than fourfold between 1975 and 2022, affecting over 390 million individuals worldwide. Notably, the

steepest upward trajectories are now observed in LMICs, particularly in sub-Saharan Africa, where health systems remain largely oriented toward infectious diseases and undernutrition rather than chronic disease prevention [1]. These trends suggest not only a growing burden but also a widening inequity in exposure, vulnerability, and capacity for response.

The public health significance of adolescent obesity extends beyond its immediate prevalence. Obesity during adolescence is a strong predictor of adult obesity and is independently associated with early onset of non-communicable diseases such as type 2 diabetes, cardiovascular diseases, and certain malignancies. Evidence indicates that metabolic alterations, insulin resistance, and vascular changes may begin during adolescence, thereby extending the life-course burden of disease and increasing future healthcare costs [2,3]. Consequently, rising adolescent obesity prevalence represents both a current and a future health threat, particularly in settings with limited preventive infrastructure.

In Nigeria, available evidence indicates a steady but uneven increase in adolescent obesity prevalence. Although national data remain fragmented, recent studies report notable variations across geographic and socio-economic contexts. A multicenter study spanning six geopolitical zones reported substantially higher prevalence rates of overweight and obesity among adolescents in urban areas compared with rural counterparts (12.2% versus 3.4%), underscoring the influence of urban living environments on obesity risk [4]. Similarly, school-based studies have shown higher prevalence among students attending private and urban schools, suggesting the role of socio-economic advantage, food environments, and lifestyle factors in shaping obesity patterns [4]. These findings highlight that prevalence figures alone may obscure critical contextual drivers unless examined alongside environmental and behavioral determinants.

Beyond prevalence, adolescents' knowledge of obesity particularly its causes, health consequences, and preventive strategies plays a pivotal role in early intervention and risk reduction. However, existing evidence suggests a disconnect between awareness and accurate, actionable knowledge. While many adolescents recognize the term "obesity," fewer demonstrated an understanding of its associated comorbidities or preventive behaviors. For example, only a small proportion of secondary school students were able to correctly identify both the causes and health consequences of obesity in previous studies [5]. Furthermore, reliance on social and electronic media as primary information sources may contribute to misinformation or superficial understanding, limiting adolescents' ability to adopt effective preventive practices [6]. This gap underscores the need to critically assess not just what adolescents know, but the depth and quality of that knowledge.

The determinants of adolescent obesity are complex and multidimensional, encompassing socio-demographic, behavioral, and environmental factors. Higher socio-economic status has been associated with increased access to energy-dense foods, screen-based entertainment, and sedentary lifestyles, particularly in urban settings [7]. Conversely, adolescents from lower-income households may experience obesity through different pathways, including limited access to affordable healthy foods, unsafe environments that restrict physical activity, lower parental nutrition literacy, chronic stress, and increased exposure to ultra-processed foods [8]. Psychosocial influences such as peer norms, stress, and body image perception further interact with these structural factors to shape dietary behaviors and weight outcomes [9].

Urban–rural disparities remain especially salient in understanding adolescent obesity dynamics in Nigeria. Urban adolescents are more likely to encounter obesogenic environments characterized by fast-food availability, aggressive food marketing, and reduced opportunities for physical activity. In contrast, rural adolescents may face limited access to health information, preventive services, and structured physical activity programs, which may delay recognition and management of obesity-related risks [10]. These contrasting contexts suggest that uniform interventions are unlikely to be effective and that localized, context-sensitive strategies are required.

Despite increasing research attention, there remains a paucity of comparative studies in Nigeria that simultaneously examine obesity prevalence, adolescents' knowledge of obesity-related comorbidities, and the socio-behavioral factors influencing risk across urban and rural settings. Much of the existing literature focuses either on prevalence alone or on urban populations in isolation, limiting comprehensive understanding of the interrelationships between knowledge, environment, and behavior [11].

Addressing this gap is essential for informing targeted and equitable public health interventions.

Therefore, this study aims to compare the prevalence of obesity, assess adolescents' knowledge of obesity-related comorbidities, and identify key socio-demographic and behavioral factors influencing obesity among adolescents in urban and rural settings of Delta State, Nigeria.

METHODS

Study design

This was a comparative and descriptive cross-sectional study conducted in secondary schools across urban and rural areas of Delta State, Nigeria. The study aimed to assess socio-demographic characteristics and behavioral factors, obesity prevalence, and knowledge of obesity-related comorbidities among in-school adolescents.

Study population and sampling

This study was conducted among in-school adolescents in selected secondary schools across urban and rural settings in Delta State, Nigeria. The target population comprised students aged 10–19 years enrolled in junior and senior secondary classes.

Sample size determination and sampling procedure

A minimum sample size of 954 participants was estimated using the formula for comparing two proportions: $n = (Z1\text{-alpha}/2 + Z1\text{-beta})^2 \times P1(1 - P1) + P2(1 - P2) / (P1 - P2)^2$. Plugging in these values, the minimum required sample size was approximately 244 per group. To account for a 10–15% non-response rate and larger school enrollment in urban areas, the sample was increased to 670 for urban and 284 for rural respondents, resulting in a total sample size of 954.

A stratified random sampling technique was adopted to ensure representativeness. The sampling process followed four main steps:

Schools were stratified into two major strata—urban and rural—based on their geographical location. Within each stratum, further stratification was done by school type (public versus private) and class level (junior versus senior secondary school), yielding four sub-strata per setting.

From a comprehensive list provided by the State Ministry of Basic and Secondary Education, four urban and three rural schools were randomly selected using simple random sampling (balloting).

Within selected schools, classes were selected using simple random sampling (balloting method) to participate in the study.

Student selection

Eligible students in the classes were selected proportionally using systematic sampling with an interval of every 5th student selected to administer the questionnaire (class register as sampling frame) until the required sample size per stratum was met.

Inclusion criteria were enrollment in the selected schools aged between 10 and 19 years. Students with known chronic illnesses affecting weight (e.g., endocrine disorders) were excluded.

Data collection

Data were collected using a structured, interviewer-administered questionnaire and anthropometric measurements. The questionnaire was developed based on previous validated instruments from similar adolescent obesity studies [12] and adapted to the Nigerian context to ensure cultural relevance.

Instrument design and content

The questionnaire consisted of four sections: Section A was used to assess Socio-demographic information; Section B was used to assess knowledge of obesity and related comorbidities; Section C was used to assess lifestyle factors and dietary habits and Section D assessed perceived barriers to obesity prevention (i.e., factors influencing obesity prevalence).

Validity and reliability

Content validity was ensured by having three experts, one each in public health, adolescent medicine, and clinical nutrition review the instrument. To assess internal consistency, Cronbach's alpha was calculated, and the knowledge scale achieved a reliability coefficient of 0.78, which is considered acceptable. Feedback gathered during the pre-test phase was used to improve question clarity, refine language, and adjust the overall length of the instrument. For respondents in rural areas, the final version of the questionnaire was translated into Pidgin English or the local dialect where necessary and administered by trained field workers.

Anthropometric measurements

Height was measured using a portable stadiometer, with participants standing upright, barefoot, and looking straight ahead.

Measurements were taken to the nearest 0.1 cm. Weight was assessed using a calibrated digital scale, with participants wearing minimal clothing and no footwear or headgear. Readings were recorded to the nearest 0.1 kg. Body Mass Index (BMI) was then calculated as weight in kilograms divided by height in meters squared (kg/m^2). Obesity was determined using WHO age- and sex-specific BMI percentiles, with values at or above the 95th percentile classified as obesity.

Knowledge assessment

Knowledge of obesity-related comorbidities was assessed using 12 questions comprising multiple-choice and binary (yes/no) formats, adapted from a previous study in Nigeria [13]. Each correct response was awarded one point, giving a maximum obtainable score of 12 points for respondents who answered all questions correctly. The total knowledge score was used to classify respondents based on knowledge competency.

The benchmark for adequate knowledge was established based on best practices in health literacy assessment, where a score of 60% to 70% is commonly accepted to represent a satisfactory level of comprehension in educational settings.

Therefore, responses were categorized into "adequate knowledge" and "inadequate knowledge" based on predefined scoring thresholds. A cutoff score of 8 correct responses (representing 66.7% of the total score) was set as the threshold for adequate knowledge. Good (Adequate) Knowledge: Respondents who provided 8 out of 12 correct responses were scored as "adequate (good) knowledge". Poor (Inadequate) Knowledge: Respondents who provided < 8 out of 12 correct responses were scored as "inadequate (poor) knowledge". Classification ensured that only adolescents who demonstrated a substantial level of accurate understanding of the various comorbidities were categorized as having adequate knowledge.

Statistical analysis

Data were analyzed using IBM SPSS version 26. Descriptive statistics (frequencies and percentages) were used to summarize socio-demographic characteristics. Chi-square tests were conducted to examine the association between categorical variables, such as obesity status and selected socio-demographic or lifestyle factors. Binary logistic regression was also performed to identify predictors of obesity and its comorbidities, with *p-values* < 0.05 considered statistically significant.

Ethical considerations

Ethical approval for this study was obtained from the Novena University Ethics Review Board with approval reference number NUO/PG/PhD/ERB/24/008. Written informed consent was obtained from the parents or legal guardians for adolescents less than 16 years, while adolescents more than 16 years provided both informed consent and assent before participating with assurance of confidentiality. Participants and their guardians were provided with detailed information sheets explaining the study's objectives, procedures, potential risks, and benefits. The voluntary nature of participation and the right to withdraw at any time without penalty were emphasized.

Participants who were identified as overweight or obese during anthropometric measurements were referred to the school health officers for appropriate health education and counseling. The study adhered to the ethical principles outlined in the Declaration of Helsinki and Nigeria's National Code of Health Research Ethics.

RESULTS

Socio-demographic characteristics

Table 1 presents a comparative analysis of socio-demographic variables between urban and rural adolescents. Statistically significant differences were observed across multiple domains: Age distribution differed slightly but significantly ($p<0.05$), with rural students having a higher proportion in the youngest age group (10–13 years). Sex distribution showed that females predominated in urban schools (60.9%), whereas males were slightly more represented in rural areas (49.3%) ($p<0.05$). Religion was also significantly different ($p<0.05$), with more urban students identifying as Christians (91.5%), while rural students showed greater religious diversity, including traditional beliefs, although Christianity also predominated (83.1%). School type revealed a major disparity ($p<0.05$), as the vast majority of urban students (86.3%) attended private schools, compared to only 28.9% in rural areas. Extra-academic activities also differed ($p<0.05$): urban students were more likely to play computer games (58.5%), while rural students were more engaged in farming activities (21.5%).

Table 1: Socio-demographic characteristics of respondents in urban and rural settings

Variable	Option	Urban (n = 670) Freq (%)	Rural (n = 284) Freq (%)	Total (n = 954) Freq (%)	χ2 Value	*p-value*
Age group (years)	10–13	80 (11.9%)	47 (16.5%)	127 (13.3%)	6.872	0.032*
	14–17	469 (70.0%)	196 (69.0%)	665 (69.7%)		
	18–19	121 (18.1%)	41 (14.4%)	162 (17.0%)		
Sex	Male	262 (39.1%)	140 (49.3%)	402 (42.1%)	4.689	0.030*
	Female	408 (60.9%)	144 (50.7%)	552 (57.9%)		
Religion	Christianity	613 (91.5%)	236 (83.1%)	849 (89.0%)	16.763	0.0002*
	Islam	33 (4.9%)	22 (7.7%)	55 (5.8%)		
	Traditional/Others	24 (3.6%)	26 (9.2%)	50 (5.2%)		
School type	Public	92 (13.7%)	202 (71.1%)	294 (30.8%)	182.317	<0.000*
	Private	578 (86.3%)	82 (28.9%)	660 (69.2%)		
Extra-curricular activities	Farming	67 (10.0%)	69 (21.5%)	136 (14.3%)	25.116	<0.001*
	Playing computer games	392 (58.5%)	143 (50.4%)	535 (56.1%)		
	Learning skills	58 (8.7%)	21 (10.2%)	79 (8.3%)		
	No activity	153 (22.8%)	51 (18.0%)	204 (21.4%)		

Overview of measurement tool (knowledge assessment)

Table 2 highlights a significant urban-rural disparity in obesity prevalence and knowledge of selected comorbidities. No significant differences were found in knowledge of asthma, depression, dyslipidemia, or Attention Deficit Hyperactivity Disorder (ADHD) in this study.

Based on the information in the Data Collection section, here is the structure of the instrument used for the knowledge assessment:

Table 2a: Overview of measurement tool (Knowledge assessment)

Instrument component	Details	Source (Source of information)
Domain assessed	Knowledge of obesity-related comorbidities	5
Total questions	12 questions/statements	66
Format	Multiple-choice and Binary (yes/no) formats	7
scoring	1 point awarded per correct response. Maximum score is 12.	8
Classification	Good/Adequate Knowledge: 8 correct responses 9	10
	Poor/Inadequate Knowledge: < 8 correct responses 11	12

Nutritional status and knowledge of comorbidities in urban and rural adolescents

This table provides a summary of the outcome variables (Nutritional Status) and the assessed knowledge of related comorbidities for both groups.

Overall knowledge levels and classification criteria

Figure 1 categorizes adolescents' knowledge of obesity-related comorbidities using a scoring system: A higher proportion of urban students (60.7%) had good knowledge (≥8 out of 12 correct responses) compared to rural students (53.2%) ($p<0.05$). Nevertheless, over 41.0% of the total sample still had poor knowledge.

Predictors of Adolescent Obesity and Summary of Knowledge Levels

This table is divided into two sections: Section 1 identifies the factors significantly associated with the outcome of obesity (Binary Logistic Regression), and Section 2 summarizes the key descriptive knowledge findings across the total sample.

Adolescents in urban areas were over two times more likely to be obese than those in rural areas (OR = 2.143). Students classified as having poor knowledge of obesity-related comorbidities had 51.7% increased odds of being obese (OR = 1.517). Despite over half the adolescents (58.5%) having good knowledge of the consequences (comorbidities) of obesity, an alarming 93.1% of the total sample demonstrated poor knowledge of the causes and control (prevention) of obesity.

Table 2b: Nutritional status and knowledge of obesity-related comorbidities

Indicator/Variable	Urban (n = 670) Freq (%)	Rural (n = 284) Freq (%)	χ2 Value	*p-value*
Nutritional Status (BMI-for-age)			25.831	<0.0001*
Underweight	100 (14.9%)	110 (38.7%)		
Healthy/Normal Weight	466 (69.6%)	158 (55.6%)		
Overweight	6 (0.9%)	4 (1.4%)		
Obesity (95th percentile)	**98 (14.7%)**	**12 (4.3%)**		
Knowledge of Comorbidities (Specific)				
Knowledge of pre-diabetes	389 (58.1%)	135 (47.5%)	8.122	0.004*
Knowledge of type 2 diabetes	385 (57.5%)	128 (45.1%)	10.295	0.001*
Knowledge of metabolic syndrome	235 (35.1%)	81 (28.5%)	3.771	0.052
Knowledge of asthma	532 (79.4%)	227 (79.9%)	0.022	0.881
Knowledge of depression	511 (76.3%)	216 (76.1%)	0.002	0.964
Knowledge of dyslipidemia	128 (19.1%)	42 (14.8%)	2.442	0.118
Knowledge of ADHD	78 (11.6%)	31 (10.9%)	0.076	0.782

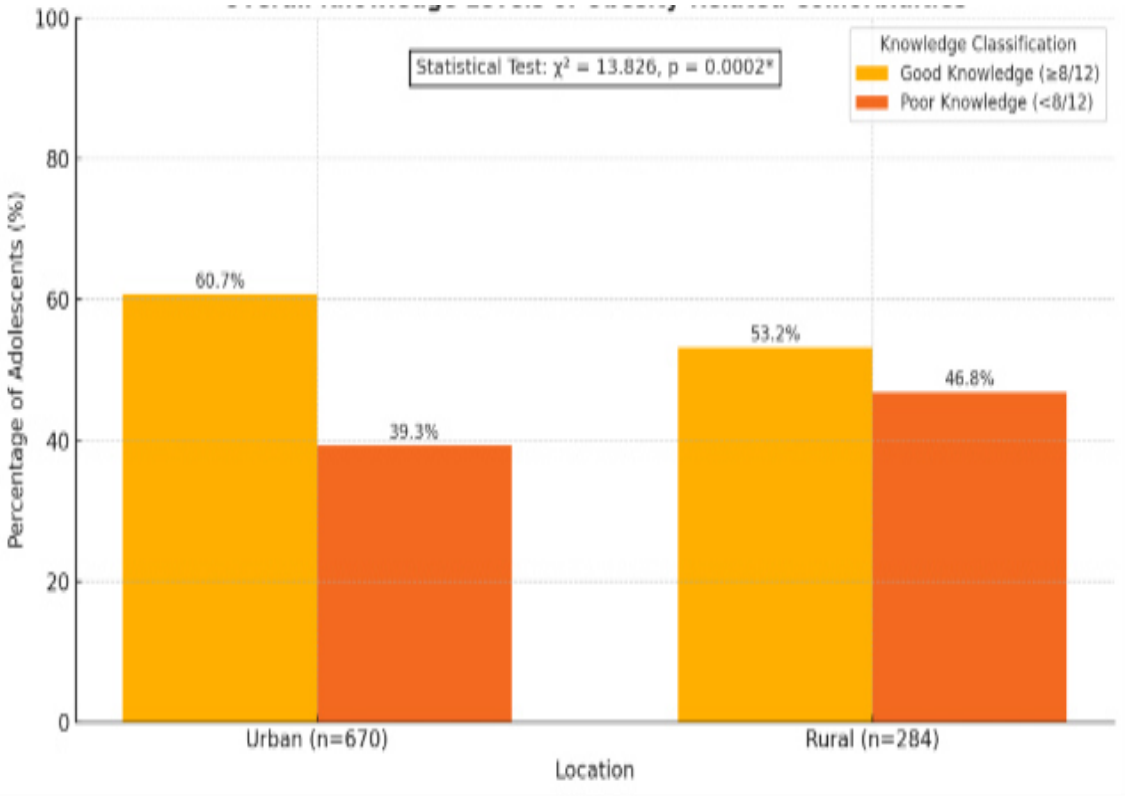

Figure 1: Overall Knowledge Levels and Classification Criteria

Table 4: Predictors of Adolescent Obesity and Key Knowledge Deficits (N=954)

Variable/Domain	Category	OR	95% CI	*p-value*	Freq (%) (Total N=954)
Binary Logistic Regression (Predictors of Obesity) 1					
Location	Urban vs. Rural (Ref)	2.143	**1.188–3.864**	0.011*	N/A
School Type	Private vs. Public (Ref)	1.892	**1.215–2.946**	0.004*	N/A
Knowledge of Comorbidities	Poor vs. Good (Ref)	1.517	**1.016–2.265**	0.042*	N/A
Gender	Female vs. Male (Ref)	1.231	0.812–1.868	0.321	N/A
Overall Knowledge Status (Descriptive) 2					
Good Knowledge of Comorbidities (8/12)	Total Sample	N/A	N/A	N/A	558 (**58.5%**)
Poor Knowledge of Causes and Control	Total Sample	N/A	N/A	N/A	888 (**93.1%**)
Good Knowledge of Causes and Control	Total Sample	N/A	N/A	N/A	66 (**6.9%**)

DISCUSSION

The findings of this study provide compelling evidence that adolescent obesity in Delta State is strongly shaped by structural, socio-economic, and informational determinants, reflecting a pronounced urban obesogenic transition. Urban environments increasingly promote lifestyles characterized by widespread availability of ultra-processed, energy-dense foods and sustained exposure to sedentary pursuits, including prolonged screen-based leisure. In contrast, rural adolescents appear to retain more traditional dietary practices and engage in higher levels of routine physical activity, which may confer partial protection against obesity. This pattern is consistent with evidence from sub-Saharan Africa and other developing regions indicating that higher socio-economic status, often operationalized through indicators such as private school attendance and urban residence, is paradoxically associated with increased obesity risk in low- and middle-income settings. In such contexts, economic advantage facilitates access to commercially processed foods and labor-saving technologies while simultaneously reducing energy expenditure.

A critical and nuanced insight from this study is the apparent disjunction between health knowledge and health outcomes among urban adolescents. Despite demonstrating significantly better awareness of obesity-related metabolic conditions, including type 2 diabetes and pre-diabetes, urban adolescents exhibited substantially higher obesity prevalence than their rural counterparts. This paradox underscores the limitation of knowledge-centric approaches to obesity prevention. Although health information is more readily accessible in urban schools, likely due to greater digital exposure, teacher capacity, and institutional resources [14], such knowledge appears insufficient to counteract powerful environmental, social, and behavioral drivers of obesity. The urban food and activity environment may overwhelm individual agency, rendering awareness alone ineffective in producing meaningful behavior change.

Furthermore, the findings suggest that adolescents' understanding of obesity is often fragmented, with greater emphasis placed on disease labels rather than on the behavioral pathways linking daily practices to long-term metabolic risk. Many adolescents failed to recognize how modifiable factors such as dietary quality, sleep duration, and sedentary behavior cumulatively influence obesity risk and metabolic health [15]. This disconnect points to systemic weaknesses within the school health education framework, where curricula may prioritize rote learning and disease identification over experiential, skills-based health education. Such an approach limits adolescents' ability to translate abstract health knowledge into practical decision-making and sustained lifestyle change [16].

Importantly, health literacy emerged as an independent predictor of obesity in this study. Adolescents with a poor understanding of obesity-related comorbidities had significantly higher odds of being obese, reinforcing the role of health literacy as a protective factor in weight management. This finding aligns with evidence emphasizing that informed decision-making is central to navigating complex food environments and resisting unhealthy social norms [17]. Without a solid conceptual foundation in metabolic health, adolescents are ill-equipped to critically evaluate food choices, recognize early risk signals, or adopt preventive behaviors in environments saturated with calorie-dense foods and sedentary alternatives.

Collectively, these findings highlight the need for integrated, context-specific, and multi-level interventions that extend beyond individual knowledge dissemination. In urban settings, obesity prevention strategies must prioritize environmental and policy-level actions, including reducing exposure to unhealthy food marketing, limiting availability of ultra-processed foods around schools, and promoting active lifestyles through school and community infrastructure. In rural contexts, interventions should focus on strengthening foundational health literacy while simultaneously preventing the gradual adoption of obesogenic behaviors as socio-economic conditions evolve.

Ultimately, embedding comprehensive nutrition and metabolic health education within the national school curriculum delivered through participatory, behavior-focused pedagogies is essential. Equally important is the systematic training of teachers as health advocates capable of reinforcing practical lifestyle skills rather than abstract health facts. Such a dual focus on educational reform and environmental modification is critical to reversing current obesity trends and mitigating the future burden of non-communicable diseases among adolescents in Delta State and comparable settings [18].

CONCLUSION

This study set out to compare the prevalence of various nutritional status categories, including underweight, normal weight, overweight, and obesity; assess knowledge of obesity-related comorbidities; and identify key socio-demographic and behavioral factors influencing obesity among in-school adolescents in urban and rural settings of Delta State, Nigeria. The findings revealed a significantly higher prevalence of overweight and obesity in urban adolescents compared to their rural peers, while rural adolescents showed relatively higher levels of underweight. Urban students demonstrated moderately better knowledge of obesity-related comorbidities; however, there was an overall poor understanding of the causes and prevention of obesity in all its forms across both groups. Urban residence, private school attendance, and poor knowledge emerged as significant predictors of adolescent overweight and obesity.

Based on the findings, there is a need to integrate comprehensive nutrition and health education into school curricula, focusing on nutrition, physical activity, and lifestyle habits that address underweight, overweight, and obesity. Implementation of targeted interventions in urban and private schools to reduce sedentary behaviour and promote healthy habits can reduce unhealthy weight patterns among adolescents. There is also a need to enhance rural school health programs with tailored, culturally relevant obesity prevention education. Efforts to curb obesity among adolescents should also involve parents and caregivers in supporting healthy behaviours at home. Lastly, it is essential to prioritize adolescent nutrition in policy planning, including infrastructure for physical activity, school-based programs, and broader initiatives that support healthy growth and development for all adolescents, regardless of weight category.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study. No financial or non-financial interests influenced the design, execution, analysis, or reporting of this research.

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