Prevalence of Obesity and Predisposition to Metabolic Syndrome among School-Based Adolescents in Botswana and Nigeria

by

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Abstract

The increasing prevalence of overweight and obesity across the globe has been described as epidemic. This study compared the prevalence of overweight, obesity and body fat distribution between adolescent females in Nigeria and Botswana. Participants were drawn from secondary schools in both countries. The variables measured were weight, height, body mass index (BMI), waist/hip circumference (W/HC) ratio. WC was used as a measure of abdominal adiposity, BMI for general adiposity and HC for subcutaneous adiposity. Data were analysed using descriptive statistics and ‘t’ test to compare the two groups. There were significant differences in age, height, body weight, BMI, HC and W/HC ratio except WC. Increased physical activity was recommended.

Introduction

In the developed world, obesity is now the most common disease of childhood and adolescence (Reilly, 2006). Hill (2006) submitted that since 1980, the entire population, both in the United States of America and throughout the world have been increasing in weight. The prevalence and increasing incidence also seem to cut across socio-economic status, level of education, age and the level of development of the population (Caterson and Gill, 2002; Fontana, et al. 2007; Fouad, Rastam, Ward and Mazak, 2006; Hippel, Powel, Downey and Rowland, 2007; Senf, Shisslak and Crago, 2006). In Africa and other developing countries, there have been an acute transition from traditional to a westernized or modern-world life-style. For instance, in Nigeria, (West Africa), and in Botswana, (Southern Africa), fast food outlets have increased in the last 10 years. Working and non-working citizens of all age categories have deemed it fashionable and convenient to buy and eat at the fast food outlets rather than prepare their food and eat at home. Researchers have classified obesity into central and general (Ascanso, et al., 2003; Brunner, et al., 2007; Gutin, et al, 2007; Willis, et al., 2007; Okura, et al 2003). The most widely used measures of total or general and abdominal obesity or adiposity are the body mass index (BMI) and waist circumference respectively. While abdominal obesity is recognised as a major risk factor for coronary heart diseases (CHD), waist circumference and WHR are more strongly associated with metabolic risk factors, incident cardiovascular disease (CVD) events and deaths (Fouad, et al. 2006; Heitmann, et al. 2004).

According to Senf, et al. (2006), there is an increasing prevalence of weight-related diseases in children. Excess body adiposity is a major component of Metabolic Syndrome (MS), a consortium of diseases which have been traced to later lead to diabetes type 2, heart diseases and cerebro-vascular accident, if not properly controlled and treated (Bakker et al. 2007;
Kaslimal et al 2006). MS is a cluster of health threatening and life-style related conditions. According to Bakker, Gansevoort and de Xeeuw (2007), the criterion used to define MS are, increased waist circumference, increased triglycerides, decreased HDL-cholesterol, increased blood pressure and increased plasma glucose. Any one who has three or more of these criteria is diagnosed as having MS.

Among children, the epidemic of childhood inactivity and consequent obesity appear to be fuelled by several factors including societal, cultural, industrial, financial, environmental and family factors. Although Parsons, Power, Logan and Summerbell (1999) suggested that parental obesity, low economic status and early maturation were some of the major factors that predispose to overweight and obesity in childhood, findings and research reports indicated increasing prevalence of overweight and obesity to be independent of socio-economic status (Corvalan et al. 2007; Fouad et al. 2006; McCarthy et al. 2005). Corvalan et al. (2007) reported significant positive association between size at birth, infant, early and later childhood growth and adult body composition. They found increased BMI in infancy and later childhood to be positively associated with four adult body composition measures of Body BMI, percent body fat, abdominal circumference and fat-free mass.

Indeed overweight and obese children and adolescents have been known to shun physical activities, are socially inept, lazy and possess negative self-image. It has also been linked with breathing problems (CDC-NCHS, 2007). Ochs-Balcom, et al. (2006), reported significant inverse relationship between abdominal adiposity and pulmonary function. Obesity affects the quality of life and increases health care costs (Bowman, 2006; JAMA, 2006).

Anthropometric measures of relative fatness are inexpensive and easy to use. The indirect methods of estimating body composition include measuring Body Mass Index (BMI), waist circumference, hip circumference and waist hip ratio. According to the Council on Sports Medicine and Fitness and Council on School Health (2006), BMI tends to correlate well with more precise measures of adiposity.

This study therefore compared the prevalence of overweight, obesity and body fat distribution between females in two African countries, Nigeria and Botswana. The two countries are socio-economically, politically and ethnically comparable. Null hypothesis was set for each of the measured variables and was tested at an alpha level of p< 0.05

Method

Participants

Participants comprised secondary school female students. Letters seeking consent for the study were written to the respective school heads and only those schools, whose Heads gave permission were used in the study. The schools included both public and private ones. In Nigeria, the ages of students in secondary schools, ranged from 11 to 18 years due to a liberal secondary school entrance age policy, while in Botswana, the age range is strictly from 13 years to 20 years. Two hundred students were sampled from 10 secondary schools in Nigeria’s business capital, Lagos (200) while two hundred and twenty two were sampled from 10 schools in Botswana capital, Gaborone. Participants were selected randomly from among only those who regularly participated in the schools recreation activities after school hours. A total of 422 female adolescents were involved in the study.

Procedure for data collection

The variables measured were body weight, height, Body Mass Index (BMI), waist circumference, hip circumference and waist-hip ratio. While waist circumference was used as a measure of
central or abdominal adiposity, BMI was used as a measure of general adiposity. Hip circumference was used as a measure of subcutaneous adiposity. While subject’s weight was measured with standard Avery weighing scale, calibrated from 1 to 200 Kg, subject’s height was measured with a stadiometer attached to the weight scale. The stadiometer was calibrated from 1 cm to 220 centimeter. Before use, each instrument was re-calibrated with known weights and heights respectively. The waist and hip circumferences were measured according to the procedure of Norton and Olds (1996). While the waist circumference was taken at the level of the narrowest point between the lower coastal border and the iliac crest after expiration, the hip circumference was taken at the level of the greatest posterior protuberance of the buttocks. Measurements were taken in centimeters to one decimal place. The international classification of overweight and obesity according to BMI (CDC-NHANES, 2007; Tuncelli, et al., 2006; WHO, 2006) was adopted:

- Normal range: 18.5 - 24.99 (Kg/m2)
- Overweight: 25 – 29.99 (Kg/m2)
- Obese > 30 (Kg/m2)

Before the collection of data, the aims and demands of the measurements were explained to all participants in the presence of their sports or Physical Education teacher. All students thereafter signed the informed consent for participation form. Data were collected by the two main researchers, who were assisted by three trained testers each. The main researchers were present throughout all data collection processes.

**Data Analysis**

Data were analyzed for means and standard deviation while the ‘t’ test for independent samples was used to compare the two groups and to test the null hypotheses.

**Results**

Table 1 shows the result of the measured variables and the associated ‘t’ test measuring the mean differences between Nigeria and Botswana female adolescents. There were significant differences in age, height, body weight, BMI, hip circumference and waist hip ratio. They were however not significantly different in waist circumference.

Although samples were drawn from the respective country’s secondary schools, Botswana subjects were significantly older than Nigeria’s (p<0.05). This can be attributed to the different educational policies on age of entry into secondary schools, of the two countries. While Nigeria operates a liberal policy that allows children to progress into Secondary Schools at individual pace, provided they pass the entrance examination, Botswana children can only sit for entrance examination and be admitted into secondary school from the age of 13 years. Botswana children enter the primary schools at the age of 7 and must go through a mandatory 7-year primary school education programme.

However the regular age for admission into primary school in Nigeria is 6 years. Thus while the average Nigerian child enters secondary school at the age of 10-11 years, the average Botswana child enters at the age of 13 years. The age range of the Nigerian adolescents was 11-18 years while that of Botswana was 13 to 20 years. Based on this significant age difference one would expect the Botswana group to manifest poorer adiposity measures. This is because studies have reported direct relationships between age and physical inactivity and its measures (Gregory, et al., 2007; Han, et al., 1998; Hussey, et al., 2007).

Samples Mean BMI fall into the desirable category of BMI (CDC-NHANES, 2007; WHO, 2006). However, Bell et al. (2006) in a study on 6-13 year-old children found an increasing BMI z-score
to be continuously associated with complications of overweight in children. They explained further that children’s risk of most complications increase across the entire range of BMI values including those within the desirable values.

Table 1: Nigeria-Botswana Female Adolescents Physical Characteristics and ‘t’ test. (n1=200; n2=222; N=422)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Nigeria Adolescents</th>
<th>Botswana Adolescents</th>
<th>‘t’ value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>14.67</td>
<td>15.32</td>
<td>5.183</td>
<td>0.001</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.61</td>
<td>1.57</td>
<td>3.352</td>
<td>0.001</td>
</tr>
<tr>
<td>B-Weight (kg)</td>
<td>48.68</td>
<td>52.22</td>
<td>4.435</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>18.97</td>
<td>21.31</td>
<td>7.071</td>
<td>0.001</td>
</tr>
<tr>
<td>W-C. (cm)</td>
<td>63.60</td>
<td>63.69</td>
<td>0.085</td>
<td>NS</td>
</tr>
<tr>
<td>H-C (cm)</td>
<td>73.80</td>
<td>86.68</td>
<td>10.109</td>
<td>0.001</td>
</tr>
<tr>
<td>W-H ratio</td>
<td>0.867</td>
<td>0.734</td>
<td>18.222</td>
<td>0.001</td>
</tr>
</tbody>
</table>

In order to identify specific influences on the comparison, Botswana girls were found to be significantly older, shorter, heavier, had higher BMI, higher hip circumference and lower WHR than their Nigerian counterparts. Except for waist circumference where the two groups were not significantly different. Although the Botswana girls were significantly shorter, they had 7.3% more body weight than the Nigerian girls. It is worth noting the culturally unique large hip circumference of Botswana girls. While they did not differ in waist circumference, the Botswana girls had 17.5% more hip circumference. This obviously resulted in the significantly lower WHR of the Botswana girls. The WHR of 0.867 of the Nigerian girls falls into very high risk zone of the WHR norm for 20 -29 years old lady (Heyward, 2002). Considering the fact that as young girls, they are not expected to have accumulated much visceral fat, they are thus expected to have less WHR.

Discussion

The fact that the Botswana adolescents were significantly older than their Nigerian counterparts would make one to expect the Botswana group to be more predisposed to metabolic and CVD risks but the reverse appears to be the case. The Botswana group had a larger hip circumference, which according to results from several studies, should protect them against metabolic and CV diseases (Heitmann, et al., 2004; Yusuf 2006; Snijder et al., 2006; Wang and Hoy 2004). Indeed, Snijder, et al. (2004) in a study on variety of non-white ethnic groups confirmed the protective association of relatively larger hips against metabolic and CV diseases. The relatively large hips are a culturally unique feature of Botswana citizens and it is more pronounced in the females. This might be the major reason why cardiovascular diseases are not major health concerns in Botswana, at least for now. However blood pressure problems was 7.2%, of all out-patients attendance in the hospitals in 2000 (Botswana Central Statistic Office, 2003) and is the third most common health problem. Since there are other several causes of blood pressure problems, it is doubtful if obesity is the major cause among Botswana adults.

The influence of fast food eateries on nutrition is a negative trend even though it is now an important part of the new and modern life in Nigeria. All these luxuries of modern life could be held responsible for the high adiposity and low physical activity levels of the adolescent Nigerians. Although the Nigerian adolescents have more access to recreation opportunities, it is
doubtful if they made adequate use of these opportunities. On the other hand, Botswana adolescents seem to be genetically protected, at least for now, against metabolic and CVD risks consequent to their large hips relative to their waist.

Conclusion

There were significant differences in age, height, body weight, BMI, hip circumference and waist/hip ratio except in waist circumference. It was observed that large hips is a culturally unique feature of Botswana citizens and reasons for low risk rating in obesity while the reverse is the case for Nigeria female adolescents. In order to check and stem the predisposition to obesity's ugly trend, a multi-disciplinary and multi-factoral approach appears inevitable. For instance, this may include the introduction and the expansion of the school Physical Education (PE) programme and making PE curriculum compulsory in schools from pre-primary and elementary to senior secondary, making recreation periods, in addition to food breaks, compulsory in all schools, encouraging children to pursue physically active life styles and making activity-promoting changes in the environment. Since parents have also been implicated as significant factors in children and youths physical activity levels and intensity, there appears the need to counsel parents on the needs to encourage their children to spend quality and active out-door life. Warburton et al. (2006), suggest counselling parents and children on the several health benefits of physical activity while Slentz, et al. (2007) presented empirical results showing that physical inactivity has profound negative effects on lipoprotein metabolism. Therefore, active lifestyle must be promoted in the prevention of metabolic syndrome.

Reference

Bell, L., Byrne, S., Thompson, A., Ratnam, N., Blair, E., Bulsara, M. Et al. (2006). Increasing BMI z-score is continuously assoaited with complications of overweight in children, even in the health weight range. Journal of Clinical Endocrinology & Metabolism, doi.10.1210/jc.2006-1714


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