

Original Article

Association of Waist Circumference and Blood Pressure among Primary School Children in Selected Schools of Chattogram, Bangladesh

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Abstract

Background: Childhood body mass index and waist circumference are important for public health concern as well as responsible for metabolic disorders that persists until adulthood.

Objectives: The purpose of the study is to observe any association between waist circumference and blood pressure among primary school children.

Methodology: This cross-sectional study was performed among children of different schools in Chattogram, Bangladesh. Data was collected from March to September 2016 for a period of six months. The representative sample of 6 to 12 years old primary school going students with the normal weight, overweight and obese children were selected. Data on BMI, waist circumference and blood pressure were recorded and detailed demographic data were collected in structured data collection sheet for each participant from primary school.

Results: Total number of 600 students were recruited for this study. Mean age those children was 9.57 ± 2.16 years. The ratio of boy and girl being 1.47:1. Among them 246(41%) middle class comprising the major percentage compared to urban 378(63%). The overall prevalence of overweight and obesity was 23.0% and 17.16% respectively. Prevalence of waist circumference at higher than 90th percentile was 0%, non-obese (13.5%) and overweight and obese group (92.85%), respectively. Prevalence of high BP in overall group was 12.16%. This study revealed that waist circumference was associated with high BP in school children 6 to 12 years adjusted to age, sex and BMI.

Conclusion: In conclusion elevated blood pressure in children is associated with waist circumference.

Keywords: Waist circumference; overweight; obese; hypertension

Introduction

In worldwide epidemic of obesity it is a leading concern in public health policies.¹⁻² Waist circumference provides a measure of central obesity which has been specifically

associated with cardiovascular risk factors.³ Report of longitudinal study of blood pressure in childhood suggested an important role for early detection and enhancing a better understanding of the natural history of elevated blood pressure.⁴ Abdominal obesity which can be easily measured by waist circumference has been recognized as a better predictor for cardiovascular disease and metabolic morbidities than body mass index.⁵⁻⁸ Children with elevated blood pressure becoming more commonly remain at increased risk of hypertension and metabolic syndrome particularly at their later life.⁹⁻¹⁰

Blood pressure measurement has neither been included in the elementary school health examinations, nor it is practiced routinely during paediatric medical care in Bangladesh. This may facilitate under diagnosis of paediatric hypertension in clinical settings. However, compared to BMI, waist circumference remains a better

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index for investigating metabolic abnormalities such as hypertension. Muffies et al¹¹ suggested that waist circumference is very helpful in detecting metabolic and cardiovascular risk among overweight children. Overweight and obesity are strongly correlated with primary hypertension in children.¹² It is suggested that waist circumference has advantages over BMI as because it includes waist measurement that is believed to be correlated to risk of cardiovascular events.¹³

Several studies have shown significant increases in obesity among Asian and Caucasian children over the past 20 years¹⁴⁻¹⁶. The prevalence of high BP among children in several conducted studies in western countries ranging from 7.0 to 19.0% cases¹⁷⁻¹⁸. Waist circumference (WC) more specifically reflect adiposity than BMI which reflects both lean and fat mass. Intra-abdominal fat is strictly associated with metabolic complications of obesity and cardiovascular risk¹⁹⁻²⁰ in adults. In children the relationship between waist circumference and blood pressure was demonstrated in some studies²¹. This present study was undertaken to observe any association between (WC) and blood pressure in primary school children.

Methodology

Study design and setting: This cross-sectional study was performed among children of some selected schools of Chittagong, Bangladesh from March to September 2016 for a period of six months.

Sampling: Primary school going children aged 6 to 12 years old with the normal weight, overweight and obese children were selected in this study. Consecutive purposive sampling technique was applied. Prevalence of pediatric hypertension was taken 4.0% in this study. After calculation, the targeted responders were 36750. Due to resource and time constrains, 600 samples were taken as study population.

Ethical consideration: The research protocol was approved by local Institutional Ethics Committee. A written informed consent was taken from the parents.

Inclusion criteria: School going students with the age of 6 to 12 years with both sexes studying in class 1 to 5 in the selected primary schools.

Exclusion criteria: More than 12 and less than 6 years of old and children with pre-diagnosed co- morbidities with the waist circumference less than 3rd centile.

Data collection process: All the anthropometric measurements were done by the researchers and some trained assistants. Children wearing light weight clothing without shoes were measured for standing height (stadiometer) and weight (scale). WC was measured to the nearest of 0.1cm at the midpoint between lower margin of the last palpable rib and the top of iliac crest by a non-elastic tape. Blood pressure was measured using a sphygmomanometer on the right arm for three times and taken as the mean of three measurements. Data for socio-demographic clinical variables were obtained from all participants by a questionnaire.

Data analysis: After editing and coding, the coded data directly entered into the computer by using SPSS/PC software and graph and chart by MS excel. Statistical test for analyzing data were performed by t-test, chi-square test, proportional differences.

Result

Total number of 600 school children were taken as sample for study. The Mean age was 9.57 ± 2.16 years. Among the urban respondents 257(67.98%). Among the urban children were watched TV/video or game/internet for more than 2 hours. Only 107(28.3%) children had vegetable or fruits daily into their food. Proportion of daily vegetable or fruits consumption was more in rural children 187(84.23%) compared to urban children 207(28.30%). Proportion of urban children 257(67.98%) watched significantly ($p > 0.001$) more TV/video game/internet for > 2 hr than the rural children 53(23.87%). (Table 1).

Table 1: Food consumption and recreation habits

Variables	Urban N (%)	Rural N (%)	P value
Daily vegetable/ fruits consumption	107(28.30)	187(84.23)	
Taking junk food/fast food (at least once in a week)	214(56.87)	86(38.73)	<0.001
Watching TV/video game/internet for > 2 hrs	257(67.98)	53(23.87)	

This study shows, using BMI cut-off points introduced by WHO. Children had overall prevalence of overweight (23%) and obesity (17.1%), respectively. (Figure I) in this study.

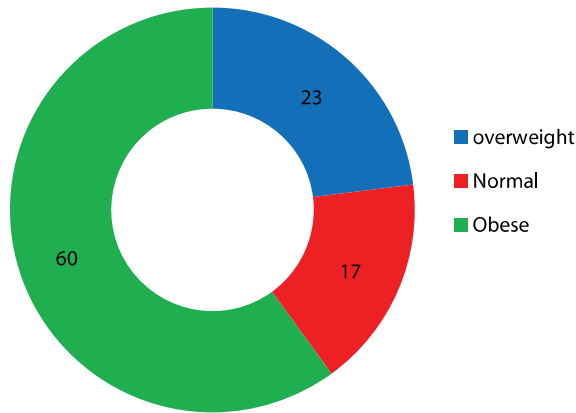


Figure I: Prevalence of overweight and obesity among 6 to 12 year aged children (n=600)

359(59.83%) children had BMI within normal limit, 138(23.0%) had 85th to 95th percentile and 103(17.16%) had BMI >95th percentile, respectively. Children were classified as non-obese or normal (BMI ≤ 85th percentile), overweight (BMI, 85th to 95th percentile), and obese (BMI ≥ 95th percentile). Based on these cut-off points, obesity was more common in girls (19.42%) than boys (15.64%) respectively (Table 2).

Table 2: Nutritional status of children according to their BMI (n=600)

BMI Percentile	Boys n (%)	Girls n (%)	Total n (%)
<85 th	213 (59.5%)	146 (60.3%)	359 (59.8%)
85 to 95 th	89 (24.9%)	49 (20.3%)	138 (23.0%)
>95 th	56 (15.6%)	47 (19.4%)	103 (17.2%)

358(59.8%) children had normal weight, and all of them had WC <90th percentile. Among overweight children 138(23%), 109(78.9%) children had WC <90th percentile and 29(21.1%) had WC >90th percentile. Almost all the obese children 99(96%) had WC >90th percentile. Regarding operational definition central obesity was defined as WC higher than the 90th percentile. Overall central obesity was 128(21.33%) in school children (Table 3).

Table 3: Distributions of children according to waist circumference (n=600)

Variable	Waist Circumference		Total N (%)
	<90th Percentile N (%)	>90th Percentile N (%)	
Normal	359 (100)	0 (0)	359 (59.8)
Over Weight	109 (78.9)	29 (21.1)	138 (23)
Obese	4 (38.8)	99 (96.1)	103 (17.1)
Total	472(78.66)	128(21.33)	600 (100)

The prevalence of high blood pressure was 3(12.16%) and was 11.45% in boys and 13.22% in girls. Among children who had normal weight, no cases were detected as hypertensive. In obese boys and girls, 41(73.21%) and 25(53.19%) had high blood pressure respectively. Children who were overweight there was no case of high blood pressure among boys but 7(14.28%) girls had high blood pressure. A positive correlation was found between waist circumference and with the trends of rising of systolic blood pressure (SBP) >95th in the studied group (Figure II).

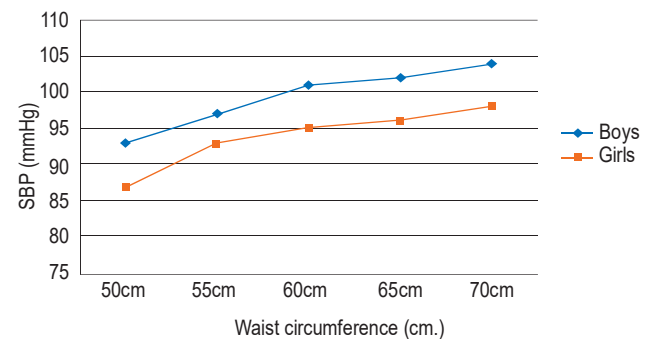


Figure II: Association of systolic blood pressure (SBP) >95th in the studied group

Similarly, a positive correlation was found between waist circumference with the trends of rising of diastolic blood pressure (DBP) >95th in the studied group (Figure III).

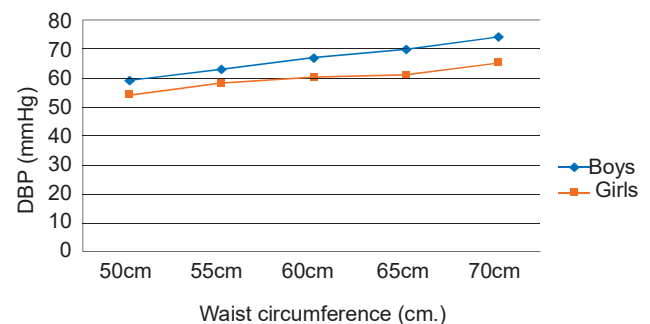


Figure III : Trends of diastolic blood pressure (DBP) >95th in the studied group

Discussion

In this study, 359 boys were evaluated among whom 89(24.86%) children were overweight, 56(15.64%) were obese and 213(59.49%) were normal. There is a significant difference in the Mean \pm SD of BMI among these 3 groups which were non obese 16.36(1.28%), overweight 2.5(1.8%), and obese 25.3(2.7%). The prevalence of waist circumference was higher than the 90th percentile 0%, 13.8% and 92.3% in three groups respectively. Therefore, the central obesity was in accordance with finding of BMI.

The systolic and diastolic BPs were higher in the obese group than in the other two groups. Hypertension was present in 16.7% students in obese group but was not present among other groups. There was a close association between WC, BMI, systolic and diastolic BP. Many studies have shown that blood pressure is associated with being overweight in children and adolescents of western countries.^{6,7,9,10} In a study, 84 students were evaluated among whom 28 students are overweight, 40 students obese and 16 non obese. The prevalence of WC higher than 90th percentile is 0%, 28.6% and 87.5% in the non-obese, overweight and obese groups respectively and hypertension is present in 25.0% of the obese group but not present in the other two groups. There was a positive association between WC, BMI, age, systolic BP and diastolic blood pressure.²²

The results show that of the 359 children who had normal weight, all had waist circumference less than 90th centile; however, in overweight children 109 subjects have waist circumference less than 90th centile and 29 subjects have waist circumference more than 90th centile. Almost all the obese children (99) had waist circumference more than 90th centile. Overall central obesity (waist circumference more than 90th centile) is found in 128(21.33%) subjects. In this study 358 boys are evaluated, among them 89(24.86%) subjects are overweight, 56(15.64%) subjects are obese and 213(59.49%) subjects are nonobese or normal.

Associations between elevated BP and waist circumference have been documented in children in Greece²⁵, Mexico²⁶ and USA.²⁷ A previous study²⁸ had found that with 1 cm incremental increase in waist circumference, the OR of elevated blood pressure is 1.069 (95% CI 1.01-1.11). High weight to height ratio increases risk of cardiovascular disease not only in children, but also in adults.²⁹ The best cutoff points for waist circumference to predict elevated blood pressure for boys and girls are 59 cm and 57 cm with the

sensitivity 62.69%, 62.58% and specificity 67.75%, 63.61%, positive predictive value 34.5%, 22.6%, negative predictive value 86.9%, 90.9% respectively. Compared to BMI, it is likely that waist circumference is more important because it has a greater association with metabolic syndrome and cardiovascular diseases.³⁰

There are limitations of this study. It was done among the school children in Chittagong city only which does not reflect the overall picture of the country. A large scale study needs to be conducted to reach to a definitive conclusion.

Conclusion

To conclude, the prevalence of high BP among children was positively correlates with waist circumference. The risk group can be screened out by waist circumference percentile which is reliable, less expensive and easier to apply for people of all ages, particularly in settings with scarce resources and limited health care capacity.

References

1. Santos-Beneit G, Sotos-Prieto M, Pocock S et al. Association Between Anthropometry and High Blood Pressure in a Representative Sample of Preschoolers in Madrid. *Rev Esp Cardiol* 2015; 68(6): 477–484.
2. Sung RYT, Yu CCW, Choi KC et al. Waist circumference and body mass index in Chinese children: cutoff values for predicting cardiovascular risk factors. *International Journal of Obesity* (2007); 31: 550–558.
3. Chukwujekwu IE, Ezejindu DN, Nwosu NM. Anthropometric Study of Weight, Height and Blood Pressure in Children from NNEWI North Local Government of Anambra State, South East Nigeria. *Inter J of Sci and Res Pub*, 2014; 4(4): 1-5.
4. Chen T, Choy C, Chan W et al. Waist-to-Height Ratio and Elevated Blood Pressure Among Children in Taiwan. *Ind Paed* 2012; 49(16): 463-465.
5. Taylor RW, Williams SM, Grant AM, Ferguson E, Taylor BJ, Goulding A. Waist circumference as a measure of trunk fat mass in children aged 3 to 5 years. *Int J Pediatr Obes*. 2008;3:226–233.
6. Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. The Expert Committee on Clinical Guidelines for Overweight in Adolescent Preventive Services. *Am J Clin Nutr*, 1994; 59: 307–16.

7. Zhang, Ying-xiu; Wang, Zhao-xia; Zhao, Jin-shan; Chu, Zun-hua. Profiles of blood pressure among children & adolescent categorized by BMI & waist circumference. <http://journals.lww.com/bpmonitoring/Citation/2016>. Blood Pressure Monitoring: October 2016; 21(5): 295–300.
8. Knowles G, Pallan M, Thomas G. Physical Activity and Blood Pressure in Primary School Children: A Longitudinal Study. *Hypertension*. 2013; 61:70-75.
9. Sun SS, Grave GD, Siervogel RM, Pickoff AA, Arslanian SS, Daniels SR. Systolic blood pressure in childhood predicts hypertension and metabolic syndrome later in life. *Pediatrics* 2007; 119:237-246
10. Maffeis CM, Banzato C, Talamini G: Waist-height ratio, a useful index to identify high metabolic risk in overweight children. *J Pediatr* 2008; 152: 207-213.
11. Riley M, Bluhm B. High Blood Pressure in Children & Adolescents. *Am Fam Physician*. 2012;85(7):693-700.
12. Hansen ML, Gunn PW, Kaelber DC. Underdiagnosis of hypertension in children and adolescents. *JAMA*. 2007;298(8):874-879.
13. Chu NF: Prevalence and trends of obesity among schoolchildren in Taiwan: the Taipei Children's Heart Study. *Int J Obes*, 2001; 25: 170-176.
14. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM: Prevalence of overweight and obesity among US children, adolescents and adults, 1999-2002. *JAMA* 2004; 291:2847-2850.
15. G. Paradis, M. Lambert, J. O'Loughlin et al. Blood pressure and adiposity in children and adolescents. ***Circulation***, vol. 110, no. 13, 2004, pp. 1832–1838.
16. S. Genovesi, M. Giussani, F. Pieruzzi et al. Results of blood pressure screening in a population of school-aged children in the province of Milan: role of overweight, ***J of Hypertension***, 2005; vol. 23, no. 3, pp. 493–497.
17. Rankinen T, Kim SY, Perusse L, Despres JP, Bouchard C. The prediction of abdominal visceral fat level from body composition and anthropometry: ROC analysis. *Int J Obes Relat Metab Disord*. 1999; 23: 801-9.
18. Pi-Sunyer FX. Health implications of obesity. *Am J Clin Nutr*. 1991; 53:1595S-1603.
19. Chen B and Li H. Waist circumference as an indicator of high blood pressure in preschool obese children. *Asia Pac J Clin Nutr* 2011; 20 (4):557-562.
20. Moreno LA, Pineda I, Rodriguez G, Fleta J, Sarria A, Bueno M. Waist circumference for the screening of metabolic syndrome in children. *Acta Paediatr* 2002; 91:1307-1312.
21. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatr* 2004(2 Suppl);114:555-76.
22. Hirschler V et al. Can Waist Circumference Identify Children With the Metabolic Syndrome? *Arch Pediatr Adolesc Med*. 2005;159:740-744.
23. Janssen I, Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, Berenson GS: Combined influence of body mass index and waist circumference on coronary artery disease risk factors among children and adolescents. *Pediatrics* 2005; 115:1623-1616.
24. Savva SC, Tornaritis M, Savva ME, Kourides Y, Panagi A, Silikiotou N, Georgiou C, Kafatos A. Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *Int J Obes* 2000; 24:1453-1458.
25. Perichart-Perera O, Balas-Nakash M, Schiffman-Selechnik E, Barbato-Dosal A, Vadillo-Ortega F. Obesity increases metabolic syndrome risk factors in school-aged children from an urban school in Mexico City. *J Am Diet Assoc* 2007; 107:81-91.
26. Maffeis C, Grezzani A, Pietrobelli A, Provera S, Tatò L: Does waist circumference predict fat gain in children? *Int J Obes* 2001; 25:978-983.
27. Chen B and Li H. Waist circumference as an indicator of high blood pressure in preschool obese children. *Asia Pac J Clin Nutr* 2011; 20 (4):557-562.
28. Yenovesi S, Autolimi L, Yiussani M et al. Usefulness of waist circumference for the identification of childhood hypertension, 2014.