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Evaluation of microalbuminuria in obese adolescents

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Abstract *Background:* Obesity is a risk factor for metabolic syndrome with insulin resistance. Its effect on renal and cardiovascular diseases is reported in developed countries, but rarely established among adolescents in developing countries.
Subjects and methods: A cross-sectional study of 846 adolescents selected from 12 secondary schools in Port Harcourt, Nigeria. Obese subjects with Body Mass Index (BMI) equal to or greater than the 95th percentile for age and sex on the United States CDC growth chart were selected and studied. Urine samples of subjects without overt proteinuria were tested for microalbuminuria using the micral test strips.
Results: Seventy-three of the subjects were obese giving the prevalence of obesity to be 8.6%. Microalbuminuria was present in 23 (35.4%) of the 65 obese subjects without overt proteinuria. The proportional prevalence was higher in females (42.9%), in age group 10-14years (42.2%), in subjects with hypertension (57.1%), and family history of hypertension (50.0%) and diabetes mellitus (37.5%) [p > 0.05].
Conclusion: There is high prevalence of adolescent obesity, and a high prevalence of microalbuminuria among obese adolescents in Port Harcourt. We recommend efforts at reducing obesity as a means of preventing renal disease in adolescents.

Key words: obesity, microalbuminuria, end stage renal disease, adolescents, Nigeria

Introduction

Obesity is a major worldwide public health problem, and its prevalence is increasing like an epidemic.[1,2] Obese children are at greater risk for type 2 diabetes mellitus, cardiovascular and renal damage/disease as adolescents and also in adult life.[3] These complications are attributed to the widespread vascular endothelial dysfunction in obese subjects.[4] Microalbuminuria is a marker of endothelial dysfunction and an indicator of early damage to the kidneys and cardiovascular system.[5]

Previous community-based studies in children in the United States of America (USA) showed that overweight children had less microalbuminuria than leaner children.[6,7] However, studies from obesity clinics also in the USA reported that among overweight children, presence of various cardiovascular risk factors such as diabetes mellitus, insulin resistance and hypertension were associated with more microalbuminuria.[8,9]

In Africa, there are few reported studies on the prevalence of obesity in children and adolescents.[10,11] However, there is paucity on data on the prevalence of microalbuminuria in obese adolescents. This study aims to determine the prevalence of obesity and microalbuminuria among obese adolescents in Port Harcourt, Nigeria.

Subjects and methods

A cross-sectional study of 846 students, aged 10 – 19years was conducted over a period of eight weeks between September 29th to November 10th 2008 in twelve (eight private and four public) secondary schools in Port Harcourt City. Students with the following conditions were excluded from the selection; those that had vigorous exercise or competitive sport twelve hours prior to the study, fever at the time of study or a history of febrile illness two weeks prior to the study, symptoms

and signs suggestive of pre-existing renal disease, female students who were menstruating or within one week of cessation of menses or history of vaginal discharge, and male students with of history urethral discharge.

Ethical clearance was obtained from the Research and Ethics Committee of the University of Port Harcourt Teaching Hospital (UPTH). Permission was also obtained from the Rivers State Ministry of Education, principals of the selected schools as well as the selected students and their parents/guardians.

The study was carried out on school days in the various schools. Obese subjects with Body Mass Index (BMI) [calculated as weight (kg) /height (m^2)] $\geq 95^{th}$ percentile for age and sex on the United States sex-specific BMI-for-age growth charts[12] were selected and then studied. A detailed history was obtained including family history of diabetes mellitus or hypertension. The social class of each subject was determined using the social classification described by Oyedeji.[13] Hypertension was defined as blood pressure greater than or equal to the 95th percentile for age, sex and height.[14] Each subject voided about ten milliliters (mls) of spot urine which was shared into two universal containers (A) and (B). A dipstick urinalysis was performed on the urine sample on container A using the Combi-Screen^R.10SL manufactured by Macherey Nagel MN, Germany with Lot number 56704. Presence of glycosuria in the presence of polyuria, polyphagia or polydipsia was suggestive of diabetes mellitus. However, the diagnosis of diabetes mellitus was not confirmed with a fasting blood sugar level because the investigators were not permitted to collect blood samples from the students. The subjects who were negative for proteinuria and blood on dipstick urinalysis had their urine samples in container B tested for microalbuminuria using the Micral-test strips manufactured by Roche, USA with Lot number 28989833. A reading of 20mg/L and above was considered positive for microalbuminuria.

Data Analysis

Data from the study was analysed using the Statistical Package for Social Sciences (SPSS) version 15.0. The Chi- square (χ^2) analysis, was used where appropriate to test proportions. In all cases, a p value of < 0.05 was regarded as statistically significant.

Results

Out of the 846 students recruited for the study, 73 subjects were obese giving a prevalence rate of 8.6%. Table 1 shows the characteristics of the obese subjects. There were 24 (32.9%) males and 49 (67.1%) females with a M:F ratio of 1:2.0. Majority (72.6%) of the obese subjects were aged 10 – 14 years. The mean age was 13.6 ± 2.1 years, and mean BMI was 30.9 ± 3.5kg/m^2. Majority (68.5%) of the subjects were in private schools and 64.4% belonged to socio-economic classes 1 and II.

Table 1: Characteristics of the Obese subjects

Parameter	Number	%
Sex		
Female	49	67.1
Age group (years)		
10 - 14	53	72.6
15 - 17	16	21.9
18 - 19	4	5.5
School Type		
Private	50	68.5
Public	23	31.5
Social Class		
I	40	54.8
II	7	9.6
III	13	17.8
IV	12	16.4
V	1	1.4

Prevalence of Microalbuminuria in Obese Adolescents

Eight (11.0%) of the obese subjects had overt proteinuria on dipstick urinalysis and were excluded from further analysis. The remaining 65 (89.0%) students were tested for microalbuminuria and analysed. Microalbuminuria was present in 23 of the 65 obese subjects giving a prevalence rate of 35.4%. They comprised of 5 (21.7%) males and 18 (78.3%) females. As shown in Table 2, the proportional prevalence of MA was higher in females (42.9%) although the difference was not statistically significant ($p = 0.089$). Although, MA was higher in subjects within age group 10 – 14 years (42.2%)), those in private schools (38.6%) and those in socio-economic classes I and II (65.2%), the differences were however not statistically significant ($p > 0.05$).

Table 2: Characteristics of the Obese Subjects with and without Microalbuminuria

Characteristics	Microalbuminuria Positive(%)	Microalbuminuria Negative(%)	Total No(%)	P value
Sex				
Male	5(21.7)	18(78.3)	23(100)	0.089
Female	18(42.9)	24(86.7)	42(100)	
Age group (years)				
10 – 14	19(42.2)	26(57.8)	45(100)	0.141
15 -17	4(25.0)	12(75.0)	16(100)	
18- 19	0(0.0)	4(100)	4(100)	
Type of School				
Private	17(38.6)	27(61.4)	44(100)	0.581
Public	6(28.6)	15(71.4)	21(100)	
Socio-economic class				
I	11(33.3)	22(66.7)	33(100)	0.807
II	4(57.1)	3(42.9)	7(100)	
III	4(33.3)	8(66.7)	12(100)	
IV	4(33.3)	8(66.7)	12(100)	
V	0(0.0)	1(100.0)	1(100)	

Factors associated with Microalbuminuria in Obese Adolescents

Table 3 shows the identified factors associated with microalbuminuria in the obese subjects.

Hypertension: Hypertension was documented in seven (10.8%) of the obese subjects. The proportional prevalence of microalbuminuria was higher in subjects with hypertension (51.7%) compared to those with normal blood pressure (32.8%). However, the difference was not statistically significant (p = 0.233; odds ratio [OR] = 0.365; 95% Confidence Interval [CI] = 0.074 – 1.799).

Possible Diabetes Mellitus: One (1.5%) subject had features suggestive of diabetes mellitus (presence of glycosuria, polyuria, polyphagia or polydipsia). This subject also had microalbuminuria but the difference was not statistically significant when compared to the subjects without features suggestive of diabetes mellitus (p = 0.354).

Family history of Hypertension: Family history of hypertension was documented in four (6.2%) of the obese subjects. Microalbuminuria was present in two (50.0%) of these subjects. The difference was not statistically significant (p = 0.610). However, the odds of microalbuminuria is higher in subjects with family history of hypertension (OR = 1.905; 95% CI = 1.905 (0.250 -14.501).

Family history of Diabetes Mellitus: Family history of diabetes mellitus was documented in eight (12.3%) of the obese subjects. The proportional prevalence of microalbuminuria was higher in subjects with family history of diabetes mellitus (37.5%). Though the difference was not statistically significant (p = 1.000), but odds of having microalbuminuria was higher in subjects with family history of diabetes mellitus (OR = 1.110; 95% CI = 0.240 – 5.133).

Table 3: Factors associated with Microalbuminuria in Obese Adolescents

Factor	Microalbuminuria Positive(%)	Microalbuminuria Negative(%)	P value	Odds ratio (95%CI)
Hypertension	2	3 (42.9)	0.233	0.365 (0.074 - 1.799)
Normal BP	19 (32.8)	39 (67.2)		
Possible DM	1 (100.0)	0 (0)	0.354	0.344 (0.245 - 0.482)
No features of DM	22 (34.4)	42 (65.6)		
Fx of Hypertension	2 (50.0)	2 (50.0)	0.61	1.905 (0.250 -14.501)
No Fx of hypertension	21 (34.4)	40 (65.6)		
Fx of DM	3 (37.5)	5 (62.5)	1	1.110 (0.240- 5.133)
No Fx of DM	20 (35.1)	37 (64.9)		

Key: CI = Confidence Interval; DM = Diabetes Mellitus; Fx = Family history

Discussion

The global increase in childhood obesity has triggered intensive research on the development and prevention of obesity in children in the western world.[15] The prevalence of obesity reported in the present study is lower than the 17.4% reported among children aged 2 – 19 years in the United States of America[16] and the 35% prevalence reported in England.[17] The higher prevalence of obesity in the developed countries may be attributed to sedentary life style and high consumption of unhealthy fatty food by children and adolescents in these countries. The prevalence of obesity in the present study is however comparable to the 7.5% reported by Charkar et al[18] among Lebanese adolescents in a similar developing country. It is however much higher than the 0 – 2.5% prevalence in males and 0 – 4.3% prevalence in females of overweight and obesity combined reported by Monyeki et al[11] in a study conducted in children aged 3 – 10 years in a rural community in South Africa. This may probably be because the study in South Africa was conducted among younger children living in rural areas unlike the present study were majority of the subjects were from high socioeconomic class and attending private schools in an urban area. Obesity is strongly associated with microalbuminuria, which is a risk marker of progressive renal damage in patients with known renal disease and healthy subjects.[19,20] Glomerular hyperfiltration, hyperinsulinaemia with insulin resistance, low grade inflammation and leptin found in obesity have been postulated as possible mechanisms of renal damage.[20]

The prevalence of microalbuminuria of 35.4% among obese adolescents in the current study is much higher than the 8.9% by Nguyen et al[6]and 10.1% by Burgert et al[8] in the United States of America. The smaller sample size studied in the present study may have accounted for this disparity. Also, the non exclusion of orthostatic proteinuria in the subjects in the present study may be a contributory factor to the high prevalence of microalbuminuria, but this is not absolute. While Burgert et al[8] used first early morning urine in their studies to eliminate orthostatic proteinuria in the subjects, Nguyen et al[6], similar to the present study, used random urine samples of their subjects and reported a lower prevalence of microalbuminuria.

This present study shows that microalbuminuria was more prevalent in obese subjects with hypertension, possible diabetes mellitus, family history of hypertension and diabetes mellitus. This finding is supported by previous studies which reported that presence of cardiovascular risk factors such as hypertension, impaired fasting glucose, insulin resistance, metabolic syndrome, high triglyceride and low high density liproprotein (HDL) cholesterol levels increased the risk of microalbuminuria in overweight and obese adolescents.[6,11,21] Obesity is associated with increase intraglomerular capillary pressure resulting in glomerular hyperfiltration.[22] Therefore, the presence of hypertension and/or diabetes mellitus in these obese patients may provide a second 'hit', causing endothelial dysfunction that leads to microalbuminuria.[23] However, in contrast to the present study, previous community-based studies in children in the United States showed that overweight children had less microalbuminuria than leaner children.[6,7]

The finding of decreasing prevalence of microalbuminuria with increasing age in the present study is supported by a previous study which showed that proteinuria decreased with increasing age.[24] This is in sharp contrast to a previous study which reported a positive correlation between microalbuminuria and age.[21]

We observed in this study that females had higher prevalence of microalbuminuria compared to males. This observation is similar to the findings recorded by Nguyen et al[6] in obese adolescents. The cause of the gender disparity cannot be readily explained but there is evidence that there is increased rate of albuminuria in females during puberty.[25] In addition, Davis et al[26] noted that females have significantly higher daytime but not night time urinary albumin excretion compared to boys, which may suggest a higher possibility of orthostatic albuminuria in females.

Conclusion

The prevalence of obesity and microalbuminuria in obese Nigerian adolescents is high. We recommend efforts at reducing obesity in children through regular exercises and changes in lifestyle. Furthermore, screening of all obese adolescents for microalbuminuria should be included as part of the school health programme to enable detection and so that appropriate interventions can be commenced early to prevent rapid deterioration in renal function and subsequent development of end stage renal disease.

Limitations of the Study

These include inability to identify and exclude students with orthostatic proteinuria and physiologic proteinuria which may result from routine physical activity such as trekking to school. The study also did not determine those students with transient proteinuria because only a single urine sample was tested for albuminuria.

Conflict of interest : None
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