Original Research Article

Over weight, obesity and metabolic syndrome in a semi urban adolescent population in Uyo, Nigeria

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Abstract

Background: Overweight and Obesity are becoming increasingly common in developing countries with the attendant health risks associated with these conditions including Metabolic syndrome. The aim of this study was to find out the prevalence of overweight, obesity and metabolic syndrome in a population of adolescents living in a semi urban area and the relationship between the weights of these children and the various components of the metabolic syndrome. **Materials and Methods:** One hundred and fifty-five adolescents aged 10-17 years were selected via a multistage random sampling technique. Sociodemographic data were obtained using a structured questionnaire and anthropometric indices were measured using standard tools. Overweight and obesity were defined based on the International Obesity Task Force criteria while metabolic syndrome was defined using the International Diabetes Foundation criteria. Blood samples were taken for Fasting blood sugar, serum Triglycerides and High-density lipoprotein cholesterol. **Results:** The prevalence of overweight, obesity and metabolic syndrome were 1.94%, 0%, and 1.94% respectively. Weight showed a significant positive correlation with the study participants' waist circumference, systolic and diastolic blood pressures but not with serum triglyceride, high density lipoprotein cholesterol and fasting blood glucose levels. Abdominal obesity and hyperglycaemia werealso significantly associated with Metabolic syndrome. **Conclusion:** The prevalence of overweight, obesity and metabolic syndrome was very low in the population studied however, weight demonstrated a significant positive correlation with some components of the metabolic syndrome.

Key words: Adolescents, Metabolic syndrome, Overweight, Obesity

Introduction

The terms overweight, obesity and metabolic syndrome are conditions that are becoming increasingly common in various parts of the developed world especially in the adult population [1]. In developing countries also, overweight and obesity have become more prevalent even in children with the attendant health risks associated with them [1-2]. Obesity in itself may or may not necessarily lead to Metabolic Syndrome (Met S) but can be considered as a marker for Met S [3].

Metabolic syndromeconsists of a group of risk factors which have been found to predispose individuals to the development of cardiovascular disease, type 2 Diabetes Mellitus (DM), hypertension, dyslipidaemia, non-alcoholic fatty liver disease (NALFD), polycystic ovarian syndrome (PCOS) and obstructive sleep apnoea (OSA)[4].

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There are varying definitions of MetS in both children and adults [5-9]. Defining MetS in children is more difficult because of the variability in their metabolic status throughout childhood [10]. Also, as they transition from adolescence to adulthood, large proportions of children previously defined as having MetS during childhood, do not meet the diagnostic criteria on follow-up 3 to 6 years later [11]. Despite this variability, Morrison et alfound that MetS in childhood predicted both MetS and type 2 Diabetes mellitus in adulthood 25-30 years later [12].

There is a paucity of studies on MetS in our environment especially in children and because this syndrome represents a clustering of cardiometabolic risk factors that can predispose these children to the development of cardiovascular disease and type 2 DM in latter life, it has become pertinent to screen for its occurrence and predisposing risk factors in our environment and hence the purpose of this study.

Materials and Methods

Ethical considerations: Ethical approval for the study was obtained from the University of Uyo Teaching Hospital ethics and research committee while informed consent was obtained from the study participants/parents.

Study setting and population: This study was conducted in Mbiabong Etoi, one of the twenty-two villages in the Etoi clan of Uyo local government area of Akwa Ibom state in south Nigeria. It is a semi urban metropolis located to the north of the state capital, Uyo. A simple random sampling method was used to select Mbiabong community out of the twenty villages and it has only one secondary school from which the study subjects were recruited.

One hundred and fifty-five children aged between 10-17 years were recruited into the study, twenty-sixstudents each were randomly selected by a simple balloting system from each class arm i.e. classes 1- 5, twenty-five from class 6. The minimumsample size was calculated using the formula for calculating sample size for a cross sectional study [13] using a prevalence rate for Metabolic syndrome of 0.9%[14].

Data collection: Demographic data was obtained using a structured questionnaire. Anthropometric parameters including weight, height, and waist circumference (WC) were measured using standard tools. Height and weight were measured with subjects wearing light clothing and without shoes. Height was measured with a stadiometer and recorded to the nearest 0.1 cm. Weight was also measured to the nearest 0.1 kg using a calibrated scale after adjusting appropriately before each measurement. The waist circumference was measured to the nearest 0.1 cm at the midpoint between the bottom of the rib cage and the top of the iliac crest at the end of exhalation. The participants' blood pressure was measured twice after a 15-minute rest using the right arm, and the mean was recorded as their blood pressure. Hypertension was defined as elevated systolic blood pressure (SBP) ≥130mmhg, diastolic blood pressure (DBP) ≥85mmhg. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Overweight and obesity were defined based on the International Obesity Task Force (IOTF) definition which defines obesity as body mass index(BMI) ≥30 and overweight as BMI ≥25[15].

Specimen collection/Laboratory analyses: Venous blood was collected from the study participants following a 10-12 hour overnight fast. Using a multi sample needle, blood was collected from the cubital fossa after antiseptic preparation of the venipuncture site. The blood for fasting plasma glucose was tested using a Fine Test glucometer while that for serum triglycerides (TG) and high-density lipoprotein cholesterol (HDL-c) was collected into plain vacutainers and allowed to clot. Specimens were centrifuged using the bucket centrifuge at 4000 rpm for ten minutes and the supernatant collected. Low density lipoprotein (LDL) and very low-densitylipoprotein (VLDL) fractions were precipitated quantitatively by the addition of phosphotungistic acid. After centrifugation, the cholesterol concentration in the HDL fraction was determined by the enzymatic end point method. Serum TG assay was done using enzymatic methods (Colorimetric). All three assays were performed using the Spectrum lab Chemistry Analyzer, New Life Medical Instrument, England and quality control sera from Randox Laboratories, UK.

Definition of MetS: This was defined as the presence of abdominal obesity and at least two out of the four components of hyperglycaemia, elevated blood pressure, hyper triglyceridaemia and low High-Density Lipoprotein-c as defined by the International Diabetes Foundation (IDF) criteria for MetS [Table 1][5].

Table-1: The International Diabetes Federation Consensus Definition for Metabolic Syndrome. Adapted from Zimmet et al.

Criteria	Age(10-16years)	Age(>16years)
Abdominal Obesity	WC ≥ 90th percentile or adult cut-off if lower	WC ≥ 94cm in males. WC ≥ 80cm in females
Hypertension	SBP ≥ 130mmHg or DBP ≥ 85mmHg	SBP ≥ 130mmHg or DBP ≥ 85mmHg
Hyperglycaemia	FPG ≥ 5.6mmo/L(100mg/dl)	FPG ≥ 5.6mmo/L(100mg/dl)
Dyslipidaemia	TG ≥ 1.7mmol/L (150mg/dl) and/or HDL-c < 1.03mmol/l(<40mg/dl)	TG ≥ 1.7mmol/L(150mg/dl) and/or HDL-c <1.03mmol/l(40mg/dl) in males, <1.29mmol/l(50mg/dl) in females

Data Analysis- Data was analyzed using STATA Corp version 15 and all analysis was performed at 5% level of significance. All data were re-coded during data cleaning with no link to individuals. Frequency tables were constructed for the data with quantitative variables expressed as Mean ± SD, and qualitative variables as frequencies (percent).

Pearson's moment correlationwas used to determine the levels of correlation between the components of MetS and weight and the level of statistical significance was put at 5%. The study participants were classified as either underweight, normal weight, overweight or obese based on the International Obesity Task Force (IOTF) definition [15]. The composite variable called metabolic syndrome was computed using the IDF criteria [5].

Results

There was a total of one hundred and fifty-five adolescents whowere recruited into the study of which 110 (70.97%) were females and 45 (29.03%) were males giving a F:M ratio of 2.4:1. The ages of the subjects ranged from 10-17 years with mean and standard deviation of 13.99±2.21 and their weight (Kg) ranging from 19 to 72 with mean and standard deviation of 42.03±10.45. Other characteristics of the subjects are as presented in Table 2.

The BMI classification of these study participants showed that 1.94% are overweight and 58.06% are underweight (Table 3). Also 1.94% of these adolescents had metabolic syndrome. The distribution pattern of the components of metabolic syndrome is presented in Table 4.

Only abdominal obesity and hyperglycaemia were found to be significantly associated with the presence of MetS in this study (χ^2 = 40.048, p-value =< 0.0001, χ^2 = 5.057, p-value = 0.025 respectively).

The study participants weights showed a significant positive correlation with their waist circumference, systolic and diastolic blood pressures as displayed in Table 5. Also, WC was found to be positively correlated with SBP and DBP.

Table-2: Characteristics of Study Participants.

Characteristics	Frequency (%)	Mean ± SD	Minimum	Maximum
Age		13.99±2.21	10	17
Gender				
Male	45 (29.03)			
Female	110 (70.97)			
Weight		42.03±10.45	19	72
Height		151.23±11.45	115	182
Waist Circumference		65.09±6.30	50	96
Systolic Blood Pressure		108.06±14.24	76.6	163
Diastolic Blood Pressure		67.52±10.37	33	100
Triglycerides		1.37±0.48	0.6	2.8
High Density Lipoprotein		1.03±0.39	0.3	2.6
Fasting Blood Sugar		5.36±0.56	3.5	6.8

Table-3: Body Mass Index (BMI) Categories.

BMI Category	Frequency (%)
Underweight	90 (58.06)
Normal Weight	62 (40.00)
Overweight	3 (1.94)

Table-4: Pattern of Distribution of Components of Metabolic Syndrome.

	Metabolic Syndrome		χ^2 (P-value)
	No (%)	**Yes (%)**	
Abdominal Obesity			40.048 (<0.0001)
No	144 (94.74)	0 (0.00s)	
Yes	8 (5.26)	3 (100.00)	
Hypertension			0.102 (0.749)
No	147 (96.71)	3 (100.00)	
Yes	5 (3.29)	0 (0.00)	
Hyperglycaemia			5.057 (0.025)
No	79 (63.71)	0 (0.00)	
Yes	45 (36.29)	3 (100.00)	
Triglyceridaemia			0.060 (0.806)
No	149 (98.03)	3 (100.00)	
Yes	3 (1.97)	0 (0.00)	
HDL			2.269 (0.132)
No	66 (43.42)	0 (0.00)	
Yes	86 (56.58)	3 (100.00)	

Table-5: Correlation of components of metabolic syndrome to Weight

	Weight	WC	SBP	DBP	TG	HDL	FBS
Weight	1.000						
WC	0.7576*	1.000					
SBP	0.5869*	0.4409*	1.000				
DBP	0.5230*	0.4022*	0.7741*	1.000			
Triglycerides (TG)	-0.1380	-0.0509	-0.0558	-0.0306	1.000		
HDL	0.1122	0.0573	0.0664	0.0990	-0.0751	1.000	
FBS	0.0924	0.1719	0.1493	0.1394	0.0938	-0.0582	1.000

WC – Waist Circumference; SBP – Systolic Blood Pressure; DBP – Diastolic Blood Pressure; TG – Triglycerides; HDL – High Density Lipoprotein; FBS – Fasting Blood Sugar

*Significant correlation at 5% level of significance

Discussion

Overweight and obesity are one of the major predisposing factors for the development of Metabolic syndrome [10,16]. With the increasing prevalence of these two factors in developing countries, it is expected that the prevalence of MetS will also rise. None of the participants in this study was found to be obese based on the IOTF definition for obesity using the BMI cut off ≥30. Prevalence rates for overweight and obesity in adolescents have been found to vary in different parts of Nigeria. In south western Nigeria, Ojofeitimi et al in a rural area in Osun state of Nigeria, obtained prevalence rates of obesity ranging between 0-0.2% in adolescent females attending public and private schools respectively which is similar to the findings in this study that was also conducted in a public school [17]. This is contrary to the findings by Oduwole et al in Lagos, a cosmopolitan city who obtained a rate of 9.4% [18]. In the south south, Ansa et al obtained rates of between 3-4% in adolescents aged between 13-18 years [19]. In Uyo, Opara et al obtained a prevalence rate of 0.2% in children aged between 2-14 years in public schools which is similar to what was obtained in this study [20]. These variation in prevalence rates in obesity obtained in the different studies may be explained by the various cut off points used for defining obesity and overweight in these studies and environmental influences such as diet and lifestyle.

Very few studies have been done on the prevalence of MetS in children and adolescents in our environment. Most of the published studies in Nigeria have been done on MetS in adults with varying frequencies based on different criteria for defining MetS [21-23]. The frequency of MetS obtained in this study was very low when compared to that obtained by Onyenekwu et al in his study which was carried out on adolescents and young adults aged between 13-23 years. He had a prevalence rate of 14.3% with 84.6% of those with MetS being adolescents [16].

This study was carried out in already overweight and obese adolescents and young adults when compared with the index study and demonstrates the fact that MetS is commoner in obese and overweight adolescents when compared with those who are of normal weight or underweight. This finding is also buttressed by Ahmadi et al in a study on adolescents in Iran and Chen in China where compared with normal weight children, overweight and obese children were more likely to have MetS[24-25].

Studies done in Africa on MetS have been done mainly in adults however, Aboul Ella in Egypt in North Africa obtained a prevalence rate of 7.4% in 4250 adolescents aged 10-18 years [26]. This prevalence rate is also much higher than what was obtained in this study. The small sample size of the index study when compared to the large sample size in the Egyptian study is the likely explanation for this significant difference and buttresses the fact that a much larger study is needed in our environment. In assessing the correlation between various components of the Met S and the weights of study participants, it was found that their weights demonstrated a significant positive correlation with their systolic and diastolic blood pressures and their waist circumference but not with their triglyceride, high density lipoprotein and fasting blood sugar levels.

Weight, which is a measure of general adiposity being one of the components of BMI plays a significant role in the development of MetS. Onyenekwu et al found significant differences in the BMI, waist circumference, systolic blood pressure, fasting plasma glucose and HDL levels between those who had MetS and those who did not have with those who had MetS having higher values of BMI, WC, SBP and FPG [16]. This also buttresses the finding in this study where hyper-glycaemia was significantly more common in those with MetS when compared to those without. They had a low prevalence of hypertriglyceridaemia which corroborates the finding in the index study that weight was not significantly correlated with triglyceride levels. This is contrary to findings by Ahmadi et al who observed significant, consistently higher values of TG in both younger and older adolescents who were overweight and obese than in those of normal weight. This observed difference may be as a result of diet and lifestyle factors [24].

Systolic and diastolic blood pressure also showed a significant positive correlation with the weights of the study participants and is in keeping with findings by various other authors[27-29]. Fasting blood sugar did not demonstrate any significant correlation with weight in this study. This is similar to the observation in the Iranian study by Ahmadi et al[24] that there was no significant difference in fasting blood sugar levels between those who were of normal weight, overweight or obese in junior high school students.

However, this observed trend did not hold true for those in the high school who were presumably older adolescents for which they proffered changes in the hormonal milieu as a possible explanation. Onyenekwu et al[16] also did not findany significant difference in FBS between those who were of normal weight and those who were overweight or obese and corroborates the finding in this study.

Waist circumference (WC), which is a measure of central adiposity and is the major criterion in the definition of MetS using the IDF criteria [5] was significantly associated with the presence of MetS in this study and also had a significant positive correlation with the weight of the study participants and this corroborates findings by other authors [16,24]. Chen et al also observed that WC was a more sensitive predictor of MetS and its components in children when compared to BMI as was the case in this study[30].

This central adiposity is a consequence of the pathophysiological processes found in MetS in which insulin resistance is the root cause [10].

The major limitation of this study was its relatively small sample size when compared to the large studies done in other settings and is an area for future research while its area of strength is the additional information it gives about Metabolic syndrome in an age group that has been least studied in our environment.

Conclusion

In conclusion, the prevalence of overweight adolescents in this study was very low with none of them being found to be obese, rather over fifty percent of them were underweight. The prevalence of MetS in this study population was also very low and in the small percentage that had MetS, waist circumference, systolic and diastolic blood pressure were found to have a significant correlation with the weights of the individuals concerned. The findings in this study suggest that overweight, obesity and MetS are not yet health problems in adolescents in our environment as findings in other areas of the country and developing world indicate. However, with the gradual urbanization taking place in our environment, it is pertinent to note that it may be just a matter of time before these problems become prevalent and thus, there is still a need for health education for the populace.

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