

Original Research Article

Prevalence and determinants of underweight, overweight, and obesity among adolescent secondary school students in Dongola City, Northern Sudan in 2019

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ABSTRACT

Background: Adolescents comprise 1.2 billion of the world population. There is a worldwide increase in the prevalence of obesity and overweight among adolescents. This study aimed to determine the prevalence of underweight, overweight, and obesity among secondary school adolescents in Dongola city, North Sudan.

Methods: A cross-sectional, school-based study was conducted among adolescents from 7 out of 11 schools in Dongola city in November 2019. Multistage sampling method was used besides ethical approval and informed consent were taken. Data was collected through questionnaire, weight and height of each participant were measured, body mass index was calculated and the World Health Organization (WHO) (5-19 years) reference chart was used to determine underweight, overweight, and obesity. Chi-square test and multinomial logistic regression were performed to determine factors associated with underweight, overweight, and obesity.

Results: The study included 695 students with 397 (57.1%) males. The prevalence rates of underweight, overweight, and obesity were 12.2%, 15.7% and 5.2% respectively. Male students had more than twice times (OR=2.37; 95%CI=1.29-4.37) likely to be underweight. Students with family history of obesity had almost twice and two and half times (OR=1.78; 95% CI: 1.15-2.76) and (OR=2.46; 95% CI: 1.21-4.98) more likely to have overweight and obesity respectively. Students living in urban areas had thirteen times (OR=13.0; 95% CI: 1.76-96.7) more likely to be obese.

Conclusions: The prevalence rates of underweight, overweight, and obesity are high compared to primary school children in Northern State. There is a need to strengthen the school health program and further studies involving rural and urban schools are recommended.

Keywords: Adolescents, North Sudan, Obesity, Overweight, Secondary school, Underweight

INTRODUCTION

The prevalence of obesity and overweight are increasing worldwide among all age groups, including children and adolescents to become major chronic health disorders in childhood and adolescence.¹ The World Health Organization (WHO) defines adolescents as individuals in the age group of 10-19 years and adolescents comprise about 1.2 billion or one in every 6 of the world population.²

The prevalence of overweight in adolescents ranges from 11% to 30% in different WHO regions.² The overall prevalence of adolescent overweight plus obesity is 20% in Africa, 22-25% in Europe and 30% in America.¹ The prevalence rates of overweight and obesity show great variation among adolescents in Arab countries.³ The highest prevalence rates are in Kuwaiti male adolescents (25.6% for overweight and 34.8% for obesity) whereas the lowest rates are reported from Algerian adolescents (9.3%

for overweight and 4.1% for obesity).³ In the Eastern Mediterranean region, the prevalence of overweight plus obesity ranges from 7% to 45% in school children including adolescents.⁴ Regarding underweight, the global age-standardized prevalence rates of 9.2% in girls and 14.8 in boys in 1975 decreased to 8.2% and 12.4 respectively in girls and boys (5-19 years of age).⁵

In Sudan, available studies also showed variation in the prevalence of overweight and obesity among the adolescent population. A study performed on adolescents of 14-18 years of age in Khartoum State revealed prevalence rates of overweight and obesity of 7.5% and 3.1% respectively with both overweight and obesity being more prevalent among females than males.⁶ Another study from Khartoum State involving children and adolescents of 10-18 years of age from primary and secondary schools revealed prevalence rates of 10.8% for overweight and 9.7% for obesity.⁷ In Sudan the prevalence of underweight in children and adolescents (5-19 year) decreased from 36.5% in 2000 to 30.2% in 2016 in boys and from 22.4% in 2000 to 18.1% in 2016 in girls.⁸ The prevalence of underweight was 13.9% in adolescents of 10-18 years in Khartoum State.⁷

Literature review revealed no studies of overweight or obesity among adolescent secondary school students in the Northern State but a study performed in primary school children of 6 to 14 years in Argo city, Northern State demonstrated prevalence rates of overweight, obesity and underweight of 6.2%, 1.5% and 8.26% respectively.⁹ Adolescent overweight and obesity predispose to early development of diabetes mellitus (DM), hypertension and atherosclerotic cardiovascular disease.^{10,11} Primary prevention programs can be adopted to maintain ideal body weight and encourage exercise in secondary schools. Therefore, the authors aim to determine the prevalence of overweight, obesity and underweight among adolescents in the secondary schools of Dongola City, Northern Sudan.

METHODS

Study design, area, and population

A cross-sectional, school-based study was carried out in November 2019 among secondary schools in Dongola city. Dongola is the capital of the Northern State, Sudan. Dongola is on the west bank of the Nile River, about 278 miles (448 km) Northwest of Khartoum. There are 11 male and female secondary schools in Dongola city. According to the data from the State Ministry of Education; 3534 Students come from different (rural and urban) parts of the Northern State to these schools. The study population included female and male students (13-18 years of age) in Dongola.

Sampling techniques

The minimum sample size was 625 when determined by the formula given below, when the prevalence of

overweight and obesity among adolescents in Sudan was taken as 20.5% with 95% confidence interval and 5% precision.⁷

$$\text{Sample size} = \frac{z^2 P(1 - P)}{d^2}$$

The multistage sampling method was adopted to select the study sample. Firstly, simple random sampling was used to select seven schools from eleven secondary schools of males and females. Secondly, the sample size was appropriately distributed among selected schools. Thirdly, stratified sampling methods were applied to select students from different classes in each school. A total of 695 students were selected from the 3534 students according to systematic data from the Ministry of Education, Northern State, Sudan. Exclusion criteria included refusal to participate in the study and being absent from the school on the day of recruitment.

Data collection

Data was collected by using questionnaire and performing anthropometric measurements. The structured questionnaire was used to collect information about socio-demographic characteristics, dietary habits, food frequency intake, sedentary behaviors, physical activity and sleeping duration hours.

Body weight and height were measured to the nearest 0.1 kg and 0.5 cm using digital scales (Soehnle, Germany) and a non-stretch tape fixed to a flat vertical wall, respectively. Body mass index (BMI) values were calculated from the following equation given.¹²

$$BMI = \text{weight (kg)} / \{\text{height (m)}\}^2$$

To ensure quality of data collection, the authors conducted a two-days training to medical students of the 6th year, University of Dongola (batch 17) as data collectors on how to fill the questionnaire, measure and report the height and the weight of the secondary school students. All measurements were taken in the morning and completed within 15 days for all participants. The age of each participant was extracted from school records. BMI of each participant was calculated according to the WHO guideline on BMI for age (5–19 years) chart (WHO growth reference 2007). Z score >3 standard deviation (SD) was considered obese, >2 SD overweight and <2 SD underweight.¹³

Ethical approval

The study protocol was approved by the ethics committee of the Ministry of Health, Northern State, Sudan. Permission was taken from the department of statistics and planning, Ministry of Education, Northern State and secondary schools administrators. Written informed consent was obtained from each participant and informed consent was taken from the parents by contacting them directly or by using mobile phones.

Data analysis

Data was analyzed using the statistical package for social science (SPSS, version 25). Qualitative data was expressed as frequency and percentage. A p value of <0.05 was used to determine the level of significance. Multinomial logistic regression was used to examine the association between BMI classification and other demographic factors.

RESULTS

A total of 695 secondary school students, 397 (57.1%) males and 298 (42.9%) females from seven schools participated in this study. BMI calculation demonstrated that the prevalence of underweight obesity and overweight were 12.2%, 15.7% and 5.2% respectively while 66.9% had normal weight as shown in Figure 1.

Our results revealed that overweight and obesity were significantly common among females than males ($p<0.001$), in students residing in urban than rural areas ($p<0.01$) and students with family history of obesity ($p<0.001$). In addition, overweight and obesity were significantly common among students taking more the three meals per day ($p<0.042$) as shown in Table 1.

Compared to the normal weight group and as shown in Table 2, multinomial logistic regression analysis showed that male students had more than two times ($OR=2.37$;

95% CI: 1.29-4.37) more likely to be underweight. Students with family history of obesity had almost two times ($OR=1.78$; 95% CI: 1.15-2.76) and almost two and half ($OR=2.46$; 95%CI: 1.21-4.98) times more likely to have overweight and obesity respectively. In addition, students living in urban areas had thirteen times ($OR=13.0$; 95%CI: 1.76-0.96.7) more likely to be obese.

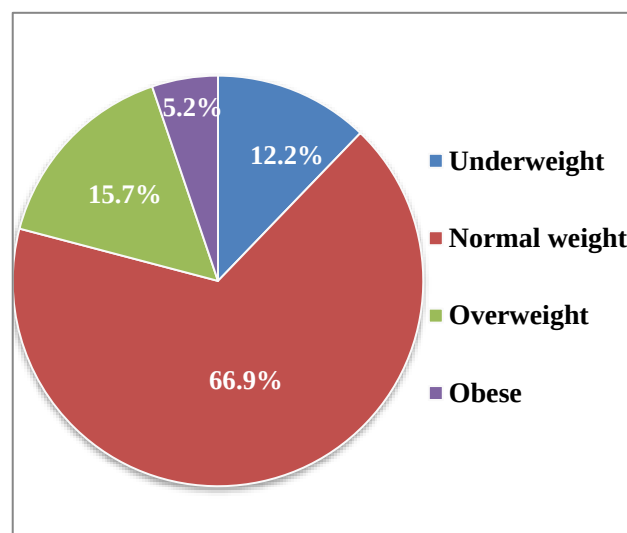


Figure 1: The prevalence of overweight, obesity and underweight among secondary school adolescents in Dongola city, North Sudan, 2019 (n=695).

Table 1: Association between BMI categories (underweight, overweight and obesity) and different socio-demographic factors among secondary school adolescents of Dongola City (n=695).

Variables	Total N (%)	Normal weight N (%)	Underweight N (%)	Overweight N (%)	Obese N (%)	P value
Age group (years)						
<16	393 (56.5)	166 (42.2)	175 (44.5)	40 (10.2)	12 (3.1)	0.062
≥16	302 (43.5)	139 (46)	107 (35.4)	41 (13.6)	15 (5)	
Gender						
Male	397 (57.1)	193 (64.8)	54 (18.1)	37 (12.4)	14 (4.7)	<0.001
Female	298 (42.9)	272 (68.5)	31 (7.8)	72 (18.1)	22 (5.5)	
Residence						
Urban	495 (71.2)	328 (46.9)	49 (9.9)	83 (16.8)	35 (7.1)	<0.001
Rural	200 (28.8)	137 (68.5)	36 (18)	26 (13)	1 (0.5)	
Family history of obesity						
Yes	235 (33.8)	144 (61.3)	21 (8.9)	50 (21.3)	20 (8.5)	<0.001
No	460 (66.2)	321 (69.8)	64 (13.9)	59 (12.8)	16 (3.5)	
Physical activity						
Yes	386 (55.5)	252 (65.3)	57 (14.8)	59 (15.3)	18 (4.7)	0.142
No	309 (44.5)	213 (68.9)	28 (9.1)	50 (16.2)	18 (5.8)	
Number of daily meals						
<Three	143 (20.6)	97 (67.8)	7 (4.9)	30 (21)	9 (6.3)	0.042
Three	492 (70.8)	332 (67.5)	68 (13.8)	69 (14)	23 (4.7)	
>Three	60 (8.6)	36 (60)	10 (16.7)	10 (16.7)	4 (6.7)	

Table 2: Logistic regression analysis of adolescents from secondary schools of Dongola city (N=695).

Variables	Normal weight	Underweight		Overweight		Obese	
		B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)
Gender (male versus female)	Reference	0.866	2.37 (1.29-4.37)**	-0.19	0.83 (0.53-1.3) ^{ns}	0.22	1.25 (0.61-2.65) ^{ns}
Family history (yes versus no)	Reference	-0.063	0.94 (0.541-1.63) ^{ns}	0.576	1.78 (1.15-2.76)**	0.899	2.46 (1.21-4.98)**
Residence (urban versus rural)	Reference	-0.449	0.64 (0.36-1.05) ^{ns}	-1.171	1.187 (0.73-1.94) ^{ns}	-2.568	13.0 (1.76-0.96.7)*

Ns: not significant ($p \geq 0.05$); *significant ($p < 0.05$); **significant ($p < 0.01$).

DISCUSSION

Underweight

Underweight is a useful indicator of current nutritional status in adolescents, reflecting decreased fat and muscle mass.¹⁴ Significant underweight in adolescents is associated with higher rates of morbidity and mortality in adulthood.¹⁵ The prevalence rate of underweight (12.2%) in this study was low compared to the prevalence rates from 7 different African countries, as seen in Table 3.¹⁶ Moreover, it was low compared to the prevalence in adolescents aged 10-18 years in Khartoum State (20.5%).⁶ The prevalence of underweight in our study was higher than that of primary school children in Argo city of 8.3%.⁹

With regards to gender distribution, males were more likely to be underweight with an odds ratio of 2.37. The study from 7 different African countries also revealed that males had higher prevalence rates of underweight compared to females in all the studied countries.¹⁶

Table 3: Prevalence rates of underweight, overweight and obesity in adolescent school children from North Sudan compared from the prevalence rates from 7 African countries.¹⁶

Country	Under-weight	Overweight (obesity included)	Obesity
Sudan (this study from North Sudan)	12.2	20.7	5.2
Egypt	12.6	31.4	9.3
Morocco	24.0	16.6	3.6
Djibouti	31.9	18.8	5.2
Benin	17.5	11.2	0.6
Ghana	25.7	8.7	1.0
Malawi	21.1	10.0	0.8
Mauritania	22.3	24.3	3.4

Overweight and obesity

The overall prevalence of overweight plus obesity of 20.9% in our study was almost similar to the overall prevalence rate of 20% in Africa, but it was low compared to overall prevalence rates from Europe and North America.¹ The prevalence rates of overweight and obesity

in this study were compared to the prevalence rates from 7 different African countries in Table 3, the overall prevalence of overweight (obesity included) was low compared to that from two countries (Egypt and Mauritania) while it was high compared to the other 5 countries.¹⁶ The prevalence rates of both overweight and obesity were low in our study compared to two different studies from Egypt, which borders the Northern State.^{17,18} In addition, compared to two studies from India, the prevalence rates of both overweight and obesity were high in our study.^{19,20} The prevalence of overweight was higher than that of two studies conducted in Khartoum state, but the prevalence of obesity was high compared to the study by Musaiger et al and low compared to the other study by Nagwa et al.^{6,7}

The prevalence rates of both overweight and obesity in our study were high compared to the rates in primary school children from Argo city in the Northern State which might be explained by the growth spurt that normally occurs at puberty.⁹ The study from primary schools in Argo revealed a significant increase in overweight with increasing age (from 4% in <10 years to 8.6% in >10, $p=0.001$) as well as a non-significant increase in obesity ($p=0.3$).⁹

The prevalence rates of overweight and obesity were significantly high among female adolescents, urban residents, and participants with family history of obesity. Most of the studies showed great variation in the prevalence of overweight and obesity among male and female adolescents.^{1,3,4} In Khartoum State, overweight is more common among females compared to males in the two studies whereas obesity is more common among females in one study and more common in males in the second study.^{6,7} In Argo city, overweight is more common among females and obesity more common among male primary school children.⁹

The current study has some limitations; first, the cross-sectional design is incapable of making causal inferences. Second, BMI is unable to predict body fat in adolescents accurately. Despite these limitations, the findings provide valuable evidence regarding nutritional status in adolescents in Dongola city, North Sudan.

CONCLUSION

This study concludes that prevalence rates of underweight, overweight and obesity are high compared to the study on

primary school children from Argo city in Northern State. The rate of overweight is high compared to studies from Khartoum and India. There is a need to strengthen the school health program to look for and manage nutritional problems among adolescents. Further large-scale studies involving rural and urban schools are recommended.

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