RESEARCH ARTICLE

Prevalence of Abdominal Obesity and Associated Factors Among Secondary School Students in Kisangani, DRC: A Cross-Sectional Study

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Abstract: Background: Adolescent obesity is a growing public health concern globally, including in sub-Saharan Africa. This study aimed to assess the prevalence and associated factors of abdominal obesity among school-aged adolescents in Kisangani, Democratic Republic of Congo (DRC). **Methods:** We conducted a cross-sectional descriptive study from October to December 2023 in 15 secondary schools across five communes of Kisangani. A total of 1,416 students aged 11 to 18 years were enrolled. Data were collected using structured interviews and anthropometric measurements. Abdominal obesity was defined according to the International Diabetes Federation (IDF) 2007 pediatric criteria. Bivariate analyses were performed to identify associated factors. **Results:** The overall prevalence of abdominal obesity was 12.35%, with a significantly higher rate in girls (15.83%) than in boys (3.10%). Key associated factors included female sex (OR = 5.85; p < 0.0001), sedentary behavior (watching TV > 3 hours/day), use of motorized transport to school, frequent meat consumption, and having three or more meals per day. Co-occurrence of other metabolic risk factors such as elevated triglycerides, high fasting glucose, and low HDL-C was observed in up to 2.33% of adolescents, meeting the criteria for metabolic syndrome. **Conclusion:** Abdominal obesity and its associated risk factors are prevalent among adolescents in Kisangani, especially among girls. Immediate public health interventions focused on nutrition, physical activity, and lifestyle habits are essential to curb the rising trend of adolescent obesity in urban areas of the DRC.

Keywords: adolescent obesity, abdominal obesity, metabolic syndrome, Kisangani, Democratic Republic of Congo, risk factors, cross-sectional study

1 Introduction

Adolescent obesity is a major predictor of obesity persistence into adulthood, which significantly increases the risk of severe comorbidities and premature mortality. Overweight or obese youths are more likely to maintain excess body weight as adults, placing them at early risk of developing chronic non-communicable diseases such as type 2 diabetes and cardiovascular disorders [1].

In recent decades, the global prevalence of obesity and diabetes has risen sharply, contributing to a parallel increase in metabolic syndrome (MS), a cluster of risk factors associated with major health outcomes [2]. As of 2010, more than 42 million children worldwide were classified as overweight, with nearly 35 million residing in low- and middle-income countries. While this trend was initially confined to industrialized nations, it has since extended to developing countries now facing the dual burden of undernutrition and overnutrition [1].

In developed countries, childhood obesity has reached alarming levels. For example, in the United States, the prevalence of obesity among children aged 6–11 years rose from 6.5% in 1976–1980 to 17% in 2003–2006, according to NHANES data [3]. In Africa, the trend is also concerning. An epidemiological study in Senegal reported a 9.3% prevalence of obesity among schoolchildren, while another study revealed that 56.8% of hospitalized children had obese parents, highlighting the influence of familial and socioeconomic factors on childhood obesity.

Obesity is the leading risk factor for type 2 diabetes in children. A Canadian study (2006-2008) found that 95% of new pediatric cases of type 2 diabetes occurred in obese children,

defined by a body mass index (BMI) above the 95th percentile for age and gender [4]. Obesity is frequently associated with insulin resistance, a key condition predisposing individuals to diabetes and other metabolic complications. Preventing childhood obesity has thus become a pressing public health challenge. Early screening, promoting balanced dietary habits and encouraging physical activity are effective strategies, yet remain underutilized in many settings [5].

In this context, our study seeks to explore the association between dietary behaviors, sedentary lifestyles, and the prevalence of obesity among secondary school students in Kisangani. Our goal is to contribute to reducing obesity-related morbidity and mortality by providing local evidence to inform targeted public health interventions.

2   Methods

2.1   Study Design, Period and Setting

This was a cross-sectional descriptive study conducted in secondary schools in Kisangani, the capital of Tshopo province in northeastern Democratic Republic of Congo. Data were collected from October 16 to December 20, 2023. A total of 15 secondary schools were selected across five communes of the city (three schools per commune), excluding Lubunga due to accessibility constraints.

2.2   Study Population

The target population consisted of students aged 11 to 18 years enrolled in the selected schools. Students with a known severe illness or clinical signs suggestive of a serious condition were excluded.

2.3   Variables of Interest

(1) Dependent variable: Obesity.
(2) Independent variables:
   a. Sociodemographic characteristics: age, sex, school grade, residential area, marital status and education level of the guardian;
   b. Socioeconomic status;
   c. Dietary habits;
   d. Physical activity;
   e. Clinical and anthropometric measurements:
      i. Weight (kg) and height (cm);
      ii. Waist circumference (WC, in cm), measured at the midpoint between the lowest rib; and the iliac crest, at the end of expiration;
      iii. Systolic and diastolic blood pressure (mm Hg).

Abdominal obesity was defined according to the pediatric criteria of the International Diabetes Federation (IDF, 2007): a WC $\geq$ 94 cm for boys and $\geq$ 80 cm for girls, based on sex and ethnic-specific thresholds. Measurements were taken using a calibrated scale and stadiometer for weight and height, and a mercury sphygmomanometer ("Vasquez" type) for blood pressure.

2.4   Data Collection Technique

Data were collected using a structured questionnaire combining direct anthropometric measurements and individual interviews. Investigators were trained by the research team, which included the principal investigator, an internist, and a public health specialist.

2.5   Data Processing and Analysis

Quantitative variables with normal distribution were described using means and standard deviations (SD), while skewed variables were summarized using medians and interquartile ranges (IQR). Qualitative variables were expressed as proportions. Associations between dependent and independent variables were assessed using contingency tables and the Pearson Chi-square test or Fisher's exact test, depending on the conditions of applicability.

3   Results

The sample was predominantly female (72.7%) with a median age of 15. Most tutors had at least secondary education, and 77.8% were in stable marital unions. Over two-thirds of adolescents reached school without transport, indicating limited socioeconomic mobility

for many families (Table 1). Overall obesity prevalence was 12.35%, significantly higher in girls (15.83%) compared to boys (3.10%). The prevalence of metabolic syndrome ($\geq$ 3 criteria) was relatively low (2.33%) but disproportionately affected girls. Combinations involving triglycerides and low HDL were more frequent in girls, suggesting early lipid profile disturbances (Table 2). Obesity was strongly associated with female sex, longer TV time, and use of transportation to school, suggesting sedentarism as a central determinant. The number of meals per day and frequency of meat consumption also showed statistically significant associations. Variables like breakfast skipping, tutor education, snacking, and physical education at school were not significantly associated with obesity (Table 3).

Table 1   Sociodemographic and clinical characteristics of respondents (n = 1416)

Variable	Category	n	%
Age (years), median (P75–P25)			15 (17–13)
Age group (years)	11–14	634	44.8
	$\geq$ 15	782	55.2
Gender	Female	1030	72.7
	Male	386	27.3
Menarche (among girls)	Yes	862	83.7
	No	168	16.3
Age at menarche, median (P75–P25)			13 (13–12)
Tutor's education level	Primary	71	5.1
	Secondary	687	48.5
	University	658	46.4
Tutor's marital status	Living with partner	1102	77.8
	Living without partner	314	22.2
Tutor's occupation	Government employee	573	40.5
	Liberal profession	417	29.5
	Trader	353	24.9
	Unemployed	72	5.1
Means of school transport	With transport	433	30.6
	Without transport (walk, *etc*.)	983	69.4

Table 2   Prevalence of obesity and associated comorbidities among adolescents aged 11-18 years

Condition	Boys (n = 386)	Girls (n = 1030)	Total (n = 1416)
$\geq$ 1 risk factor (present)	16 (4.14%)	174 (16.89%)	190 (13.41%)
Obesity	12 (3.10%)	163 (15.83%)	175 (12.35%)
Hypertension (HTN)	4 (1.03%)	11 (1.07%)	15 (1.05%)
$\geq$ 2 risk factors present	8 (2.07%)	84 (8.15%)	92 (6.49%)
Obesity + HTN	3 (0.77%)	6 (0.58%)	9 (0.64%)
Obesity + High glucose (GJ)	3 (0.77%)	26 (2.52%)	29 (2.05%)
Obesity + High TG	1 (0.25%)	30 (2.91%)	31 (2.19%)
Obesity + Low HDL-C	1 (0.25%)	22 (2.13%)	23 (1.62%)
$\geq$ 3 risk factors (MetS)	6 (1.55%)	27 (2.62%)	33 (2.33%)

4   Discussion

4.1   Prevalence of Obesity and Associated Risk Factors Among Adolescents Aged 11-18 Years

In this cross-sectional study conducted among adolescents in Kisangani, the overall prevalence of abdominal obesity was 12.35%, with a significantly higher rate among girls (15.83%) compared to boys (3.10%). This gender disparity aligns with findings from similar studies conducted in sub-Saharan Africa. For example, Ndiaye (Senegal) [1] and Sekokola (South Africa) reported a higher prevalence of overweight and obesity in adolescent girls, the latter reaching 47.5% among girls versus 24.1% among boys [6].

This gender difference can be partially attributed to sociocultural norms that encourage boys to engage more in outdoor activities, while girls are often confined to domestic responsibilities, limiting their physical activity. In addition, psychological factors, including body image

Table 3 Bivariate analysis of factors associated with obesity among adolescents aged 11-18 years

Variable	Obese n (%)	OR (95% CI)	p-value
Gender			< 0.0001
Male	12 (3.11%)	5.85 (3.21–11.71)	
Female	163 (15.83%)	Reference	
Tutor's education level			0.160
Secondary	85 (11.21%)		
University	90 (13.68%)	Reference	
Time spent watching TV			< 0.0001
1–2 hours/day	18 (3.74%)	6.2 (3.76–11.05)	
≥ 3 hours/day	157 (16.79%)	Reference	
Transport to school			< 0.0001
With transport	77 (17.78%)	1.95 (1.39–2.73)	
Without transport	98 (9.97%)	Reference	
Breakfast intake			0.112
Yes	95 (13.79%)	1.29 (0.93–1.80)	
No	80 (11.00%)	Reference	
Number of daily meals			< 0.0001
1–2 meals	62 (8.34%)	2.21 (1.58–3.13)	
≥ 3 meals	113 (16.79%)	Reference	
Meat consumption (binary)			0.990
Yes	174 (12.37%)		
No	1 (12.50%)	Reference	
Meat consumption frequency			0.0003
1–2 times/week	64 (9.67%)	1.60 (1.15–2.27)	
≥ 3 times/week or daily	111 (14.72%)	Reference	
Snacking between meals			0.120
Yes	161 (12.85%)		
No	14 (8.59%)	Reference	
Sport at school			0.920
Yes	89 (12.28%)		
No	86 (12.45%)	Reference	

concerns and emotional eating, may disproportionately affect adolescent girls, further increasing their risk of obesity.

The most common metabolic abnormalities observed among the adolescents were elevated triglycerides (36.36%) and fasting glucose (35.53%), followed by low HDL-cholesterol levels (25.61%). These metabolic risk factors are often silent but may signal early signs of metabolic syndrome, particularly when combined with abdominal obesity. Only 1.05% of the study participants presented with elevated blood pressure, indicating it is less common at this age but not negligible.

4.2 Coexistence of Risk Factors and Metabolic Syndrome

Notably, 13.41% of adolescents exhibited at least one risk factor for metabolic syndrome (SMET), and 6.49% presented with at least two. The most frequent dual risk combinations were high fasting glucose with low HDL-C (13.22%) and high glucose with elevated triglycerides (11.57%). The prevalence of metabolic syndrome, defined as the presence of at least three components, was 2.33%. This highlights a significant proportion of adolescents already on the trajectory toward cardiometabolic disease.

Compared to high-income countries, where adolescent obesity reaches approximately 30% in North America and 20% in Europe, the prevalence in our study is lower but still concerning, especially considering the rapid urbanization and nutrition transition occurring in African cities. Importantly, childhood obesity has a high persistence into adulthood, ranging from 20–50% if obesity begins before puberty, and 50–70% if it starts after [1].

4.3 Associated Risk Factors

Several factors were significantly associated with obesity in our population. Being female was a strong predictor (OR: 5.85, p < 0.0001). Other significant contributors included sedentary behaviors, such as screen time (watching TV for three or more hours per day), and the use of motorized transport to school (OR: 1.95). These findings are consistent with prior studies [7] emphasizing the role of physical inactivity and passive commuting in the development of obesity among school-aged children.

In addition, dietary patterns played a notable role. Adolescents who consumed only one or two meals per day were more than twice as likely to be obese (OR: 2.21) compared to those consuming three or more meals. This paradoxical result may be explained by irregular eating patterns leading to increased snacking and poor nutritional quality. Indeed, frequent snacking and a high intake of calorie-dense foods low in essential nutrients are common in low-income settings, where affordability often dictates food choices.

Meat consumption frequency was another influential factor. Adolescents consuming meat three or more times a week were significantly more likely to be obese (OR: 1.6), suggesting a shift toward Westernized dietary habits rich in animal proteins and fats. Conversely, consistent physical activity, including participation in sports at school, appeared to offer a protective effect, although the association in this study did not reach statistical significance.

These findings echo those of Sunnegardh et al. [8], who found that higher physical activity levels in children aged 8–13 were associated with lower fat mass. Similarly, a Canadian review [9] highlighted the benefits of increasing the intake of legumes, which promote satiety, glycemic control, and weight maintenance. Such dietary recommendations are particularly relevant for low-resource settings and should be promoted in local nutrition education programs.

5 Conclusion

This study highlights a concerning prevalence of abdominal obesity among adolescents aged 11 to 18 in Kisangani, with a markedly higher rate among girls. Several behavioral and nutritional factors, such as sedentary lifestyle, mode of transportation, number of meals per day, and frequency of meat consumption, were significantly associated with the occurrence of obesity. These findings reflect the growing impact of lifestyle changes on adolescent health, even in low-resource settings.

The frequent coexistence of obesity with other metabolic risk factors is particularly alarming, as it suggests an increased likelihood of developing cardiovascular disease and type 2 diabetes later in life.

In light of this emerging public health issue, early, multisectoral, and context-specific interventions are urgently needed. Promoting physical activity in schools, strengthening nutrition education, and improving access to healthy foods should be key components of prevention strategies targeting youth in the Democratic Republic of Congo.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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