Original Research Article

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Microalbuminuria in obese children

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ABSTRACT

Background: Obesity is a global pandemic both in adults and children and many factors contribute to this pandemic. Early diagnosis and prevention of long-term complications associated with obesity is the main goal of treatment in addition to dietary control and lifestyle modifications. Microalbuminuria, a marker of impending renal insult in adults is less understood in children. The objective of this study was to determine microalbuminuria in obese children 5-18 years of age.

Methods: This study was single centre, and cross-sectional observational study. Children between 5-18 years of age with obesity (Body mass index >95th centile for sex and age) participated in the study. Microalbuminuria based on urinary albumin to creatinine ratio and relation to obesity was studied.

Results: Fifty-four children (M:F=0.9:1) were included in the study. Family history of obesity, hypertension, diabetes mellitus was present in 53.7% (n=29), 33.3% (n=18), 27.8 (n=15) children respectively. Microalbuminuria was observed in two children (3.8%). Mean BMI (38.25±7.42 kg/m² vs 26.13±4.13 kg/m²) (p=0.009), mean waist circumference (97.50±4.95, vs 83.52±0.94 cm) (p=0.044), mean waist hip ratio (0.93±0.04 vs 0.88±0.09) was more in children with microalbuminuria when compared to without microalbuminuria. One obese child with microalbuminuria had hypertension.

Conclusions: Microalbuminuria, though a good marker of renal insult in adults, may not be prevalent in obese children. It may me more prevalent in obese children with higher BMI, truncal obesity and WHR, hence these children should be screened for the same.

Keywords: Obesity, BMI, Microalbuminuria, Hypertension

INTRODUCTION

Childhood obesity is a significant global health problem, creating complications in childhood, adolescence, and adulthood. There is an increasing trend of obesity among boys and girls over the last two decades, globally and in India. Due to upwelling obesity, the comorbidities associated with obesity are also on the rise. Microalbuminuria caused by endothelial dysfunction due to obesity is a headstrong indicator of intensifying renal disease and cardiovascular mortality. With the growing trend of obesity, type 2 diabetes, and metabolic syndrome, screening for microalbuminuria seems pertinent in the pediatric population to diagnose and prevent renal,

cardiovascular, and metabolic complications and decrease morbidity and mortality in adulthood.^{3,4}

Objective

The objective of the study was to determine the clinical profile of children of 5-18 years of age with obesity and its correlation with microalbuminuria in these children.

METHODS

A single centre cross-sectional observational study was done in obese children between the ages of 5-18 years

visiting Kasturba Medical College and Hospital, Manipal, a tertiary care centre in South India.

After approval from the Institutional Ethics committee, the study was conducted from November 2018 to May 2020. All the children aged between 5-18 years attending the department of paediatrics with obesity, i.e.; children with BMI more than 95th centile for sex and age, were included in the study after obtaining informed consent from parents. Children with known chronic diseases like metabolic diseases (e.g., hypothyroidism, diabetes mellitus), renal diseases (e.g., nephrotic syndrome), diseases causing proteinuria (e.g., lupus, nephrotic syndrome), drugs causing obesity (e.g. steroids, valproate), and syndromic children (e.g., Down syndrome) were excluded from the study.

Detailed history, including demographic data, diet history, lifestyle, family history, was obtained. Anthropometry measures being weight, height, BMI, waist circumference, hip circumference was noted. Examination features such as acanthosis nigricans, cushingoid features, and blood pressure were recorded and entered in a prevalidated proforma. Obesity was defined as 'BMI ≥95th centile for age and sex'.

Waist circumference (WC) was 'measured as the midpoint between the lower rib margin and the iliac crest, and hip circumference (HC) was measured at the widest portion of the buttocks, with the non-stretchable tape, parallel to the floor'. Waist hip ratio (WHR) was 'calculated by dividing waist circumference by head circumference, and standard deviation scores for WC and WHR were estimated'. Blood pressure was measured by a standard sphygmomanometer after the child had rested for 5 min in the sitting position, using the appropriate cuff size.

A fasting venous blood sample was taken for determination of plasma glucose and measured by hexokinase enzymatic method. Plasma concentration and thyroid function tests as evaluation for obese children were done by electrochemiluminescence immunoassay. Microalbuminuria was defined 'albumin/creatinine ratio of more than 30 mg/g and less than 300 mg/g of creatinine'. Random microalbumin and random creatinine were estimated in urine samples by calorimetric and Jaffe's method, respectively. The urinary albumin/creatinine ratio was 'calculated and expressed as milligrams of albumin per gram of creatinine'. Through measuring the urine albumin-to-creatinine ratio in an untimed urine specimen, the misleading impact of differences in urine volume on urinary content was prevented.

Statistical analysis

SPSS for windows version 20 was used for the analysis of the data. All values were expressed as the mean±standard deviation. The descriptive data were expressed as

percentages, medians, and interquartile ranges or as mean and standard deviations.

Student t test, Chi-square test was used for the comparison of data accordingly. The logistic regression models were developed to evaluate the associations with microalbuminuria. To detect the relationship of microalbuminuria and other variables, correlation analysis was used.

RESULTS

Of the 58 children enrolled in the study, 4 children were excluded (two children were hypothyroid and two on sodium valproate). A total of 54 children were included in the study sample, and data were analysed. The mean decimal age was 11.26±3.34 years (range of 5-17 years) with 26 boys (48.1%) and 28 girls (51.9%), with the male: female ratio of 0.9:1.

Family history of obesity, hypertension, diabetes mellitus were present in 53.7% (n=29), 33.3% (n=18), 27.8% (n=15) children respectively. The mean BMI in the study group was 26.6±4.74 kg/m² with the range of 19-43.5 kg/m². Hypertension was observed in two obese children (3.7%). Abdominal obesity (waist circumference more than 90th centile) was observed in 85.2% (n=46), and 5 had waist circumference between 75th-85th centile, and 3 children had waist circumference between 50th-75th centile. The mean W:H ratio was 0.87±0.09 in boys and 0.87±0.08 in girls. Acanthosis nigricans was present in 16.6% (n=9) of children, of whom 6 were boys, and 3 were girls.

In the present study, microalbuminuria was observed in two children (3.8%). The first child was a thirteen-years-old obese boy with a normal diet, sedentary lifestyle, family history of obesity, and hypertension. His BMI was 33 kg/m 2 , with abdominal obesity and acanthosis nigricans. He had hypercholesterolemia, hypertriglyceridemia, no insulin resistance, and no metabolic syndrome.

He was observed to have microalbuminuria of 96.9 mg/g of creatinine. The second child was a 14 years old morbidly obese female with overeating behaviour and a sedentary lifestyle. She had screen time of more than 2 hours/day with a family history of obesity and hypertension. Her BMI was 43.5 kg/m² with abdominal obesity and a waist-hip ratio of 0.9. She was hypertensive (managed with anti-hypertensive drugs subsequently). She had insulin resistance and a normal lipid profile. She was observed to have microalbuminuria of 124 mg/g of creatinine.

The mean BMI in children with microalbuminuria was 38.25±7.42 kg/m² (range 33-43 kg/m²), which was significantly more when compared to the mean BMI in children without microalbuminuria (26.13±4.13 kg/m², range: 19-40) (p=0.009). The mean waist circumference in

children with microalbuminuria was 97.50 ± 4.95 , which was significant compared to the mean waist circumference in children without microalbuminuria (83.52 ± 10.94 cm) (p=0.044). The mean waist-hip ratio in children with microalbuminuria was 0.93 ± 0.04 when compared to the mean waist-hip ratio of 0.88 ± 0.09 children without microalbuminuria, and the difference was statistically not significant (p=0.419).

It was observed that only 1 obese child with microalbuminuria had hypertension, and 52 children in the present study did not have hypertension and microalbuminuria. Although a statistically significant difference was found, clinical conclusion cannot be drawn because of the small sample size.

Table 1: Baseline characteristics of the study population.

Demographic characteristic	Number (N)	Percentage (%)	
Age (years) mean±SD	11.26 <u>+</u> 2.34 (range 5-17 years)		
5-11	26	48.1	
12-18	28	51.9	
Gender			
Male	26	48.1	
Female	28	58.9	
Family history of obesity			
Yes	29	53.7	
No	25	46.3	
Family history of hypertension			
Yes	18	33.3	
No	36	66.7	
Family history of diabetes			
Yes	15	27.8	
No	39	72.2	
BMI mean±SD (kg/m²)	26.6 <u>+</u> 4.74 (range 19-43.5)		
Blood pressure			
>95 centile	2	3.7	
<95 centile	52	96.3	
Waist circumference			
50 th -75 th	3	5.6	
75 th -90th	5	9.2	
>90 th	46	85.2	
Waist:hip ratio (mean±SD)			
Males	0.87 <u>+</u> 0.09		
Females	0.87 <u>+</u> 0.08		
Acanthosis nigrican			
Present	9	16.6	
Males	6	23.0	
Females	3	10.7	
Absent	45	83.4	
Microalbuminuria			
Present	2	3.8	
Absent	52	96.2	

Table 2: Clinical profile of obese children with microalbuminuria.

Clinical profile	Microalbuminuria Present (%)	Microalbuminuria Absent (%)	P value
Gender			
Boys	1 (50)	25	0.935
Girls	1 (50)	27	
BMI			0.009
Mean±SD	38.25±7.42	26.13±4.13	0.009

Continued.

Clinical profile	Microalbuminuria	Microalbuminuria	P value
Chincai profile	Present (%)	Absent (%)	
Range	33-43	19-40	
Waist circumference	97.5±4.95	83.52±10.94	0.044
W:H ratio (Mean±SD)	0.93±0.04	0.88 ± 0.09	0.419
Blood pressure			
>95 percentile (N=2)	1 (50)	1 (2)	0.000
<95 percentile (N=52)	1 (50)	51 (98)	_

DISCUSSION

Obesity is defined as the BMI of more than 95th centile for age and sex. This definition recommends using WHO recommended levels (international), which relies on agesex specific BMI centiles or standard deviation (SD) scores.⁵ The revised IAP guidelines recommend the adult equivalent of 27 (95th centile) as cut-offs for obesity.⁷ The age-standardized prevalence of obesity increased from 0.7% in girls in 1975 to 5.6% in 2016 and from 0.9% in 1975 to 7.8% in boys aged 5-19 years in 2016.⁸

In the present study, obesity was equally observed in males and females. Shah et al reported that obesity was more in boys than girls in a majority of high and upper middle-income countries worldwide. The gender difference in the present study could be attributed to the lower middle-income group of the study population. In the retrospective, observational study by Corica et al among 260 children aged between 2 and 17 years, BMI was positively associated with family history for obesity. A family history of obesity and cardiometabolic disorders were the prominent risk factors for the onset and severity of early childhood obesity. The present study had a good percentage of children who had a positive family history of obesity predisposing to childhood obesity and later on obese individuals in the future.

Hypertension is one of the adverse outcomes of obesity. Rosner et al reported that an increase in BMI was one of the risk factors for elevated blood pressures in children. In the present study, hypertension was observed in two children. The mechanisms causing hypertension in obesity were stimulation of the sympathetic nervous system, activation of the renin-aldosterone-angiotensin axis, insulin resistance, the disproportion in adipokines like leptin and adiponectin. This further leads to constriction of vessels, dysfunction of endothelium, and sodium reabsorption resulting in hypertension.

Waist circumference (WC), an indicator of central adiposity, is associated with metabolic complications of obesity in the pediatric population. However, the cut-off points of WC for classification of abdominal adiposity in children and adolescents have not been established yet, which limits its use.¹²

Microalbuminuria is defined as an albumin/creatinine ratio of 30-300 mg/g of creatinine. In obese patients with diabetes and hypertension, microalbuminuria is a

significant predictor of progressive renal disease and cardiovascular disease. 13 Microalbuminuria has a strong association with impaired fasting insulin and abnormal lipid profile. In our study, only two children who were obese had microalbuminuria. However, Shedfy et al reported the prevalence of microalbuminuria is 29% among the 62 obese children investigated. 14 Okpere et al reported that the prevalence of microalbuminuria shows gender specificity being more in females (45.3%) than males (20.4%). ¹⁵ Mohammed Sanad et al (n=150), in their study on obese children with microalbuminuria, had significantly higher values of waist circumference (p<0.05), systolic blood pressure (p<0.05), triglyceride (p<0.01), and LDL (p<0.01) levels. 16 Our study showed mean BMI, waist circumference, and hypertension were more in obese children with microalbuminuria.

Hypertension in the background of microalbuminuria may be due to histological changes in the form of glomerular basement membrane thickening, glomerulosclerosis, and interstitial fibrosis, which were present prior to the initiation of proteinuria and reduced functional activity of the kidney. The higher mean BMI and waist circumference could be due to mechanisms that could link hyperinsulinemia to albuminuria, which consists of elevated glomerular haemodynamic pressure and endothelial dysfunction causing microalbuminuria in obese children.

The limitation of the study was a small sample size, as a large sample size would be required to minimize type II error.

CONCLUSION

Microalbuminuria, though a good marker of renal insult in adults, may not be prevalent in obese children. It may be more prevalent in obese children with higher BMI. Microalbuminuria may be directly related to truncal obesity and mean WHR, as observed in the present study. Hypertension may be more common in obese children with microalbuminuria. Obese children with higher BMI, truncal obesity, WHR, and hypertension may be screened for microalbuminuria.

Although these observations were statistically significant, clinical conclusions cannot be drawn because of the small sample size. Further studies with a larger sample size may be required to consolidate the observations.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

REFERENCES

- 1. Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1922 to 1935. N Engl J Med. 1992;327(19):1350-5.
- 2. Khadilkar VV, Khadilkar AV, Cole TJ, Chiplonkar SA, Pandit D. Overweight and obesity prevalence and body mass index trends in Indian children. Int J Pediatr Obes. 2011;6(2):216-24.
- 3. Rosenbloom AL, Joe JR, Young RS, Winter WE. Emerging epidemic of type 2 diabetes in youth. Diabetes Care. 1999;22(2):345-54.
- Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, et al. Obesity and the metabolic syndrome in children and adolescents. N Engl J Med. 2004;350(23):2362-74.
- 5. Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85(9):660-7.
- 6. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012;7(4):284-94.
- 7. Indian Academy of Pediatrics Growth Charts Committee, Khadilkar V, Yadav S, Agrawal KK, Tamboli S, Banerjee M, et al. Revised IAP growth charts for height, weight and body mass index for 5-to 18-year-old Indian children. Indian Pediatr. 2015;52(1):47-55.
- 8. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128-9 million children, adolescents, and adults. Lancet. 2017;390(10113):2627-42.

- 9. Shah B, Tombeau Cost K, Fuller A, Birken CS, Anderson LN. Sex and gender differences in childhood obesity: contributing to the research agenda. BMJ Nutr Prev Health. 2020;3(2):387-90.
- Corica D, Aversa T, Valenzise M, Messina MF, Alibrandi A, Luca F, et al. Does Family History of Obesity, Cardiovascular, and Metabolic Diseases Influence Onset and Severity of Childhood Obesity? Front Endocrinol. 2018;9:187.
- 11. Rosner B, Cook NR, Daniels S, Falkner B. Childhood blood pressure trends and risk factors for high blood pressure: the NHANES experience 1988-2008. Hypertension. 2013;62(2):247-54.
- 12. Herter AI, Osuna E, Sarnovska Z, Zimmermann MB. Significant Decrease in Childhood Obesity and Waist Circumference over 15 Years in Switzerland: A Repeated Cross-Sectional Study. Nutrients. 2019;11(8):1922.
- 13. Wachtell K, Ibsen H, Olsen MH, Borch JK, Lindholm LH, Mogensen CE, et al. Albuminuria and cardiovascular risk in hypertensive patients with left ventricular hypertrophy: the LIFE study. Ann Intern Med. 2003;139(11):901-6.
- 14. Sedfy HH, Toaima NN, Ahmed MA, Bahy DL. Microalbuminuria in obese children and adolescents and the metabolic syndrome. QJM. An Int J Med. 2018;111(1):138-200.
- 15. Okpere AN, Anochie IC, Eke FU. Prevalence of microalbuminuria among secondary school children. Afr Health Sci. 2012;12(2):140-7.
- 16. Sanad M, Gharib A. Evaluation of microalbuminuria in obese children and its relation to metabolic syndrome. Pediatr Nephrol. 2011;26(12):2193-9.

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