ORIGINAL ARTICLE

Prevalence of obesity among adolescents in Ile-Ife, Osun state, Nigeria using body mass index and waist hip ratio: A comparative study

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ABSTRACT

Background: Obesity is a global epidemic not just among adults but also among children and adolescents. This study described the prevalence and pattern of obesity among in-school adolescents in Ile-Ife, Osun State using two standard methods, Body Mass Index (BMI) and Waist Hip Ratio (WHR) with a view of comparing the two methods as well as identifying any correlation between the two methods. **Materials and Methods:** Five hundred male and female respondents, aged 10-19 years, were randomly selected through a multistage sampling technique from private and public schools in Ife Central Local Government Area. Quantitative data were collected with the aid of a pre-tested, semi-structured, self-administered questionnaire. Anthropometric measurements of respondents, BMI and WHR, were recorded. Chi square and linear regression analyses were used. Statistical significance was tested at the 5% level. **Results:** The prevalence of obesity was 4.2% using BMI of which 12 (57.1%) were females and nine (42.9%) were males. There was significant association between sex and BMI, $\chi^2 = 9.490$ ($P = 0.020$). Using WHR, the prevalence was 37.2% of which 180 (96.8%) were females and six (3.2%) were males. There was also significant association between sex and WHR ($P < 0.001$). Weak correlation ($r = 0.02$) was found between BMI and WHR among the females, $P = 0.043$. **Conclusion:** There was a difference in the prevalence of obesity using the two methods. Although, the correlation between the two methods was weak among females, WHR yielded a higher prevalence for obesity with remarkable difference especially among the females. Prevention of adolescent obesity should be encouraged especially among females.

Key words: Adolescents, body mass index, comparative, obesity, pattern, prevalence, waist hip ratio

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INTRODUCTION

Obesity, a global epidemic is one of the major causes of non-communicable chronic diseases.[1] It is one of the leading causes of morbidity and mortality in both developed and developing countries.[2] The increasing public health concern is not unconnected with the health hazards obesity poses. Studies have shown that obesity is linked with non-communicable disorders that include hypertension, Type 2 diabetes mellitus, stroke, arthritis, coronary heart disease, breast and prostate cancers.[3-5]

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The increase in obesity prevalence seen among adults is now observed in children.[6] Obesity among children and adolescents has reached an epidemic proportion in developed countries and is now being seen in developing countries and this is of great concern.[7-9] Adolescents are said to make up about 20% of the world's population with 85% living in developing countries.[10] They are often seen as having little disease burden when compared with children and adults and were neglected until recently. There are few studies in this environment to show the prevalence of obesity among Nigerian adolescents.

This study, therefore, described the prevalence and pattern of obesity among in-school adolescents in Ile-Ife, Osun State using two standard methods, BMI and WHR and also identified correlation between the methods.

MATERIALS AND METHODS

The study was conducted in Ile-Ife, a semi-urban town in

Osun State, Southwest Nigeria. Five hundred students, aged 10-19 years were selected through multistage sampling technique. Of the 20 secondary schools in the town, a total of five schools (two public and three private) were randomly selected. Respondents were also randomly selected from the junior classes and the senior classes of the school. Data were collected using pre-tested, semi-structured, self-administered questionnaires.

Before the questionnaires were administered, ethical approval was obtained from the local government office and permission was also obtained from school authorities as well as the parents/guardians of the respondents.

The questionnaires contained information on the socio-demographic characteristics of the respondents as well as anthropometric measurements of each respondent which included weight, height, hip and waist measurements. The measurements were taken by trained personnel. Random checks were done to ensure accuracy of measurements and to correct for errors.

Body weights of the respondents were measured using a standard portable bathroom scale. The scale was checked for accuracy after every 10th person. Each respondent was weighed wearing light clothing. Weight was measured to the nearest 0.1 kg. Respondents were weighed before their mid day lunch break. Respondents' heights were measured as the distance from the top of the head to the bottom of the feet with no shoes on using a fixed stadiometer to the nearest 0.1 cm. The data were used to calculate the BMI (kg/m^2) of the respondents. The BMI was classified based on age and sex specific cutoffs from the 2000 Centers for Disease Control and Prevention growth charts for adolescents to determine those that were overweight and those that were obese among adolescents. Waist circumference (in cm) was done with a flexible tape measuring midway between the lowest rib and the superior border of the iliac crest at the level of the umbilicus with the respondent standing and breathing normally. Hip circumference was done using a flexible tape to measure the widest diameter around the greater trochanter. The waist-hip ratio, WHR was calculated to the nearest 0.05.

Data were analysed using Statistical Package for the Social Sciences (SPSS) 16 and EPI-info version 6 software. Statistical significance was determined at the level of $P < 0.05$. Mean, standard deviation, chi square and linear regression analysis were used to investigate the relationship between WHR and BMI.

RESULTS

The sociodemographic characteristics of the respondents are presented in Table 1. A total of 500 respondents were interviewed of which 236 (47.2%) were males and 264 (52.8%) females. Two hundred and sixty-seven (53.4%) were of the early adolescent age group (ages 10-14 years), while 233 (46.6%) belonged to the late adolescent age group (15-19 years). The overall mean age was 14.17 ± 2.21 years with 14.09 ± 2.16 years for males and 14.25 ± 2.25 years for females. Fifty-one percent of the respondents belonged to the upper socioeconomic class.

The anthropometric characteristics of the respondents are shown in Table 2. The mean BMI for males was 17.1 while it was 18.1 for females, while the mean WHR for males was 0.85 and 0.82 for females.

Employing the BMI, 21 (4.2%) were classified as obese of which 12 (57.1%) were females and nine (42.9%) were males as shown in Figure 1. There was a significant statistical association between sex and BMI ($P = 0.02$).

Using WHR, 186 (37.2%) respondents were obese of which six (3.2%) were males and 180 (96.8%) were females as shown in Figure 2. The association between sex and WHR was significant, $P = 0.00$.

As shown in Table 3, obesity is higher among females in late adolescence.

Table 4 shows comparison between BMI and WHR. Although, there was no statistically significant relation between BMI and WHR with $r = 0.003$ among males, there

Table 1: Socio-demographic characteristics of the respondents

Parameter	Frequency (%)
Age groups	
(10-14 years)	267 (53.4)
(15-19 years)	233 (46.6)
Sex	
Male	236 (47.2)
Female	264 (52.8)
Family type	
Monogamous	371 (74.2)
Polygamous	129 (25.8)
Socio-economic status	
Class I	256 (51.2)
Class II	59 (11.8)
Class III	76 (15.2)
Class IV	39 (7.8)
Class V	60 (12.0)

Table 2: Anthropometric characteristics of the respondents

Parameter	Male - mean (SD)	Female - mean (SD)
Weight (kg)	42.8 (10.4)	44.6 (8.8)
Height (m)	1.57 (0.1)	1.56 (0.1)
BMI (kg/m^2)	17.1 (2.2)	18.1 (2.8)
Waist circumference (cm)	67.58 (6.7)	68.34 (6.2)
Hip circumference (cm)	79.8 (8.6)	83.40 (7.8)
WHR	0.85 (1.0)	0.82 (0.6)

BMI – Body mass index; WHR – Waist hip ratio; SD – Standard deviation

Table 3: Pattern of obesity

Age group	BMI frequency (%)	WHR frequency (%)
10-14 years		
Male	4 (19.0)	5 (2.7)
Female	6 (28.6)	1 (0.5)
15-19 years		
Male	5 (23.8)	96 (51.6)
Female	6 (28.6)	84 (45.2)

BMI – Body mass index; WHR – Waist hip ratio

Table 4: Comparison between BMI and WHR

Parameter	BMI (kg/m²)	WHR	Regression coefficient	*P* value
Male	17.1±2.2	0.85±1.0	0.003	0.367
Female	18.1±2.8	0.82±0.6	0.016	0.043*

*Statistically significant; BMI – Body mass index; WHR – Waist hip ratio

was a statistically significant relationship between BMI and WHR among females, the regression coefficient, $r = 0.016$ was, however, minimal.

DISCUSSION

A variety of criteria for obesity have been used to evaluate prevalence and trends among adolescents. It can be measured directly in which serum fat mass are estimated or indirectly through the use of anthropometric measures. One of the simplest anthropometrics measures used is weight measurement. Weights for children and adolescents are typically evaluated in relation to average weight for age, height and sex and this information can be obtained from growth charts that are based on percentile distributions of body size attained at specific ages.[11]

Epidemiological studies worldwide generally show a consistent trend of increasing obesity prevalence among children and adolescents particularly over the past three decades.[12] The result of this study showed an overall prevalence of 4.2% using BMI, whereas, the prevalence of obesity using the WHR technique was 37.2% with majority being females. This rate using BMI is low when compared to a study done by Gauthier *et al.*,[12] where a prevalence of 20% was reported and another study among Australians adolescents in which the prevalence was 16%.[13] The result of this study is, however, higher than study by that Ansa *et al.*,[14] conducted among Nigerian adolescents whose prevalence of 4% for ages 13-15 years and 3% for ages 16-18 years with higher values among the females. Akinpelu *et al.,* also reported low prevalence ranging from 0.9% to 2.7%.[15] In accordance with previous reports, overweight and obesity prevalence rates varied as a function of gender. De Vito *et al.,* in their study among 11-19 year old children in Italy reported that 8.4% were obese with a higher rate in males (9.8%) compared with females (6.5%).[16] This is, however, contrary to this study in which the prevalence of obesity was found to be higher in females using both methods and this was statistically

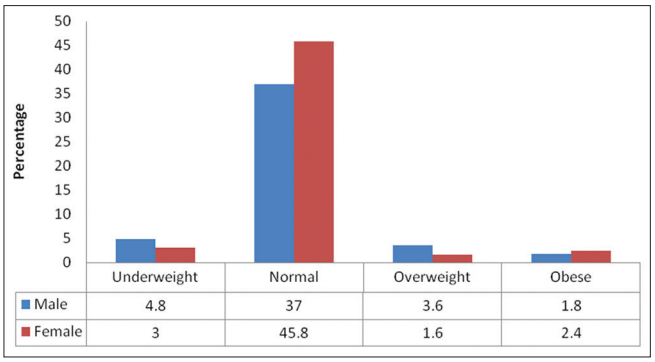

Figure 1: Prevalence of obesity using BMI technique

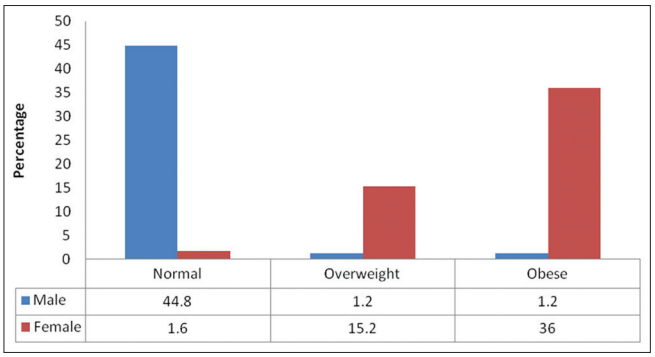

Figure 2: Prevalence of obesity using WHR

significant. This finding is consistent with other studies in which the prevalence of obesity and overweight was also higher in females.[14,17] An alternative measure is the Body Mass Index (BMI), a weight-height index that is calculated by dividing the body weight in kilograms by the square of the height in meters (kg/m²). It is a generally accepted and convenient method often used. It is easy to carry out and it is an acceptable method of assessing obesity. Although, it does not quantify total body adiposity or convey information concerning regional fat distribution and therefore regarded as a crude indication of the body fat content, BMI is useful in adolescents because it compares well to laboratory measures of body fat and is recognized to have a high correlation with adiposity.[18] The Centers for Disease Control and Prevention, 2000,[19] have developed growth reference charts, which include sex and age specific BMI ranges for children and adolescents. As observed in this study, obesity co-exists with undernutrition. Reports have shown that in many developing countries, obesity co-exist with under-nutrition.[20] In this study, there was a statistically significant correlation between BMI and WHR among the females as shown by regression coefficient, though the correlation was weak. This is in accordance with study by Farida *et al.,* who also reported significant correlation between the two methods.[21]

The disparity in the two techniques is not unexpected as WHR has been found to be more sensitive than BMI. This was the observation in a study by Ojofeitimi *et al.*, in which

WHR classified higher percentage of adult respondents to manifest excess body weight than BMI.[22] In general, the variations in the prevalence rates may be due to both environmental and genetic factors.

Waist circumference is also a common measure used to assess obesity with special reference to abdominal fat content. The presence of excess body fat in the abdomen, when out of proportion to total body fat, is considered an independent predictor of risk factors and diseases associated with obesity. Waist circumference is obtained by measuring the mid-point between the lower border of rib cage and the mid-iliac crest. The normal average waist measurement for males should be <94 cm (40 inches) while for females should be <80 cm (35 inches). Waist measurements of >94 cm and >80 cm for males and females, respectively, are considered as overweight. When the measurement is, however, >102 cm for males and >88 cm for females, the individual are regarded as obese.[23]

The waist-hip ratio (WHR) is another measure that is often used. It is achieved by measuring the circumference of the waist divided by the circumference of the hips. WHR greater than 1.0 in males and 0.8 in females has been shown to predict complications from obesity. According to Ojofeitimi et al., 2007,[22] WHR technique identified more respondents to be overweight and obese than BMI technique.

CONCLUSION

From this study, it was observed that there is a difference in the prevalence of obesity among adolescents using the two methods. WHR gave higher percentages of those that were obese whereas more females were noted to be obese compared to the males. There is also a weak correlation between the two methods among the females. Given the prevalence of obese individuals, prevention of obesity among these young ones should be encouraged especially among the females to reduce the risk of coronary heart disease, diabetes and other consequences of obesity in later years.

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