The Prevalence of Hypertension and Prehypertension among Children in Schools of Rural Health Training Area of a Tertiary Care Hospital in Nagpur, Maharashtra

Arshiya Rehman Sheikh, Chaitanya R. Patil¹, Sushama Subhash Thakre²

Department of Community Medicine, Dr Shankarrao Chavan Government Medical College, Nanded, ²Department of Community Medicine, Indira Gandhi Government Medical College, Nagpur, Maharashtra, ¹Department of Palliative Care and Psycho Oncology, Tata Medical Centre, Kolkata, West Bengal, India

Context: Chronic diseases such as diabetes, hypertension, and respiratory diseases are affecting the younger age groups occurring across the world. Raised blood pressure in children is increasing at an alarming rate. Aims: The aim was to study the prevalence of hypertension and prehypertension among children of schools in rural health training center area of a tertiary care hospital in Nagpur, Maharashtra, and to find any association between generalized obesity and central obesity with hypertension/prehypertension. Settings and Design: A cross-sectional study was conducted in the schools under the administrative cover of Indira Gandhi Government Medical College, Nagpur. Materials and Methods: Schoolchildren who had completed 10 years and not more than 13 years, whose parents gave consent, who gave assent, and apparently healthy were included in the study. The demographic particulars such as age and gender were collected using the case record form. Anthropometric measurements and blood pressure were measured using the standard guidelines. Statistical Analysis Used: Qualitative variables expressed in terms of percentages and quantitative in terms of mean and standard deviation. Chi-square test for trend and Student’s t-test were used. Results: The prevalence of hypertension and prehypertension was 3.57% and 6.25%, respectively. We found a significant association between hypertension/prehypertension with waist-to-hip ratio of the children (P < 0.05). Conclusions: We found a higher prevalence of hypertension and prehypertension among the schoolchildren in rural areas, and we found a significant association between central obesity and hypertension/prehypertension.

Keywords: Central obesity, children, raised blood pressure

INTRODUCTION

India is undergoing an epidemiological transition.¹ Chronic diseases such as diabetes, hypertension, and respiratory diseases are affecting the younger age groups.² One of the chronic diseases affecting the children is raised blood pressure. It is one of the major contributors to premature mortality across the world.³ High blood pressure has also been attributed to target organ damage, left ventricular failure, and pathological vascular changes in children. There is evidence that raised blood pressure in children increases the risk of hypertension in later adulthood. The disease burden of hypertension seen is just the tip of the iceberg. Hence, the World Health Organization has named it as a “Silent Killer.”³

The change in lifestyle and genetic factors contributes to the complex multifactorial nature of the epidemiology of hypertension among the children.⁴ There are many studies conducted in urban areas across India on hypertension in children,⁵⁻²² but there are very less data published on the studies done in rural areas.²³⁻²⁶ Hence, this study was conducted to see the prevalence of hypertension and prehypertension among children of...
Sheikh, et al.: Hypertension and prehypertension in school-going children

Materials and Methods
A cross-sectional study was conducted among schoolchildren during July 2016–October 2016. This study was conducted in rural health training center area of a tertiary care hospital in Nagpur which caters 25 schools. The list of all schools was taken from the district authorities. Of 25 schools, two schools were selected randomly by lottery method. Necessary permissions were obtained from the school authorities. Schoolchildren who had completed 10 years and not more than 13 years, whose parents gave consent, who gave assent, and apparently healthy were included in the study. The children with any acute illness for the past 7 days, those on any chronic medication, and those who are unwilling for the study were excluded from the study. Approval for the study was given by the Institutional Review Board (letter number IGGMC/Pharm/IEC/12/2016 dated March 25, 2016).

A pilot study was done on 100 eligible schoolchildren and found the combined prevalence of hypertension and prehypertension to be 6.5%. Using this prevalence, with a 95% confidence interval and 3.5% absolute error, we found a minimum sample size to be 191. The final sample size was calculated with addition of an attrition rate of 10%, which came to be 210. After arranging 400 eligible children in alphabetical order of both the schools, 250 children were selected by simple random sampling using a computer-generated table. Among them, 26 schoolchildren were not available even after giving the second follow-up to the schools.

The case record form was finalized by a team of experts from the department of community medicine and tested on schoolchildren, and necessary changes were made and used for data collection. Case record form had demographic characteristics such as age and gender and anthropometric measures. Height, weight, waist circumference, and hip circumference were measured according to the standard guidelines. Body mass index was calculated using the formula: body mass index = weight (kg)/height(m) $^2$. The age was calculated as the difference between the date of birth of the child and the date of the interview. Blood pressure was measured using a mercury sphygmomanometer and a specific cuff for adolescents. The average reading of two pressure readings was taken to be the final blood pressure, based on which it was further classified based on the standard guidelines into hypertension and prehypertension. Those children who had raised blood pressure were referred for further evaluation by a pediatrician at a tertiary care hospital in Nagpur, Maharashtra.

Statistical analysis
The data were collected, compiled, and analyzed using EPI Info Version 7.2 (Center for Disease Control and Prevention, Atlanta, USA). The qualitative data were expressed in percentage, and Chi-square/Fisher’s exact test was applied to test the difference between the two proportions. The quantitative variables were expressed in terms of mean and standard deviations, and unpaired $t$-test was used to test the difference between the two means. Chi-square for trend was used to assess the trend of prevalence of hypertension and prehypertension with a change in age. The significance level was set to 0.05, and all analyses were two-tailed.

Results
A total of 224 schoolchildren were included in the study. The mean age of the study participants included in our study was 11.46 ± 1.12 years. Majority of the schoolchildren were in the age of 10 years (26.79%) followed by 12 years (25.89%) and equal in 11 years (23.66%) and 13 years (23.66%). Majority of them were males (52.23%) in our study [Table 1].

The mean weight and mean body mass index were higher in females and mean height was higher in males, but this difference did not attain the level of significance ($P > 0.05$). The mean waist circumference, hip circumference, and waist-to-hip ratio were significantly higher in females when compared with males. However, the mean height was higher when compared to females ($P < 0.05$) [Table 2].

The prevalence of hypertension and prehypertension was 3.57% and 6.25%, respectively. The prevalence of hypertension and prehypertension was higher in females when compared to males, but the difference

| Table 1: Demographic characteristics of the study population |
|------------------------------------------------------------|
| Demographic characteristics        | Frequency (%) |
| Age (years)                          |
| 10                          | 60 (26.79)   |
| 11                          | 53 (23.66)   |
| 12                          | 58 (25.89)   |
| 13                          | 53 (23.66)   |
| Gender                       |
| Male                         | 117 (52.23)  |
| Female                       | 107 (47.77)  |
attained the level of significance only in case of prehypertension ($P < 0.05$) [Table 3].

The prevalence of hypertension and prehypertension was highest in 10-year-old children and 11-year-old children, respectively. The trend of hypertension and prehypertension was not significant with a change in age of the children ($P > 0.05$) [Table 4].

We found a significant association between hypertension and prehypertension with a waist-to-hip ratio of the children ($P < 0.05$). The mean body mass index of the children having hypertension/prehypertension was higher than those who did not but did not attain the level of significance ($P > 0.05$) [Table 5].

**DISCUSSION**

The present study was conducted to determine the prevalence of hypertension and prehypertension and its association with generalized and central obesity in children of schools in rural health training center of a tertiary care institute in Nagpur. There is a lack of evidence of this data in rural areas in India. Early diagnosis leads to early intervention and no escalation of this problem in the later life of the children. We found a prevalence of hypertension and prehypertension to be 3.52% and 6.25% in our study, which reflects the rising trend of this “Silent killer” in rural children.

The studies conducted by Yuvraj et al., Amma et al., Srinivas et al., Patil and Garg, Baradol et al., Narayanappa et al., and Gupta et al. had a lower prevalence of hypertension when compared with our study. Another study conducted in schools of New Delhi by Kaur et al. using a cluster study design found the prevalence in their study to be 3.8% and 4.4%, respectively, in low-income and high-income groups. Our study was in concordance with this study as in prevalence of low-income group children. Further, some studies conducted by Patel et al., Deshpande, Vivek and Singh, Naha et al., Sharma et al., Sharma et al., Buch et al., Shetty et al., Patil et al., and Zhou et al. showed higher prevalence of hypertension in schoolchildren. Among few studies conducted on the prevalence of prehypertension in children, studies who inferred higher prevalence compared to our study were Patel et al., Deshpande, Amma et al., Vivek and Singh, Sharma et al., Sharma et al., Balakrishnan et al., and Shetty et al. Further, some studies done by Narayanappa et al., Baradol et al., and Naha et al. showed lower prevalence compared to our study. This varied prevalence of hypertension and prehypertension in schoolchildren might be due to the geographical variation, lifestyle factors, and ethnic and genetic factors.

Majority of the studies showed a higher prevalence of hypertension and prehypertension in males when compared with females. However, our study showed a higher prevalence of hypertension and prehypertension in females when compared with males. Studies done by Yuvraj et al., Shetty et al., Shah et al., and Kishorekumar et al. were in accordance with our study. Some studies conducted by Buch et al., Deshpande, Patil and Garg, and Zhou et al. had almost equal prevalence of hypertension and prehypertension in their studies. This significant difference found in our study could be due to the hormonal effect on females that increases the chances of being overweight or obese and further increased tendency to have higher blood pressure. With increasing age, our study did not infer any significant trend in the prevalence of hypertension and prehypertension. Similar findings were inferred by the study done by Kishorekumar et al. but a significant trend was concluded in the study done by Deshpande. The reason for not attaining the level of significance in our study might be the small sample size.

We found a nonsignificant association between the body mass index and hypertension and prehypertension. Similar findings were concluded by Baradol et al., but majority of studies conducted inferred a significant association between body mass index and hypertension and prehypertension. Our study is one of the few

| Table 2: Mean and standard deviations of anthropometric variables |
|------------------|---------|---------|---------|
| Anthropometric variable | Male | Female | $P^*$ |
| Weight | 30.44±7.58 | 30.65±8.10 | 0.8416 |
| Height | 141.28±10.57 | 140.98±9.40 | 0.8220 |
| Waist circumference | 56.97±5.92 | 59.24±5.32 | 0.0020* |
| Hip circumference | 67.68±7.03 | 70.06±8.06 | 0.0199* |
| BMI | 15.08±2.51 | 15.23±2.97 | 0.6727 |
| Waist-to-hip ratio | 0.84±0.04 | 0.87±0.07 | <0.001* |

*Significant, *Unpaired t-test used. SD: Standard deviation, BMI: Body mass index

| Table 3: Prevalence of hypertension and prehypertension based on gender |
|------------------|---------|---------|---------|---------|
| Disease | Males ($n=117$), $n$ (%) | Females ($n=107$), $n$ (%) | Total, $n$ (%) | $P^*$ |
| Hypertension | 2 (1.70) | 6 (5.60) | 8 (3.57) | 0.1373 |
| Prehypertension | 4 (3.41) | 10 (9.34) | 14 (6.25) | 0.0379* |

*Fisher’s exact test applied, *Significant
studies which showed association between central obesity (waist-to-hip ratio) with hypertension and prehypertension.

Our study had some limitations. Small sample size and restricted geographical inclusion hinder the generalizability of our study. Since this was a cross-sectional study, the children who were found having normal blood pressure were not reassessed for their blood pressure, which might have missed some cases of hypertension in our study. All blood pressure measurements were taken by a single observer that can amount to bias. Other factors such as physical activity, dietary factors, family history, and biochemical profile have not been considered in our study. The strengths of the study were that the blood pressure measurements were done twice, and the average of the two measurements was included for diagnosing hypertension. We have included waist circumference and hip circumference along with body mass index as a measure of obesity. Larger sample sizes with longitudinal study design will help to assess the trends of hypertension and prehypertension among the children.

**Table 4: Prevalence of hypertension and prehypertension based on age (in completed years)**

| Prevalence | 10        | 11  | 12  | 13  | P*  |
|------------|-----------|-----|-----|-----|-----|
| Hypertension | 4 (6.67)  | 2 (3.77) | 0 (0) | 2 (3.77) | 0.1772 |
| Prehypertension | 3 (5.00)  | 5 (9.43) | 4 (6.90) | 2 (3.77) | 0.6223 |

'≠' for trend used

**Table 5: Association of body mass index and waist-to-hip ratio with hypertension/prehypertension in the study participants**

| Parameters       | Hypertension/prehypertension, mean±SD | P*  |
|------------------|--------------------------------------|-----|
|                   | Yes (n=14)                            | No (n=210) |
| BMI              | 15.73±4.08                           | 15.09±2.56 | 0.4788 |
| Waist to hip ratio | 0.88±0.09                            | 0.85±0.05  | 0.0159* |

*Significant, t Unpaired t-test used. BMI: Body mass index, SD: Standard deviation

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Yadav S, Arokiasamy P. Understanding epidemiological transition in India. Glob Health Action 2014;7:23248.
2. Mercer A. Epidemiological transition: A new perspective. In: Infections, Chronic Disease, and the Epidemiological Transition- A New Perspective. University of Rochester Press; 2014. p. 203-22.
3. World Health Organization Certified. A Global Brief on Hypertension Silent Killer, Global Public Health Crisis; 2013. Available from: http://www.who.int/cardiovascular_diseases/publications/global_brief_hypertension/en/. [Last accessed on 2017 Mar 26].
4. Ewald DR, Haldeman PhD LA. Risk factors in adolescent hypertension. Glob Pediatr Health 2016;3:2333794×15625159.
5. Zhou Y, Qian Z, Vaught MG, Boutwell BB, Yang M, Zeng XW, et al. Epidemiology of elevated blood pressure and associated risk factors in Chinese children: The SNEC study. J Hum Hypertens 2016;30:231-6.
6. Patil S, Mangeshetty R, Shridive SB. Study of prevalence of hypertension in school children aged 6 to 15 years in Guwahati city. Pediatr Educ Res 2014;2:31-4.
7. Shetty S, Shetty S, Sasiadharnar S, Shenoy V. Prevalence of pre-hypertension and hypertension in asymptomatic urban school going children of Mangalore and its correlation with BMI. IOSR J Dent Med Sci 2013;9:76-9.
8. Sundar JS, Adakalam JM, Parameswar S, Valarmarthi S, Kalpana S, Shambharam D. Prevalence and determinants of hypertension among urban school children in the age group of 13-17 years in Chennai, Tamil Nadu. Epidemiol 2013;3:130.
9. Baradol R, Patil S, Ranagol A. Prevalence of overweight, obesity and hypertension amongst school children and adolescents in North Karnataka: A cross sectional study. Int J Med Public Health 2014;4:260-4.
10. Buch N, Goyal JP, Kumar N, Parmar I, Shah VB, Charan J, et al. Prevalence of hypertension in school going children of Surat city, Western India. J Cardiovasc Dis Res 2011;2:228-32.
11. Patel U, Patel N, Jain S, Ratre B, Shirivastava S. High blood pressure in school going adolescents: Prevalence and risk factors. Pediatr Rev Int J Pediatr Res 2014;1:3-9.
12. Yuvraj BY, Nagendra Gowda MR, Rajeev KH, Prashanthkumar JH, Ujjanappa S, Shreyas M. A study on hypertension in school children of Chitradurga. Glob J Med Res 2014;14:1-5.
13. 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.
14. Kishorekumar C, Christy A, Ganeshkumar P, Vijayakumar R, Srikumar R, Gobi V. Prevalence of hypertension among school children in Puducherry. Int J Innov Res Dev 2014;3:290-5.
15. Shah S, Dave B, Sharma A, Desai A. Prevalence of hypertension and association of obesity with hypertension in school going children of Surat city, Western India. Online J Health Allied Sci 2013;12:1-3.
16. Sharma A, Grover N, Kaushik S, Bhardwaj R, Sankhyan N.
Prevalence of hypertension among schoolchildren in Shimla. Indian Pediatr 2010;47:873-6.
17. Gupta G, Agrawal D, Singh R, Arya R. Prevalence, risk factors and socio demographic co relates of adolescent hypertension in District Ghaziabad. Indian J Community Health 2013;25:293-8.
18. Veena Kamath G, Prasanna Mithra P, Pattanshetty S, Kamath A, Balakrishnan A, Mishra T, et al. Prevalence of hypertension in the paediatric population in Coastal South India. Australas Med J 2010;3:695-8.
19. Sharma R, Mandliya J, Dhaneria M, Tiwari HL. Prevalence of hypertension in mid adolescents in central India: A school based comparative study. Int J Med Res Rev 2015;3:891-9.
20. Naha NK, John M, Cherian VJ. Prevalence of hypertension and risk factors among school children in Kerala, India. Int J Contemporary Pediatr 2016;3:931-8.
21. Vivek V, Singh SK. Prevalence of hypertension in Gujarati school going children and adolescents in Anand District. Natl J Community Med 2012;3:452-7.
22. Deshpande A. Study of prevalence of hypertension in adolescents in central India. Int J Basic Med Clin Res 2014;1:66-71.
23. Narayanappa D, Rajani HS, Mahendrappa KB, Ravikumar VG. Prevalence of prehypertension and hypertension among urban and rural school going children. Indian Pediatr 2012;49:755-6.
24. Srinivas H, Harisha G, Thibbegowda C, Pushpalatha K, Susheela C. A study of blood pressure profile in rural school children of Kolar Taluka. Int J Sci Study 2014;1:24-8.
25. Amma GM, Vasudevan B, Akshayakumar S. Prevalence and determinants of prehypertension and hypertension among adolescents: A school based study in a rural area of Kerala, India. Int J Res Med Sci 2015;3:58-64.
26. Patil RR, Garg BS. Prevalence of hypertension and variation in blood pressure among school children in rural area of Wardha. Indian J Public Health 2014;58:78-83.