Correlation between blood pressure and body mass index in 5–12-year-old children of insured population

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ABSTRACT

Background: Childhood hypertension is an increasing problem all over the world; especially, in developing countries, as it has now been shown to be a precursor of adult hypertension. **Objective:** The objective of this study was to screen the patients presenting in the outpatient department (OPD) with minor illness for the presence of hypertension and its correlation with body mass index (BMI). **Materials and Methods:** This was a cross-sectional, observational study in which 105 children between 5 and 12 years of age, who presented in pediatrics OPD of a tertiary care hospital, were screened for blood pressure (BP), height, weight, and BMI. A pro forma was designed to include parental BP, diet details, physical activity, and average daily screen time. Their demographic details including BP of parents were recorded in OPD, and lifestyle of the child reflecting on screen time, physical activity, and food habits were recorded in pro forma. The children were later categorized according to their BMI and BP centiles. **Results:** BP >90th centile was found in 8 (7.6%) of the screened children and BP >90th centile was present in 5.55% of girls and 8.6% of the boys. 27 (25.7%) children had BMI >85th centile; 5 (4.7%) children had both BMI >85th centile and BP >90th centile; of them, three were boys and two were girls. **Conclusion:** This study highlights the importance of routine measurements of the BP in all children presenting in OPD to screen them for hypertension.

Key words: *Body mass index, Emergency severity index, Hypertension*

Systemic hypertension, originally thought to be disease of adults, is being increasingly recognized in pediatric population. It is an established predictor of adult hypertension and end-organ damage. An increasing number of children, adolescents, and young adults are being diagnosed with hypertension on routine screening and the number in developing countries is growing fast [1]. Childhood hypertension is being diagnosed in increasing number of children and adolescents across the world. The recent data on the US children about the prevalence of childhood hypertension show that the prevalence of prehypertension was estimated to be 14% and 6% in boys and girls, respectively, and the prevalence of hypertension was estimated to be 3–4% in many studies [2-4].

Among the several probable causes of the increase in the prevalence of blood pressure (BP), important ones include obesity, decreased physical activity, consumption of high-calorie diet, and caffeinated drinks along with mental stress and sleep deprivation. The presence of renovascular and renal parenchymal disease in children is another important factor responsible for hypertension.

Control of hypertension includes both pharmacological measures such as angiotensin-converting enzymes inhibitors, angiotensin II receptor blockers, and non-pharmacological measures such as change in lifestyle to include an increase in physical activity and decrease in consumption of high calorie, carbonated drinks, high sodium, and packaged foods. Despite a growing burden of obesity and hypertension in developing countries, there is limited information on the contribution of body mass index (BMI) to BP among the pediatric populations. Obesity-related hypertension requires studies specific for the local population as these vary according to ethnicity, lifestyles, and dietary habits which differ among areas in India.

In this context, the study of association between BMI and BP among children in the age group of 5–12 years attending outpatient facility of a tertiary care center was undertaken to identify at-risk population. Since this hospital caters to insured population under ESI Scheme and no study could be found in this group of patients; hence, this study was conducted.

MATERIALS AND METHODS

This cross-sectional observational study was conducted the pediatric outpatient department (OPD) of a tertiary care ESI hospital in New Delhi. All the children presenting in pediatric OPD with minor illnesses such as cold, mild cough, or for vaccination and follow-ups were screened with BP measurements. Children suffering from chronic kidney disease, chronic heart disease, and rheumatic disease or on any antihypertensive, diuretic, and steroid

therapy were excluded from the study. As it was an occurrence and not a prevalence study, a sample of convenience was taken.

After taking a written informed consent and ethical committee approval, patient's details including BP were recorded on a pro forma which contained their demographic details, anthropometry, BMI (calculated), BP of parents, consumption of processed food, screen time, and details of outdoor activity. A repeat BP measurement was taken after half an hour and the average of three BP readings was taken as the reference. Age was ascertained using the Aadhar card as the reference. BMI was calculated as weight (kg)/height $(m)^2$ and BMI centile was calculated using standard IAP charts. Overweight and obesity were based on BMI centiles of 85–95 and >95, respectively.

BP was measured using standardized sphygmomanometer with appropriate size cuff covering 2/3 of the arm. BP was measured with the child sitting in upright position and arm at the level of the heart. If systolic BP (SBP) or diastolic BP (DBP) was >90th centile, then repeat BP was taken after 1–3 weeks on two separate occasions. The lowest of these readings was recorded. Those diagnosed with hypertension were further investigated for the cause and managed as per standard treatment guidelines. The height centile was then used as a reference to calculate the BP centile.

Then, according to the BP centile, it was classified into four categories; <50th centile, 50–90th centile, 90–95th centile, and >95th centile. SBP or DBP ≥95th centile for age, sex, and height on three or more occasions was defined as hypertension. Prehypertension was categorized as BP between 90th and 95th centile [4]. Children diagnosed with hypertension were then evaluated in detail to find the cause of hypertension and treated accordingly. The percentages of hypertension were compared in those with BMI in the obese and overweight and normal range.

RESULTS

In this study, a total of 105 children were screened among whom, 69 (65.72%) were boys and 36 (34.28%) were girls. Overall in the study population, 25.7% (27/105) children were found to be either overweight or obese. Further, in the screened population, 18.09% (19/105) were overweight and 7.61% (8/105) were obese. In the study population, 16.66% and 5.55% of girls were overweight and obese, respectively, while 18.86% and 8.6% of boys were overweight and obese, respectively. Overall, 62.5% (5/8) of children with BP >90th centile had BMI >85th centile (Table 1).

Table 1: Gender-wise distribution of BMI centiles

BMI centile	Boys, *n* (%)	Girls, *n* (%)
<50th	36 (52.17)	21 (58.33)
50th–85th	14 (20.28)	7 (19.49)
85th–95th (overweight)	13 (18.84)	6 (16.66)
>95th (obese)	6 (8.6)	2 (5.55)
Total (105)	69 (65.72)	36 (34.28)

BMI: Body mass index

Majority of the girls, 28/36 (77.77%) had BMI <50th centile and BP <90th centile. Eight girls had BMI >85th centile, of which only two had BP >90th centile, 1 (50%) was overweight and 1 (50%) was obese (Table 2), i.e., 2/36 (5.55%) had both BP >90th centile and BMI >85th centile and one girl had BP >95th centile. Majority of the boys, 43/69 (62.31%) had BMI <85th centile and BP <90th centile; six boys were found to have BP >90th centile and of them, only three had BMI >85th centile. 19 boys had BMI >85th centile, of which only three had BP > 90th centile, two were overweight and one was obese (Table 3), i.e., 3/69 (4.64%) had both BP >90th centile and BMI >85th centile. Only one boy had BP >95th centile.

Among them, only one child had isolated high SBP and seven children had both high SBP and high DBP while none of them had isolated high DBP. Of the eight children who were found to have hypertension, parental hypertension was found in three cases. Two children were diagnosed with a history of recurrent urinary tract infections, one had inflammatory granuloma, one was asthmatic, and another had pulmonary tuberculosis. Three children had viral infection and no definite cause of hypertension could be evaluated. Two children who had hypertension, i.e., BP >95th centile, were both obese.

DISCUSSION

Obesity is increasing in epidemic proportions all over the world with rapid increase in developing countries due to easy and lucrative access to processed and high-calorie food. This has led to an increase in metabolic syndromes including dyslipidemia, diabetes, and hypertension. Obesity can be measured in routine clinical practice using BMI calculation and plotting it on standard reference charts. Although the prevalence of hypertension is far less in children than in adults, there is enough evidence to suggest that the roots of essential hypertension extend into childhood [5-8]. The occurrence of BP >90th centile in our study group of 5–12 years was 7.61% (8/105); 5.55% (2/36) for girls and 8.6% (8/69) for boys.

Of 105 children, 27 (25.71%) had a BMI >85th centile which indicates that one-fourth of the screened population had BMI higher than normal reflecting on the significant burden on pediatric population. Of these 27, 18.5% of children with BMI >85th centile for age had BP >90th centile. This was comparable with similar studies done in the past where it was shown that variation in BP had a direct correlation with age, height, and BMI. Sandvik *et al*., Paffenbarger *et al*., and Soudarssanane *et al*. found similar results [9-11]. Andriska *et al*. found in their study that 41% of hypertensive children were obese [12]. Similar study was done by Sharma *et al*. noted that rates of elevated BP (prehypertension and hypertension) were significantly higher in children with high BMI. Friedemann *et al*. reviewed literature and reported a significant effect of BMI on hypertension [13]. Furthermore, studies have shown impact of weight reduction [14] and diet control [15] on hypertension.

Limitation of the study was the sample size which was small and correlation with other factors influencing BP including lipid

Table 2: BMI centiles with respect to BP centiles in girls

BMI centiles	BP <50th centile, *n* (%)	BP 50th–90th centile, *n* (%)	BP >90th centile, *n* (%)
<50th	15 (65.21)	6 (54.54)	0
50th–85th	4 (17.39)	3 (27.27)	0
85th–95th (overweight)	3 (13.04)	2 (18.18)	1 (50)
>95th (obese)	1 (4.35)	0 (0)	1 (50)
Total	23	11	2

BMI: Body mass index

Table 3: BMI centiles with respect to BP centiles in boys

BMI centile	BP <50th centile, *n* (%)	BP 50th–90th centile, *n* (%)	BP >90th centile, *n* (%)
<50th	26 (60.46)	9 (45)	1 (16.66)
50th–85th	8 (18.6)	4 (20)	2 (33.33)
85th–95th (overweight)	7 (16.27)	4 (20)	2 (33.33)
>95th (obese)	2 (4.6)	3 (15)	1 (16.66)
Total	43	20	6

BMI: Body mass index

profile was not ascertained. We, therefore, recommend a larger sample size of children with higher BMI to be evaluated in detail including all relevant biochemical investigations.

CONCLUSION

Although the number is small, the study highlights the importance of measuring BP in all children attending OPD of a tertiary care hospital. This will help us in picking up asymptomatic children with hypertension at an early stage which will enable the clinician to investigate and manage these cases appropriately since it may have long-term consequences.

REFERENCES

1. Raj M, Sundaram KR, Paul M, Kumar RK. Blood pressure distributrion in Indian children. Indian Pediatr 2010;47:477-48.
2. Ostachega Y, Carmell M. Trends of elevated blood pressure among children and adolescents-data from the national health and nutrition survey. 1988-2006. Am J Hypertens 2009;22:59-67.
3. US dept of Health and Human Services, Healthy People 2020. Topics and Objectives, Heart Disease and Stroke. Available from: https://www.healthypeople.gov/2020/topics-objectives/topic/heart-disease-and-stroke. [Last accessed on 2018 Nov 10]
4. Kaplan NM, Victor CG. Clinical Hypertension. 10th ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2010.
5. McIntosh N. Cardiovascular Disease. In: Forfar and Arneil's Text book of Paediatrics. 7thed. Ch. 21. Edinburgh: Elsevier Ltd.; 2008.
6. Barrett K, Barman S, Boitano S, Brooks H. Cardiovascular physiology: Section VI. Ganong's Review of Medical Physiology. 23rd ed. New York, USA: McGraw Hill Professional; 2010.
7. Paul VK, Bagga A, editors. Cardiovascular disease. In: Ghai's Textbook of Pediatrics. 7th ed. New Delhi: CBS Publishers; 2010.
8. Gupta AK, Ahmed AJ. Normal blood pressure and the evaluation of sustained blood pressure elevation in childhood. Indian Pediatr 1990;27:33-42.
9. Sandvik L, Erikssen J, Thaulow E, Erikssen G, Mundal R, Rodahl K. Physical fitness as predictor of mortality among healthy, middle-aged Norwegian men. N Engl J Med 1993;328:533-7.
10. Paffenbarger RS, Hyde RT, Wing AL, Lee IM, Jung DL, Kampert JB. The association of physical activity level and other life style characteristics with mortality among men. N Engl J Med 1993;328:538-45.
11. Soudarssanane M, Mathanraj S, Sumanth M, Sahai A, Karthigeyan M. Tracking of blood pressure among adolescents and young adults in an urban slum of Puducherry. Indian J Community Med 2008;33:107-12.
12. Andriska J, Gombik M, Breyer H, Tarr A. Hypertension in children and adolescents. Results of a long term follow up study 1975-1985. Clin Exp Hypertens A 1986;8:567-9.
13. Friedemann C, Heneghan C, Mahtani K, Thompson M, Perera R, Ward AM. Cardiovascular disease risk in healthy children and its association with body mass index: Systematic review and meta-analysis. BMJ 2012;345:e4759.
14. Reinehr T, de Sousa G, Toschke AM, Andler W. Long-term follow-up of cardiovascular disease risk factors in children after an obesity intervention. Am J Clin Nutr 2006;84:490-6.
15. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents, National Heart, Lung, and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: Summary report. Pediatrics 2011;128 Suppl 5:S213-56.

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