Original Article

Association of Obesity with Hypertension Amongst School-Age Children Belonging to Lower Income Group and Middle Income Group in National Capital Territory of Delhi

Supreet Kaur, HPS Sachdev[1], SN Dwivedi[2], R Lakshmi[3], Umesh Kapil, Neha Sareen

Departments of Human Nutrition, [2]Biostatistics and [3]Cardiac-Biochemistry, All India Institute of Medical Sciences, [1]Pediatrics and Clinical Epidemiology, Sitaram Bhartia Institute of Science and Research, 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. **Subjects 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 the standard methodology. **Results and Interpretation:** The prevalence of high systolic blood pressure (SBP) in LIG and MIG school population was 3.8 and 4.4% with high WC and BMI are more likely to have hypertension.

Keywords: 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 origin of hypertension is from childhood, but it goes undetected unless specifically looked for it during this period.[1] According to many studies carried out 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 and diastolic blood pressure(DBP), respectively.[5] Similarly, a study carried on Chinese children and adolescents showed that obese children have 2.9 times higher risk of developing hypertension when compared to their normal weight counterparts.[6] Another study conducted by Lee *et al.*, on adolescents demonstrated that waist circumference (WC) as well as BMI are significantly associated (P<0.05) with systolic and DBP.[7] An Indian study conducted amongst adolescent children showed that prevalence of hypertension was about 7.0% and 2.6% amongst urban and rural children. They also found that there was significant increase in prevalence of hypertension with an increased BMI.[8] Similarly, other studies also found the same trend for prevalence

Access this article online

Quick Response Code:

Website: www.ijcm.org.in

DOI: 10.4103/0970-0218.116355

Address for correspondence:
Dr. Umesh Kapil, Department of Human Nutrition, All India Institute of Medical Sciences, New Delhi - 110 029, India. E-mail: umeshkapil@gmail.com

Received: 30-07-11, **Accepted:** 18-05-13

of hypertension amongst adolescent school children.[9] Increased body weight in children and adolescents is associated with increased systolic and DBP and can multiply the risk for adult cardiovascular disease in adulthood.[10]

There is limited data and hence the present study was conducted to find an association of BMI and 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.

Subjects and Methods

Study area

A cross-sectional study was conducted. All schools belonging to MIG category (KendriyaVidhalayas) in the NCT of Delhi were enlisted. Thirty schools were selected utilizing the population proportionate to size sampling methodology. 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. The sample size was calculated keeping in view the prevalence of hypertension as 7% amongst obese children 95% confidence interval (CI) and 10% relative precision was considered. A total of 10,248 children were selected from both LIG (4545) and MIG (5703) schools for the study. About 170 children from each school were randomly selected with the help of random number tables.

The monthly tuition fee of the school was taken as proxy of socio-economic status of the children's family. This was a limitation of the present study.

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

Study population

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

Collection of data

A pre-tested, structured questionnaire was administered to each subject to elicit information on socio-demographic profile and anthropometric measurements. Anthropometric measurements of weight, height and WC were recorded utilizing the standard equipments and methodology. Weight was recorded using Seca electronic weighing scale to nearest 100g. Height was recorded using the anthropometric height board to the nearest 0.1cm. For measurement of WC lowest rib margin and iliac crest in mid axillary line was located with the marker pen. Tape was placed horizontally midway between the lowest rib margin and the iliac crest, and wastied firmly, so that it stays in position around the abdomen about the level of umbilicus.[11]

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 was allowed for recovery from recent activity and apprehension. BP was recorded in sitting position in 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 upper arm and encircling it completely without overlapping.[12,13] BP readings were noted as per the recommendations of American Heart Association.[14] The first and the fifth Korotkoff sounds were for the systolic and diastolic BP levels, respectively. Three measurements were taken at interval of 5min each and mean of last two readings was taken for SBP and DBP. Subjects who were having SBP or DBP above 95% for that age and sex were considered to be hypertensive.[15]

The distribution of overweight (2.57%) and obese (0.12%) in LIG and overweight (6.52%) and obese (0.62%) in MIG school children was according to the BMI.

Results

The present study was conducted amongst school children in the age group of 5-16 years in NCT of Delhi from October 2005 to December 2006. A total of 10,248 school children belonging to LIG (n=4545) and MIG (n=5703) were included in the study.

BP measurements of 4545 subjects from LIG schools and 5703 subjects from MIG schools were taken. Mean height, weight, WC, systolic and DBP of the children belonging to different age groups and socio-economic status participated in the study is depicted in Tables 1 and 2. The mean difference of the parameters mentioned above between two socio-economic groups in both age groups, i.e., 5-10 years and 11-16 years was statistically significant for both sexes. It was found that the weight, height, WC, systolic and DBP increased as the socio-economic status improved.

Prevalence of high SBP and DBP is shown in Tables 3 and 4. Average SBP and DBP values of 95th percentile or greater were fixed up for each age group as the cut-

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

Parameter studied	LIG		MIG		*P* value*
	Age		Age		
	5-10 years (*n*=1070)	11-16 years (*n*=1161)	5-10 years (*n*=1694)	11-16 years (*n*=1242)	
Weight (kg)	23.4±6.6	41.5±10.8	24.5±6.3	45.7±12.1	0.000
Height (cm)	124.3±12.3	155.1±12.5	126.1±10.8	157.9±11.8	0.000
Waist circumference (cm)	50.1±6.0	59.3±7.8	53.5±6.6	65.1±9.0	0.000
SBP(mm of Hg)	111.5±8.5	114.5±9.9	112.1±9.5	117.6±10.8	0.000
DBP(mm of Hg)	74.8±7.6	75.3±7.7	72.1±8.7	74.9±8.8	0.000

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

Table 2: Mean weight, height, waist circumference, SBP and DBP amongst the female children of different age groups and different socio-economic groups

Parameter studied	LIG		MIG		*P* value*
	Age		Age		
	5-10 years (*n*=1247)	11-16 years (*n*=1067)	5-10 years (*n*=1447)	11-16 years (*n*=1320)	
Weight (kg)	22.1±5.7	39.9±8.7	24.3±6.5	43.2±9.4	0.000
Height (cm)	121.6±12.2	148.9±8.4	125.3±11.2	152.1±7.9	0.000
Waist circumference(cm)	48.9±4.8	60.0±7.2	53.7±5.7	63.4±7.4	0.000
SBP(mm of Hg)	110.5±8.8	113.5±9.2	111.9±9.7	115.5±10.4	0.000
DBP(mm of Hg)	73.7±7.3	74.3±7.8	71.4±8.5	72.6±8.5	0.000

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

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

Age (years)	Prevalence of high SBP			
	LIG		MIG	
	n	Prevalence	*n*	Prevalence
5-8	1175	56(4.8)	1659	76 (4.6)
9-12	1562	49(3.1)	1935	87 (4.5)
13-16	1808	69(3.8)	2109	92 (4.3)
Total	4545	174(3.8)	5703	255 (4.4)

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

Table 4: Distribution of study subjects according to socio-economic group and prevalence of high DBP

Age (years)	Prevalence of high DBP			
	LIG		MIG	
	n	Prevalence	*n*	Prevalence
5-8	1175	8 (0.7)	1659	76 (4.6)
9-12	1562	20 (1.3)	1935	81 (4.2)
13-16	1808	90 (4.9)	2109	76 (3.6)
Total	4545	118 (2.6)	5703	233 (4.1)

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

off points to define hypertension. According to these criteria, the prevalence of high SBP in LIG and MIG school population was 3.8% and 4.4%, respectively. Similarly, the prevalence of high DBP in LIG and MIG school population was 2.6% and 4.1% respectively. It was found that higher percentage of children from MIG schools was having high SBP and DBP when compared with children from LIG schools.

The statistical significant correlation was observed between BMI and systolic and DBP (r=0.440; P<0.001);(r=0.341;P<0.001). 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.[14] In the present study ,measurement of WC of children were carried out and the statistical significant correlation was observed between WC and systolic and DBP (r=420; P<0.001);(r=0.298; P<0.001). It can be inferred that children with high BMI and WC are more likely to have hypertension.

All the covariates at univariate analysis were included in a multivariate forward stepwise conditional logistic regression analysis taking inclusion and exclusion criteria of 0.10 and 0.05, respectively. In the model; BMI was found to be positively related to the risk of high systolic and DBP. It was found that the risk of high SBP increased 1.9 (95%CI:1.18-1.10) times in those who are either overweight or obese when compared with normal weight subjects. Similarly, it was observed the risk of high DBP increased 1.2 (95%CI:1.04-1.10) times in those who are either overweight or obese when compared with normal weight subjects.

Discussion

The present study was conducted amongst 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.[16] 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%. The prevalence of high BP was 2.8 percent, which is comparable to the results of the LIG school children of the present study.[17] Similarly, another study from Ludhiana in 2004 revealed that prevalence of sustained hypertension was 7% amongst urban children and 2.6 amongst rural children. The prevalence of hypertension of rural children was similar to the prevalence observed amongst children from LIG category in the present study.[8] Another study carried out by Gupta *et al*., on school children in the age group of 13-17 years showed the prevalence of hypertension (≥142/92mm of Hg) as 7.2%, which is higher than the results obtained in the present study.[18] This could be due to difference in 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.[19,20] In Bogalusa Heart Study, it was established that BP is correlated with height and BMI.[21] In our study ,the statistical significant correlation was observed between BMI and WC with SBP and DBP. Association of hypertension with WC was reported earlier in a study carried out by Janssen *et al*., who found that individuals with high WC are more likely to have hypertension, dyslipidemia and metabolic syndrome.[22]

In the present study, the prevalence of high systolic BP in children belonging to LIG and MIG groups in 5-16 years of age was found to be 3.8% and 4.4%, respectively. Similarly, the prevalence of high DBP in LIG and MIG children was 2.6% and 4.1%. The high prevalence of SBP and DBP remains unnoticed unless they are specifically measured during the school health examination. This indicates the prevalence of metabolic abnormities amongst the young children in the age group of 5-16 years. Based on our findings, we recommend that school health services should include a component of screening of children for the presence of hypertension. Children found with hypertension should be investigated thoroughly to rule out any underlying pathological condition. In the present study, we found an association between BP and anthropometric measurements like 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, SharanR, 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 carotidintimal-medial thickness. J Pediatr 2005;147:651-6.
4. Muntner P, HeJ, 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. Li YP, Yang XG, Zhai FY, Piao JH, Zhao WH, Zhang J, *et al*. Disease risks of childhood obesity in China. Biomed Environ Sci 2005;18:401-10.
7. Lee S, Bacha F, Arslanian SA. Waist circumference, blood pressure and lipid components of the metabolic syndrome. J Pediatr 2006;149:809-16.
8. Mohan B, Kumar N, Aslam N, Rangbulla A, Kumbkarni S, Sood NK, *et al*. Prevalence of sustained hypertension and obesity in urban and rural school going children in Ludhiana. Indian Heart J 2004;56:310-4.
9. Savitha MR, Krishnamurthy B, Fatthepur SS, Yashwanth Kumar AM, Khan MA. Essential hypertension in early and mid-adolescence. Indian J Pediatr 2007;74:1007-11.
10. Daniels SR, Kimball TR, Morrison JA, Khoury P, Witt S, Meyer RA. Effect of lean body mass, fat mass, blood pressure and sexual maturation on left ventricular mass in children and adolescents. Statistical, biological and clinical significance. Circulation 1995;92:3249-54.
11. Lohman TG, Roche AF, Martorech R. Anthropmetric standardization reference manual. Champaign, Ill, USA: Human Kinetics Books; 1988. p. 12.
12. Voors AW. Cuff bladder size in a blood pressure survey of children. Am J Epidemiol 1975;101:489-94.
13. Kirkendall WM, Burton AC, Epstein FH, Freis ED. Recommendations for human blood pressure determination by sphygmomanometers. Circulation 1967;36:980-8.
14. Williams CL, Hayman LL, Daniels SR, Robinson TN, Steinberger J, Paridon S, *et al*. Cardiovascular health in childhood: A statement for health professionals from the Committee on Atherosclerosis, Hypertension, and Obesity in the Young(AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. Circulation 2002;106:143-60.
15. National Heart, Lung, and Blood Institute. Report of the Second Task Force on Blood Pressure Control in Children1987. Task Force on Blood Pressure Control in Children. Bethesda, Maryland. Pediatrics 1987;79:1-25.
16. Gopinath N, Chadha SL, Sood AK, Shekhawat S, Bindra SP, Tandon R. Epidemiological study of hypertension in young (15-24yr) Delhi urban population. Indian J Med Res 1994;99:32-7.
17. Verma M, Chhatwa lJ, George SM. Biophysical profile of blood pressure in school children. Indian Pediatr 1995;32:749-54.
18. Gupta R, Goyle A, Kashyap S, Agarwa lM, Consul R, Jain BK.

Prevalence of atherosclerosis risk factors in adolescent school children. Indian Heart J 1998;50:511-5.

19. Chadha SL, Tandon R, Shekhawat S, Gopinath N. An epidemiological study of blood pressure in school children (5-14years) in Delhi. Indian Heart J 1999;51:178-82.
20. Falkner B, Michel S. Obesity and other risk factors in children. Ethn Dis 1999;9:284-9.
21. 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.
22. 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.

How to cite this article: Kaur S, Sachdev H, Dwivedi SN, Lakshmi R, Kapil U, Sareen N. Association of Obesity with Hypertension Amongst School-Age Children Belonging to Lower income group and middle income group in national capital territory of Delhi. Indian J Community Med 2013;38:175-9.

Source of Support: We are extremely grateful to Indian Council of Medical Research, New Delhi for providing us the financial grant for conducting the study, **Conflict of Interest:** None declared.