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BODY MASS INDEX OF NIGERIAN ADOLESCENT URBAN SECONDARY SCHOOL GIRLS

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Abstract

Background and Aims: *Body mass index (BMI) is an inexpensive and easy-to-perform method of screening for weight status, which may have detrimental health consequences. The aim of our study was to assess the pattern of BMI among Nigerian adolescent secondary school girls and determine the prevalence of underweight, overweight and obesity among them.* ***Materials and Methods:*** *In this school-based cross-sectional study, weight was measured, using the spring bathroom scale which was supported at all times on a rigid base. Height was measured without footwear with the heels together. The BMI was computed, using the formula weight/height^2 (kg/m^2). The BMI-for-age percentile chart was used in classifying the weight status of the subjects.* ***Results:*** *A total of 2,159 girls from two public urban day secondary schools participated in the study. Seven students declined to participate, giving a response rate of 99.7%. The overall mean weight, height and body mass index (BMI) of the participants were 43.16±6.07 kg (95% confidence interval, CI= 42.90-43.42), 151.53±6.20 cm (95% CI=151.27-151.79) and 19.76±3.07 kg/m^2 (95% CI= 19.63-19.89). The BMI values increased directly with age. Participants in the early adolescent stage demonstrated a significantly lower mean BMI value than either the middle or late adolescent stages. Based on WHO criteria, the prevalence rates of underweight, overweight and obesity were 7.1% (95% CI= 3.0-11.2), 8.3% (95% CI= 4.3-12.3) and 2.1% (95% CI= 2.0-6.2), respectively. The overall prevalence of healthy weight status was 82.5% (95% CI= 80.7-84.3).* ***Conclusion:*** *Nigerian adolescent secondary school girls are at increased risk of the double burden of nutrition as both underweight and overweight show a relatively similar prevalence rates.*

key words: *Body mass index, adolescence, schoolgirls, underweight, overweight, obesity.*

Background and Aims

According to the World Health Organization (WHO), individuals between the age of 10 and 19 years are regarded as adolescents [1]. The adolescent age group constitutes a large segment of the population of any nation. For instance, in Nigeria, adolescents account for approximately 23% of the total population [2]. It is estimated that there are 1.2 billion adolescents in the developing countries, representing one fifth to one quarter of the entire population [3]. Adolescent anthropometry is an indicator of nutritional status, health risk and may be

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diagnostic of obesity [1]. In general, less attention is paid to assessment of weight status during adolescence compared with childhood period [4], leaving clinicians and public health workers with relatively few tools for meeting the need to evaluate adolescents [1].

Anthropometric measurements are important, widely applicable, non-invasive and inexpensive techniques for assessing body size, proportions and composition. With regard to the adolescent, anthropometry is particularly important because it acts as a tool for the monitoring and evaluation of the hormone-mediated changes in growth and reproductive maturation during this phase of life [1]. The period of adolescence is one of the critical phases of life for the development of obesity and its presence may be ascertained, using the body mass index (BMI) [5]. The use of BMI percentiles may help to identify children at risk and quantify the severity of obesity. Prevention is critical, because effective treatment of obesity is limited. Indeed, BMI has been recommended as the basis for anthropometric indicators of underweight and overweight during adolescence [6]. Body mass index (BMI) is defined as kilograms (kg) of body weight per height in square meters (m^2) [1]. BMI is a widely used method to define the relationship between height and weight [7] and correlates (> 0.8) with body fat as determined by both skin fold thickness measurements and densitometry [8]. This suggests that BMI is a reasonable criterion for determining obesity in children and adolescents. Mei et al [9], demonstrated that for children and adolescents between the age of 2 and 19 years, the performance of BMI-for-age was comparatively better than other body-composition screening indices. Among the various anthropometric measurements, BMI has also been found to be the best established of all parameters that are related to cardiovascular diseases and risks [10]. Previous studies have shown that elevated BMI in childhood or adolescence is associated with increased risk of disease or death later in life [11-13]. According to American Diabetes Association (ADA) recommendation for screening for type 2 diabetes mellitus (T2DM) in children, presence of overweight plus two risk factors is an indication for such screening [14]. In this regard, determination of BMI and thus, overweight in adolescents represents the first step in searching for adolescents that qualify for screening for T2DM. In a recent literature review on the subject of screening for T2DM in children and adolescents, Agwu made a case for targeted opportunistic screening for overweight/obese adolescents with strong family history of diabetes and/or of ethnic minority origin [15]. Based on the above reasons, determination of BMI pattern in any given population is a worthwhile exercise. BMI is an inexpensive and easy-to-perform method of screening for the higher or lower weight categories, which may have detrimental health consequence [16]. According to WHO, using the BMI percentile range, weight status in children is categorized as follows: underweight (BMI less than 5^{th} percentile); normal weight (BMI between 5^{th} to < 85^{th} percentile); overweight (BMI between the 85^{th} to 95^{th} percentile); and obese (BMI more than the 95^{th} percentile) [1].

The purpose of the present study was to assess the pattern of BMI among Nigerian adolescent secondary school girls in Benin City and determine the prevalence of underweight, overweight and obesity among them.

Materials and methods

This descriptive-cross-sectional study was conducted in two public urban day secondary schools for girls in Oredo Local Government Area (LGA), Edo State, Nigeria. The two

schools were randomly selected by ballot from four all-girls' schools in the LGA [17]. The survey was designed to include all the students in the two schools (schools A and B), therefore no sampling was performed. There were a total of 1,394 girls in school A and 772 girls in school B, giving a grand total of 2,166 subjects, which was the target study population. The Research and Ethics Committee approved the protocol for the study. Permission to conduct the study was obtained from the school administrators, and the teachers sent consent forms to parents via the students asking for permission for the child to participate. The principals of the two schools introduced the authors during morning assembly. Subsequently, we addressed the students in their classrooms on the objectives of the study and we emphasized that the students' participation was entirely voluntary. The survey was conducted between October and November, 2012.

All the height and weight measurements were performed by one of the authors (ANO) with the assistance of the co-author, using the standard anthropometric methods of the International Society for the Advancement of Kinanthropometry (ISAK) [18]. The height of each of the participants was measured using a portable stadiometer which consisted of an anthropometer and a simple movable headboard. In measuring the height, the student stood straight, barefooted with the head held erect such that the external auditory meatus and the lower border of the eyes were in one horizontal plane (Frankfort plane). The buttocks, shoulder blades and heels touched the scale with the knees and legs together and the arms hanging naturally by the side. The movable headboard was brought against the crown of the head and the height measurement read off at maximum inspiration to the nearest centimeter and the value was recorded. The weight of each of the participants was measured to the nearest 50g, using a portable spring bathroom scale (Hana scale, model BR-9011). During weighing, the subjects wore light cotton school uniform and without any foot wear. The scale was supported at all times on a rigid base. Attention was paid to zero adjustment of the scale before each measurement and was regularly checked for accuracy, using known weights. The body mass index (BMI) was computed for each individual as weight in kilogram divided by the square of height in meters [BMI= mass (kg)/height (m^2)]. The BMI-for-age percentile chart was used in classifying weight status of the subjects. The BMI cut-off points used were those from WHO charts [1]. The study population was aged between 10 and 19 years and was categorized into stages of adolescence as follows: early (10-13 years old); middle (14-16 years old); and late (17-19 years old) [1].

Statistical analysis Statistical analysis was performed using the statistical package for social sciences (SPSS, version 16.0). Descriptive statistics such as frequencies, means, odds ratios, standard deviations (SDs), confidence intervals (CIs) and percentages were used to describe all the variables.

Results

At the time of the survey, a total of 2,166 girls (1,394 in school A and 772 in school B) were attending the two study schools. Seven students (5 from school A and 2 from school B) declined to participate, giving participation rates of 99.6% for school A and 99.7% for school B, with an overall participation rate of 99.7%. Thus, the study involved 2,159 adolescent school girls with a mean age of 15.3±1.2 years (95% confidence interval, CI=15.2-15.4). The early and middle adolescent stages together constituted 84.0% of the participants. The overall mean weight and height of the participants were 43.16±6.07 kg (95% confi-

dence interval, CI = 42.90–43.42) and 151.53±6.20 cm (95% CI = 151.27–151.79), respectively. As shown in Table 1, the mean weight increased progressively with age but dropped at the age of 19 years. Similarly, the height increased progressively with age but dropped at the age of 17 years.

Table 1. Age-specific distribution of participants and their anthropometric characteristics.

Age (years) of subjects	No of subjects No(%)	Anthropometric characteristics (mean±SD) Weight (kg) Height (cm)
10	113(5.2)	30.86±4.91 136.90±5.41
11	122(5.7)	34.85±6.04 143.11±6.10
12	320(14.8)	39.11±6.51 148.58±6.18
13	323(15.0)	44.77±6.56 153.60±6.10
14	365(16.9)	47.06±6.95 156.76±6.54
15	415(19.2)	49.66±6.25 158.23±6.05
16	154(7.1)	49.91±6.22 158.72±5.85
17	252(11.7)	51.64±5.92 157.55±5.78
18	68(3.1)	53.30±6.46 157.74±5.15
19	27(1.3)	52.74±6.00 158.31±5.55
Total	2159(100.0)	43.16±6.07 151.53±6.20

SD = Standard deviation

The body mass index (BMI) values increased directly with age (Table 2). The lowest and highest BMI values were observed at the ages of 11 and 18 years, respectively. The overall mean BMI of the participants was 19.76±3.07 kg/m^2 (95% CI = 19.63-19.89). The overall prevalence of normal BMI was 82.5%.

Table 2. Age-specific mean body mass index (kg/m^2) of participants.

Age (years) of subjects	Number of Subjects	Mean±SD BMI	95% CI
10	113	18.65±2.15	18.25-19.05
11	122	17.22±3.09	16.67-17.77
12	320	19.81±3.87	19.39-20.23
13	323	19.49±2.67	19.20-19.78
14	365	20.40±2.61	20.13-20.67
15	415	20.34±2.84	20.07-20.61
16	154	20.93±2.68	20.51-21.35
17	252	21.11±2.97	21.74-22.48
18	68	22.74±2.83	22.07-23.41
19	27	22.15±1.72	21.50-22.80
Total	2159	19.76±3.07	19.63-19.89

BMI = Body mass index; SD = Standard deviation; CI= Confidence interval

As depicted in Table 3, participants in the early adolescent stage demonstrated a significantly lower mean BMI value than either the middle or late adolescent stages. Out of a total of 2,159 participants, 153(7.1%; 95% CI=3.0-11.2) were underweight, 180(8.3%; 95% CI= 4.3-12.3) were overweight and 46(2.1%; 95% CI= 2.0-6.2) were obese. The remaining 1,780 (82.5%; 95% CI= 80.7-84.3) had healthy weight.

Table 3. Pattern of mean weight, height and BMI according to stage of adolescence.

Stage of Adolescence	No (%)	Mean weight (kg) (95% CI)	Mean height (cm) (95% CI)	Mean BMI (kg/m^2) (95% CI)
Early[a]	878	37.20±6.74 (36.75-37.65)	147.65±7.16 (147.18-148.12)	17.86±2.74 (17.68-18.04)
Middle[b]	934	45.25±6.11 (44.86-45.64)	155.82±5.88 (155.44-156.20)	20.53±2.24 (20.39-20.67)
Late[c]	347	52.84±7.26 (52.08-53.60)	155.22±6.00 (154.59-155.85)	22.32±2.67 (22.04-22.60)
Total	2159	43.16±6.07 (42.90-43.42)	151.53±6.20 (151.27-151.79)	19.76±3.07 (19.63-19.89)

BMI = Body mass index; SD = Standard deviation; CI= Confidence interval; BMI: a versus b: t= 3.37; $p < 0.05$; BMI: a versus c: t= 11.03; $p < 0.001$; BMI: b versus c: t= 4.47; $p < 0.01$

Discussion

The mean BMI (19.76±3.07kg/m^2) found among our study population is comparable to 20.0±3.5 kg/m^2, 20.0±3.4 kg/m^2, 19.5±0.1 kg/m^2 reported by Adesina et al in Nigeria [19], Montazerifar et al in Iran [20] and Goyal et al in India [21], respectively. Our data indicate that girls in early adolescent stage had a significantly lower mean BMI than either the middle or late adolescent girls. This observation is in keeping with the report of a previous study [19]. The lower mean BMI found among our early adolescent girls may be explained by the pubertal growth spurt which occurs in early adolescent stage in girls, since height is a denominator in the formula for the calculation of BMI. This age relationship defines the need to pay attention to BMI in the early adolescent stage, to prevent obesity later in life. In contrast, the report of a study in India indicated that mean BMI was higher in early than middle adolescent stage [21]. The reason for this difference is not clear.

The prevalence (7.1%) of underweight among our study population is comparable to that of 6.5% and 8.6% reported from Brazil and Russia [22], respectively but higher than the 3.8% found in another Nigerian study [19]. In the United States, the prevalence of underweight was 3.0% [22]. On the other hand, higher prevalence rates of underweight were found in Iran (10.1%) [20], China (11.5%) [22] and Turkey (11.1%) [23]. Another Nigerian study (Osun State) reported a higher prevalence rate (15.1%) which the author attributed to a high level of physical activity (farming) among their subjects [24]. Farming is not a prominent feature among our subjects. Thus, explaining the wide difference in prevalence rate of underweight between the two study populations. A similar study among Qatari adolescent school girls found that the prevalence of underweight was 5.8% [25]. The higher prevalence rate of underweight found among our study population compared with that of the other Nigerian study [19] may be due to within country differences in socioeconomic status related to study location. Their study location (Port Harcourt) is home to many multi-million dollar foreign companies engaged in the petroleum industry. Thus, their study population may come from relatively affluent families, making underweight less likely. This view is reinforced by the two-fold increase in underweight prevalence among poor farming population in Osun State, Nigeria [24]. In the case of the United States, it may be due to differences in dietary habits between the two adolescent populations. Consumption of junk food and chocolate are known risk factors for overweight [21] and this is a common eating habit among adolescent girls in the United States. Again, dietary differences may explain the higher prevalence of underweight found in Iran, China and Turkey compared with our study population. Indeed, Öner et al [23], attributed low BMI among adolescents living in the city Ederine, Turkey, to consumption of Mediterranean type of diet which contains more vegetables and less meat and carbohydrate.

The prevalence (8.3%) of overweight in our study is similar with that of 8.4% reported from Iran, using the same criteria [20]. However, the prevalence found in our study is slightly lower than 9.4% reported in another Nigerian study [19] and 9.3% reported from India [21]. A relatively higher prevalence rate (18.9%) of overweight has been reported among Qatari adolescent girls [26]. Another Nigerian study involving adolescent rural girls who are predominantly farmers reported a lower prevalence rate (6.0%) [24]. The authors attributed the relatively lower prevalence of overweight among their study population to consumption low energy-dense food and

increased physical activity related to farming, all reflecting the geographic variation of the prevalence of overweight. The practical implication of the varying differences in prevalence rates of overweight is that caution needs to be exercised when comparing prevalence rates from different studies because of its variation with gender [23], age of the study population [25], location of study (urban or rural) [23,24], socio-economic status [21], dietary habits [23] and lifestyle practices [25]. In the present study, the prevalence of underweight (7.1%) and overweight (8.3%) were relatively similar, suggesting that adolescent girls in our society are experiencing a double nutritional burden. This is not surprising because a similar finding has been reported from Port Harcourt, Nigeria [19]. A study in Istanbul, Turkey [23] involving urban adolescent girls revealed that the prevalence of underweight (10.0%) and overweight (10.3%) were comparatively similar, reflecting a double nutritional burden. A similar pattern of prevalence of underweight (5.7%) and overweight (4.6%) was also observed in an Iranian study [25]. In a recent study in India, Sharma et al [26], equally noted this double nutritional burden in adolescent girls.

Obesity prevalence (2.1%) in the present study is consistent with that of 2.1% reported from Turkey [23], 2.0% in Iran [25], and 2.9% reported from Port Harcourt, Nigeria [19] but higher than 1.5% reported from India [21]. The relative similarity in prevalence of obesity in adolescent girls in Nigeria, Turkey and Iran may be related to similarity in levels of physical activity and energy expenditure. Studies have shown that in adolescent girls, only the time spent on physical activity and the energy expenditure were significantly associated with overweight and obesity [25,27-30]. Differences in dietary habits between Nigerian adolescent girls and their Indian counterparts may explain the higher prevalence of obesity in our study compared with the study in India. On the other hand, our result is lower than the 4.7% reported from Qatar [27]. The lower prevalence of obesity in the present study compared with the study in Qatar may be due to differences in socio-economic status and level of sedentary lifestyles between Nigeria and Qatar.

Conclusion

In conclusion, Nigerian adolescent secondary school girls are at increased risks of the double burden of nutrition as both underweight and overweight show a relatively similar prevalence rates.

Duality of interest: There is no conflict of interest.

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