Brief Communication

Association of body mass index and waist circumference with hypertension among school children in the age group of 5-16 years belonging to lower income group and middle income group in National Capital Territory of Delhi

Umesh Kapil, Ajeet Singh Bhadoria, Neha Sareen, Supreet Kaur

Departments of Public Health Nutrition, Human Nutrition Unit, All India Institute of Medical Sciences, New Delhi, India

ABSTRACT

Background and Objectives: Hypertension is one of the most common diseases world-wide and the prevalence in school-aged children appears to be increasing perhaps as a result of increased prevalence of obesity. Thus, the present study was planned to establish an association between body mass index (BMI) and waist circumference (WC) with hypertension amongst school children in the age group of 5-16 years belonging to lower income group (LIG) and middle income group (MIG) in National Capital Territory of Delhi. **Materials and Methods:** Population proportionate to size methodology was adopted to select 30 clusters/schools in each LIG and MIG category. About 170 children from each school were selected randomly with the help of random number tables. Anthropometric measurements of weight, height and WC and blood pressure measurements were taken by using standard methodology. **Results:** The prevalence of high systolic blood pressure (SBP) in LIG and MIG school population was 2.8% and 4.1% respectively. Similarly, the prevalence of high diastolic blood pressure (DBP) in LIG and MIG school population was 2.7% and 4.2%, respectively. Statistical positive correlation was observed between BMI and WC with SBP and DBP. Thus, it can be inferred that children with high WC and BMI are more likely to have hypertension.

Key words: Body mass index, hypertension, waist circumference

INTRODUCTION

Hypertension is a known risk factor for coronary artery disease (CAD) in adults and the presence of childhood hypertension contributes to the early development of CAD. It is known that the origin of hypertension is from childhood, but it goes undetected unless specifically looked for it during this period.[1] According to many studies performed world-wide the prevalence of hypertension in children and adolescents appear to be increasing.[2] The growing prevalence of hypertension is coupled with increase body weight and many reports have shown an association between blood pressure (BP) and body mass index (BMI).[3,4] In Bogalusa Heart Study, it was reported that overweight children were 4.5 and 2.4 times likely to have elevated systolic blood pressure (SBP) and diastolic blood pressure (DBP) respectively.[5]

The present study was conducted to assess an association of BMI and waist circumference (WC) with hypertension amongst school children in the age group of 5-16 years belonging to lower income group (LIG) and middle income group (MIG) in National Capital Territory (NCT) of Delhi.

Corresponding Author: Dr. Umesh Kapil, Department of Public Health Nutrition, All India Institute of Medical Sciences, Ansari Nagar, New Delhi - 110 029, India. E-mail: umeshkapil@yahoo.com

Materials and Methods

Study area

A cross-sectional study was conducted. All the schools belonging to MIG category (Kendriya Vidhalayas) in the NCT of Delhi were enlisted and by utilizing the population proportionate to size sampling methodology, 30 schools was selected. Similar methodology was utilized for selecting children of LIG category (attending Municipal Corporation, Government Schools). Children attending Government Schools and Kendriya Vidhalayas were considered as belonging to LIG and MIG socio-economic groups, respectively for the purpose of this study. About 170 children from each school were selected randomly with the help of random number tables.

The study was approved by the Ethical Committee of All India Institute of Medical Sciences. Written consent was taken from the parents and the authorities for conducting the study.

Study population

The study was conducted among children in the age group 5-16 years in NCT of Delhi.

Collection of data

A pre-tested, semi-structured questionnaire was administered to each subject to elicit information on socio-demographic profile and anthropometric measurements. Anthropometric measurements of weight and height were recorded utilizing the standard equipments and methodology. Weight was recorded using Seca electronic weighing scale (Seca GmBH and Co Kg, Hamburg, Germany) to the nearest 100 g. Height was recorded using the anthropometric height board to the nearest 0.1 cm. For measurement of WC lowest rib margin and iliac crest in mid-axillary line was located with the soft pen. Tape was placed horizontally midway between the lowest rib margin and the iliac crest and was tied firmly so that it stays in position around the abdomen about the level of the umbilicus.[6]

Clinical examination of the subjects was carried out by taking their BP measurements. Before recording the BP, the procedure was fully explained to the children and sufficient time allowed for recovery from recent activity and apprehension. BP was recorded in a sitting position in the right arm by auscultatory method using a standard mercury sphygmomanometer with the subject seated and the arm extended over the table at the level of heart. A set of different-sized cuffs was used covering about 2/3 of the upper arm and encircling it completely without overlapping.[7,8] BP readings were noted as per the recommendations of American Heart Association. The first and the fifth Korotkoff sounds were for the SBP and DBP levels respectively. Three measurements were taken at the interval of 5 min each and mean of last two readings was taken for SBP and DBP.

Results

The present study was conducted among school children in the age group of 5-16 years in NCT of Delhi. A total of 10,221 school children belonging to LIG ($n = 5087$) and MIG ($n = 5134$) were included in the study. It was estimated that 47% and 53% of the subjects belonging to LIG and MIG schools were males. A BP measurement of 4545 subjects from LIG schools and 4875 subjects from MIG schools was taken.

Mean height, weight, WC, SBP, and DBP of the children belonging to different age groups and socio-economic status participated in the study is depicted in Table 1. The mean difference of the parameters mentioned above between two socio-economic groups in both the age groups, i.e., 5-10 years and 11-16 years was statistically significant. It was clearly evident that the weight, height, WC, SBP and DBP increased as the socio-economic status improves.

Prevalence of high SBP and DBP is shown in Tables 2 and 3. Average SBP and DB*P* values of 95th percentile or greater were fixed up for each age group as the cut-off points to define hypertension. According to these criteria, the prevalence of high SBP in LIG and MIG school population was 2.8% and 4.1% respectively. Similarly, the prevalence of high DBP in LIG and MIG school population was

Table 1: Mean weight, height, waist circumference, SBP, and DBP among the children of different age groups and different socio-economic groups

Parameter studied	LIG		MIG		*P* value*
	5-10 years	11-16 years	5-10 years	11-16 years	
Weight (kg)	22.4±5.9	40.8±9.9	24.4±6.4	44.6±11.0	0.000
Height (cm)	122.4±12.3	152.4±11.2	125.4±10.9	155.4±10.6	0.000
Waist circumference (cm)	49.3±5.2	59.6±7.5	53.6±6.2	64.4±8.0	0.000
SBP (mm of Hg)	110.8±8.6	114.1±9.9	112.0±9.7	116.7±10.8	0.000
DBP (mm of Hg)	74.1±7.6	74.8±7.8	71.8±8.6	73.9±8.9	0.000

*Statistically significant at 95% level of confidence. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, LIG: Lower income group, MIG: Middle income group

Table 2: Distribution of study subjects according to socio-economic group and prevalence of high SBP

Age (years)	Prevalence of high SBP			
	LIG		LIG	
	n	Prevalence	*n*	Prevalence
5-8	1175	56 (4.8)	1359	62 (4.6)
9-12	1562	49 (3.1)	1695	76 (4.5)
13-16	1808	69 (3.8)	1821	79 (4.3)
Total	4545	174 (3.8)	4875	217 (4.5)

Figure in parenthesis denote percentages. LIG: Lower income group, SBP: Systolic blood pressure

Table 3: Distribution of study subjects according to socio-economic group and prevalence of high DBP

Age (years)	Prevalence of high SBP			
	LIG		LIG	
	n	Prevalence	*n*	Prevalence
5-8	1175	8 (0.7)	1359	63 (4.6)
9-12	1562	20 (1.3)	1695	71 (4.2)
13-16	1808	90 (4.9)	1821	66 (3.6)
Total	4545	128 (2.8)	4875	200 (4.1)

Figure in parenthesis denote percentages. DBP: Diastolic blood pressure, LIG: Lower income group, SBP: Systolic blood pressure

2.7% and 4.2% respectively. It is shown in the tables that more children from MIG schools were having high SBP and DBP when compared with children from LIG schools.

The statistical significant correlation was observed between BMI ($r = 0.291$; $P = 0.000$) and WC ($r = 0.266$; $P = 0.000$) with SBP and DBP. This implies that as SBP and DBP is directly correlated with the body weight and WC.

Measurement of WC is a useful index for estimating the risk factors associated with excess abdominal fat such as type II diabetes mellitus, hypertension and hyperlipidemia.[9] In the present study measurement of WC of children were carried out and the statistical significant correlation was observed between WC ($r = 0.266$; $P = 0.000$) with SBP and DBP. It can be inferred that children with high WC are more likely to have hypertension.

DISCUSSION

The present study was conducted among school children in the age group of 5-16 years. An association was found between BP and anthropometric measurements such as WC and BMI. It was observed that children with more body weight had increased SBP and DBP.

Gopinath *et al*. reported the prevalence of hypertension among children in Delhi in the age group of 15-19 years. The overall prevalence rate was 20.5/1000.[10] Verma *et al*. studied hypertension prevalence in urban children in the age group of 5-15 years in Ludhiana (Punjab). Hypertension

was diagnosed by BP levels at more than 95th percentile.[11] The prevalence of high BP was 2.8%, which is comparable with the results of the LIG school children of the present study. Another study performed by Gupta *et al*. on school children in the age group of 13-17 years showed the prevalence of hypertension ($\geq142/92$ mm of Hg) as 7.2%, which is higher than the results obtained in the present study.[12] This could be due to the difference in the selection of the cut-off values for defining hypertension.

The relation of body size to BP has been established in a number of cross-sectional studies.[13,14] In Bogalusa Heart Study, it was established that BP is correlated with height and BMI.[15] In our study, the statistical significant correlation was observed between BMI ($r = 0.291$; $P = 0.000$) and WC ($r = 0.266$; $P = 0.000$) with SBP and DBP.

Association of hypertension with WC was reported earlier in a study performed by Janssen *et al*. who found that individuals with high WC are more likely to have hypertension, dyslipidemia and metabolic syndrome.[16]

In the present study, we found an association between BP and anthropometric measurements such as WC and BMI in children in the age group of 5-16 years of age. The children with higher body weight had higher SBP and DBP.

REFERENCES

1. Agarwal VK, Sharan R, Srivastava AK, Kumar P, Pandey CM. Blood pressure profile in children of age 3-15 years. Indian Pediatr 1983;20:921-5.
2. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. Pediatrics 2004;113:475-82.
3. Stabouli S, Kotsis V, Papamichael C, Constantopoulos A, Zakopoulos N. Adolescent obesity is associated with high ambulatory blood pressure and increased carotid intimal-medial thickness. J Pediatr 2005;147:651-6.
4. Muntner P, He J, Cutler JA, Wildman RP, Whelton PK. Trends in blood pressure among children and adolescents. JAMA 2004;291:2107-13.
5. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa heart study. Pediatrics 1999;103:1175-82.
6. Lohman TG, Roche AF, Martorech R. Anthropmetric Standardization Reference Manual. Champaign (IL): The Human Kinetic Books; 1988.
7. Voors AW. Cuff bladder size in a blood pressure survey of children. Am J Epidemiol 1975;101:489-94.
8. Kirkendall WM, Burton AC, Epstein FH, Freis ED. Recommendations for human blood pressure determination by sphygmomanometers. Circulation 1967;36:980-8.
9. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults – The evidence report. National Institutes of Health. Obes Res 1998;6 Suppl 2:51S-209.
10. Gopinath N, Chadha SL, Sood AK, Shekhawat S, Bindra SP, Tandon R. Epidemiological study of hypertension in young (15-24 yr) Delhi urban population. Indian J Med Res 1994;99:32-7.

11. Verma M, Chhatwal J, George SM. Biophysical profile of blood pressure in school children. Indian Pediatr 1995;32:749-54.
12. Gupta R, Goyle A, Kashyap S, Agarwal M, Consul R, Jain BK. Prevalence of atherosclerosis risk factors in adolescent school children. Indian Heart J 1998;50:511-5.
13. Chadha SL, Tandon R, Shekhawat S, Gopinath N. An epidemiological study of blood pressure in school children (5-14 years) in Delhi. Indian Heart J 1999;51:178-82.
14. Falkner B, Michel S. Obesity and other risk factors in children. Ethn Dis 1999;9:284-9.
15. Voors AW, Webber LS, Frerichs RR, Berenson GS. Body height and body mass as determinants of basal blood pressure in children: The Bogalusa heart study. Am J Epidemiol 1977;106:101-8.
16. Janssen I, Katzmarzyk PT, Ross R. Body mass index, waist circumference, and health risk: Evidence in support of current National Institutes of Health guidelines. Arch Intern Med 2002;162:2074-9.