# **Research Article**

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# Prevalence of hypertension and risk factors among school children in Kerala, India

Nihaz K. Naha<sup>1</sup>, Mini John<sup>2</sup>\*, Vinod Jacob Cherian<sup>1</sup>

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# \*Correspondence:

Dr. Mini John,

E-mail: drminicherian@gmail.com

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#### **ABSTRACT**

**Background:** Early diagnosis of hypertension in childhood is an important strategy in its control and hypertension may begin in childhood, perhaps even in infancy. The objective of the study was to To know the prevalence of hypertension and risk factors among school going children between 5 - 10 yrs of age in Thrissur District, Kerala India.

**Methods:** 1610 school children of the age group 5-10 years from 6 schools of rural and urban regions were selected by purposive sampling method. They were subjected to anthropometric measurements after getting informed consent. Blood pressure measurements were taken using mercury sphygmomanometer as per recommendation. Hypertension is considered when blood pressure is more than 95th percentile adjusted for age and gender based on BP percentile charts

**Results:** Total prevalence of hypertension in this study was 4.5% and Pre-hypertension is 5.8%. Urban school children with hypertension were 7.52% against rural were 1-2%, pre hypertension in urban school children were 9.4%, rural 1.84% Hypertension in males were 4.31% and in females were 4.65% Prevalence of obesity in hypertension was 11.32% against normotensive 4.61% (P <0.05). Prevalence of hypertension in children with family history of hypertension, diabetes was high and statistically significant.

**Conclusions:** We found childhood obesity, family history of diabetes mellitus ischemic heart disease and CVA had strong association with childhood hypertension. Awareness of hypertension was very low. Periodic measurements should be done in schools to identify the high risk group of children and adolescents who can develop hypertension.

Keywords: Obesity, Hypertension, Pre-hypertension, Risk factors

# INTRODUCTION

Systemic hypertension is an important health problem in childhood with an estimated population prevalence of 1-2% in the developed countries. Hypertension could have its origin in childhood and go unnoticed unless specifically diagnosed during this childhood period. Nutritional surveys, in the USA showed a significant secular increase in systolic and diastolic blood pressures. The reasons for the increase in blood pressure are attributed to obesity, change in food habits, decreased physical activity and increasing academic stress. Small

surveys in school children in India suggest a prevalence ranging from 2-5%.

Elevated blood pressure whether systolic or diastolic in both sexes and at any age is a contributor of cardiovascular diseases.<sup>3</sup> Identifying and modifying the risk factors reduces the incidence and complications in adolescents and adulthood. This study was conducted to know the prevalence and risk factors of hypertension in children in Thrissur city in central Kerala.

<sup>&</sup>lt;sup>1</sup>Department of Pediatrics, Jubilee Mission Medical College and Research Institute, Thrissur, Kerala, India

<sup>&</sup>lt;sup>2</sup>Department of Pediatrics, PK DAS Institute of Medical Sciences, Ottapalam, Kerala, India

#### **METHODS**

The study was a cross sectional study conducted in five schools from Thrissur city (three rural and three urban). The sample size was calculated keeping in view expected prevalence of hypertension in children as 5 %.

#### Study population (n)

1610 children of both sexes between age group of 5-10 years from selected schools.

#### Inclusion criteria

All students from selected schools in the specific age group, whose parents gave consent to participate in the study.

# Exclusion criteria

- Those children were absent and whose parents were not willing to give consent.
- Children had any chronic illness.

# Study variables

Socio-demographic variables

Age, sex, address .religion food habits, hours of physical activity (exercise/play), time spent on television/computer, parental education, income and relevant personal details and medical history of family members.

# Anthropometric measurements

- Weight: The body weight was measured without any footwear with minimal clothing to a nearest 0.1kg using a beam balance, with sensitivity 0.1 kg, respectively. Zero error was set after each measurement.
- Height was measured to nearest 0.1 cm by using a nonstretchable cloth tape, which was fixed to the wall vertically using cellophane tape, and by making the child stand with heels buttocks, shoulders and occiput in apposition with the wall, taking care that there is no bending of knees.
- Waist circumference: It was measured with a nonstretchable cloth tape, at the midpoint between the lowest part of rib cage and the iliac crest in a standing position during end-tidal expiration.

Blood pressure: Blood pressure recording was done by using appropriate cuff size and with a standard mercurial sphygmomanometer (Diamond Deluxe BP Apparatus), in the sitting position. Children made comfortable and explained about procedure to alleviate anxiety. <sup>4,5</sup> BP was taken on the right arm. Appropriate size cut-off was selected on the basis of upper arm circumference for each child the blood pressure was measured three times with a

period of 30 minute rest between each determination and average blood pressure was calculated. The systolic blood pressure was considered by the onset of the Korotkoff-1 sound and the diastolic blood pressure at its disappearance (Korotkoff-5). Mean systolic blood pressure (SBP) or diastolic blood pressure (DBP) levels of 90<sup>th</sup> percentile or more but less than 95<sup>th</sup> percentile for gender, age and height on at least three separate occasions is defined as pre hypertension. Hypertension was considered when average SBP or DBP of 95<sup>th</sup> percentile or more for sex, age and height on at least three separate occasions.

School authorities and Parent Teachers Association (PTA) were informed prior to the study and approval obtained.

Consent was obtained from parents prior to data collection and examination.

#### Data collection procedure

A semi-structured pre-tested questionnaire was given to each student with the help of class teacher and asked to get filled by parents at home .Questionnaire included information about demographic details (name, age sex, address, religion, history of any medical illness in the child, food habits, hours of physical activity (exercise/play), time spent on television/computer and relevant personal details and family history of hypertension, diabetes mellitus, coronary heart disease, CVA, educational status of father and mother and family income. Findings were reconfirmed with parents. The questionnaire was a validated one, prepared after consultation with experts in the health and community level. As far as possible, the free time were used for this study. The exact age of children was verified from school registers. Children were explained about study in their local language (Malayalam). Height percentiles were determined with Stature-for-age charts for both gender developed by Center for Disease Control (CDC) BMI was calculated with the formula weight in kg/ height in m2, and BMI percentiles were determined by BMI growth charts for age and gender developed by Center for Disease Control (CDC). 7,8 Blood pressure percentiles were determined by Blood pressure percentiles charts adjusted for age, gender, and height percentile developed by the National Heart Lung and Blood Institute

## Data management

Data collected were coded properly and entered in excel spread sheet (Microsoft Excel 2007) and appropriate data checking measures were used for ensuring quality of data. All the entries were double checked. Association of each of the categorical with hypertension is assessed with chi-square test. Variables showing statistically significant association with the outcome variables (P < 0.05) were considered as statistically significant.

#### **RESULTS**

Study included 1610 children which include 836males (51.9%) and 774 females (48.1%). Total prevalence of hypertension in this study was 4.5%,pre-hypertension

was 5.85% Out of total children 759 children were from rural and 851 children were from urban school. Prevalence of hypertension was 1.05% in rural school children while it was 7.52% in children from urban school.

Table 1: Prevalence of hypertension and pre-hypertension based on agglomeration area.

School	Blood pressure				Significance (p value)	
	Hypertension	Pre-hypertension	Normal	Total		
Rural (%)	8 (1.05%)	14	737 (97.10%)	759	0.0001	
Urban (%)	64 (7.52%)	80 (9.40%)	707 (83.08%)	851		

The prevalence of hypertension is found to be significantly higher in urban school children, compared to rural school children. The prevalence of combined hypertension and pre-hypertension (BP>90<sup>th</sup> percentile) is

16.2% in urban area and 2.89% in rural area. This is highly statistically significant with p value<0.05 and Chisquare of 85.54 (Table 1).

Table 2: Prevalence of hypertension and pre-hypertension based on age.

		Hypertension	Pre-hypertension	Normal	Tot	Significance (p value)
Age	5%	0 (0%)	0 (0%)	16 (100%)	16	0.0001
	6%	9 (4.21%)	13 (6.07%)	192 (83.72%	214	
	7%	22 (5.23%)	27 (6.41%)	372 (88.36%)	421	
	8%	10 (2.36%)	11 (2.6%)	402 (95.04%	423	
	9%	15 (3.91%)	25 (6.51%)	344 (89.58%)	384	
	10%	16 (10.53)	18 (11.84%)	118 (77.68%)	152	

The prevalence of hypertension and pre-hypertension seems to increase as age advances. This is highly statistically significant with p value<0.05 and Chi-square value of 40.78 (Table 2).

The prevalence of hypertension in boys and girls are almost equal, but the prevalence of pre-hypertension is more in boys. The difference is not statistically significant with p value >0.05 and Chi-square value of 5.71 (Table 3).

Physical activity also has a significant influence on Blood pressure. More than 60% of subjects in hypertension and pre- hypertension group have played hours less than 1hr. This is found to be highly statistically significant (p value <0.05) (Chi- square value is 10.59) (Table 4).

Table 3: Prevalence of hypertension and pre-hypertension based on sex.

		Hypertension	Pre-hypertension	Normal	Total	Significance (p value)
Age	Male (%)	36 (4.31%)	60 (7.18%)	740 (88.52%)	836	- 0.06
	Female (%)	36 (4.65%)	34 (4.39%)	704 (90.96%)	774	

Table 4: Comparison of BP percentile based on hours of play.

	Hypertension (%)	Pre- hypertension (%)	Normal (%)	Significance (p value)
Play<1hr	47 (65.28%)	57 (60.64%)	717 (49.65%)	
Play>1hr	25 (34.70%)	37 (39.36%)	727 (5.35%)	0.03
Total	72	94	1444	

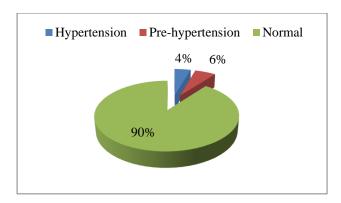


Figure 1: Prevalence of hypertension and prehypertension.

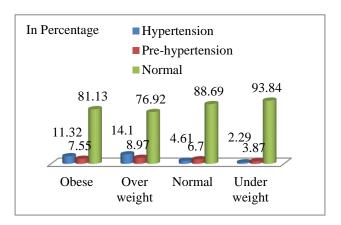


Figure 2: Relationship between BMI percentile and BP percentile.

There is a significant association (p value <0.05) between high BMI ( $>85^{th}$  percentile) and hypertension among the study subjects.

The consumption of any type of oil did not influence BP as the p value (>0.05) and Chi-square value (13.2) was found to be insignificant. This means that BP is a phenomenon much influenced by other factors rather than oil intake (Figure 2).

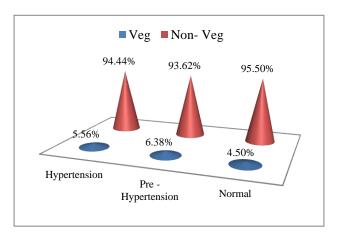


Figure 3: Comparison of BP percentile based on category of food consumed.

The same terminology as in the case of influence of oils on BP is applicable to the situation of intake of vegetarian/non-vegetarian foods. Both the Chi-square values and p values based on the cross tabulation of the intake of vegetarian/non-vegetarian foods with BMI and BP percentile (Chi-square values 0.252 and 0.840 respectively) (both p value >0.05) were not significant. This again reassures the fact that mere measurement of the mode of intake of foods is not influential on BMI or BP.

The frequency of intake of meat foods significantly influenced blood pressure (p value < 0.05). The Chisquare for frequency verses BMI was found to be significant (Chi-square value is 20.41). More than 50% of subjects who have hypertension or pre-hypertension used to consume meat at least once in a weak (Figure 3).

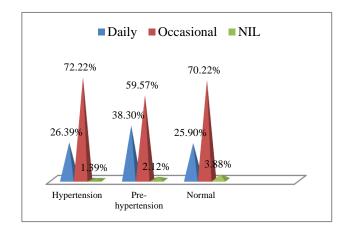


Figure 4: Comparison of BP percentile based on frequency of intake of fried food.

Relatively higher intake of fried foods was noticed in the hypertensive and pre-hypertensive category, as their frequency of intake was more of a daily phenomenon. The Chi-square value 8.4 and p value 0.05 was found to be significant at 95 percent confidence interval (Figure 4).

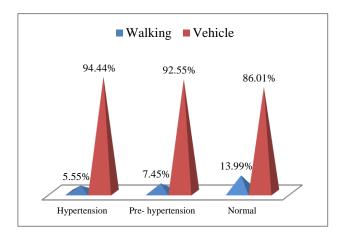


Figure 5: Comparison of BP percentile based on mode of transport to school.

Mode of transport to school has a significant influence on BP. Nearly 95% of subjects in hypertensive group and 93% of pre- hypertensive group go to school in a vehicle, It is statistically significant (p value<0.05) (Chi- square value is 7.19) (Figure 5).

Prevalence of pre-hypertension was 1.84% in rural school children and 9.40% in urban school a child the prevalence of obesity was found to be 3.3% and that of overweight was 4.8% in the study group%. Prevalence of obesity was 4.47% in urban school children while it was 1.98% in children from rural school. Prevalence of hypertension in males was 4.31% and pre-hypertension was 7.1% in females. The prevalence of hypertension in boys and girls are found almost same and prevalence of pre hypertension was found more in boys. The difference is not statistically significant (Chi-square value is 5.71) (P value is 0.06). In a study done in Surat city, Western India prevalence of hypertension in school going children is 6.4%, and the prevalence increased as the age increased.9 In a study conducted by Dyson et al, to identify and determine the relationship between overweight, obesity and hypertension there was a significant association between overweight and obesity and prevalence of Hypertension. <sup>10</sup> In this study there was a significant association between high BMI (>85th percentile) and hypertension among the study subjects. The prevalence of hypertension and pre hypertension was higher in obese 11.32% and 7.55% and in overweight 14.1% and 8.97% respectively, compared to that of normal 4.61% and 6.7%.

In studies conducted by Lauer et al and Resnicow et al children and adults who are obese have elevated blood pressure, obese children should have blood pressure determinations obtained serialy. Approximately 20% to 30% of obese children have hypertension. Obese children have a 2.4-fold risk for elevated blood pressure compared with controls. Similarly several large epidemiological studies like the Framingham heart study have documented the linear relationship between hypertension and BMI. In a follow up study in Ernakulum district of Kerala the proportion of overweight in children increased from 4.94% to 6.57% in a two year study period (2003-2005). The prevalence of hypertension in overweight children was 17.34% when compared to 10.1% in remaining students.

Similarly family history of hypertension has a strong influence on BP. It is noted that nearly 60% of subjects in hypertensive group have family history of hypertension. This is statistically significant with Chi-square value 6.75 and p value 0.03. Also there is strong association between family history of DM and BP. It is noted that more than 65% of subjects in hypertensive group and pre-hypertensive group have family history of diabetes. From this study it is clearly noted that Parent's education and family income is directly proportional to increased incidence of obesity and hypertension in their children .It is noted that nearly 80% of subjects in obese group and

overweight group and more than 80% of subjects in hypertensive group and pre-hypertensive group have family income more than ten thousand rupees/month.

In this study it is noted that in hypertensive children 12.5% had family history of CVA, whereas in children with normal BP the history of CVA in family is only 4.92%. This is found to be highly statistically significant with Chi-square value 9.52 and p value <0.05.

## **DISCUSSION**

This cross sectional study was done to determine the prevalence of hypertension and risk factors in school going children of age group of 5-10 years in central Kerala. Obesity and hypertension start in initial period of life. Early detection of hypertension and pre-hypertension translates into early interventions in childhood. The findings of this study will help to establish preventive measures to be taken in childhood for prevention of later morbidity and mortality.

In the present study, the prevalence of hypertension found to be 4.5%. It was almost similar to other Indian studies. In this study among children from rural area reported the prevalence of 1.01% and urban it was 7.52%. In the present study, the prevalence of hypertension among males was found to be 4.31% and females 4.65%. The difference was not statistically significant (P > 0.05). Similarly, Savitha et al showed not much difference for hypertension among males and females.<sup>16</sup> A trend of increase in mean values of SBP and DBP with age has been observed in both sexes as shown in Table 5. Studies in the past have indicated that age appropriate blood pressure values found to be higher among boys than girls throughout childhood and adolescence. <sup>17</sup> Soundarssanane MB et al from India also noticed increase in hypertension with increase in age.<sup>18</sup> In their study among adolescent and young adults, gives the same opinion that significant increasing trend of BP was seen mainly in males. In a recent study from India there was a relative increase in average systolic and diastolic blood pressures in girls since age of 9 years by the age of 16 years, both sexes have similar systolic blood pressure values We found almost similar observation. <sup>19</sup> The studies conducted on prevalence of hypertension in obese children incidence vary from 3.4% to 43%. Prevalence of hypertension in the present study was found to be more in overweight and obese children than normal weight both in urban and rural population. This has been reported by other studies as well. Studies from India have also shown similar trends. Present study showed direct correlation of SBP and DBP with height, weight, BMI and WC which is similar with the previously reported other studies on hypertension in children. This association also demonstrated in many studies like Norwegian study and Taiwan study, the Framingham study also showed increased prevalence of hypertension in subjects with obesity. Many studies from India had similar observations. Similar findings were also reported

among adolescent population in Hungary and France and such association in early childhood with increased mean SBP alone was reported by British cohort. 24-26 Andriska et al found 41% of their obese children were hypertensive which indicate that obesity has a crucial role in causation of hypertension.<sup>27</sup> Rate of weight gain during childhood is a risk factor for systolic hypertension, dyslipidemia, and insulin resistance 5 years late which suggests that modification of the excessive rate of weight gain may exert beneficial effects. Obesity related hypertension is a state of high cardiac output, increased sympathetic nervous system activity, sodium retention, and hyperinsulinemia. 28,29 There is a greater left ventricular mass in obese children and adults, with the major effect of adipose tissue related to central obesity rather than total fat mass.30 However an individual might have elevated blood pressure and excess adipose tissue, the elevation of serum insulin related most closely to the change in left ventricular mass rather than simply the elevated BMI.<sup>31</sup> Relatively higher intake of fried foods was noticed in the hypertensive and pre-hypertensive category, as their frequency of intake was more of a daily phenomenon. The Chi-square value 8.4 and p value 0.05 was found to be significant at 95 percent confidence interval.

Fat is the most energy dense macronutrient and excessive consumption is often believed to cause weight gain. Findings of epidemiological studies showed that not much association between fat consumption and obesity in children and young adults. The difference in this study may be due to the prevalence of intake of coconut oil in the study area is so high that, it alone cannot be assessed as a risk factor. Moreover more than mere intake of type of oil, amount of intake of oil is also important, which was not assessed in this study. The composition of the diet also may be related to blood pressure: in a study of urban adolescents with blood pressures of more than the 90th percentile, blood pressure was lower in those with higher intakes or a combination of nutrients, including potassium, calcium, magnesium and vitamin. These are the factors in a diet more likely to lead to healthy weight rather than adiposity. Study concluded that food rich in nutrients derived from fruits, vegetables, and low-fat dairy products helps in primary prevention of hypertension if instituted at an early age. 32

It is also evident from our study that the prevalence of hypertension and obesity is more in urban school children than rural children population. The rapid economic growth of the country has got major effect on the nutritional status of children. Nutritional level has been improved and because of this obesity has increased markedly in most Asian countries. The decreased physical activity in children and adolescents have been related mainly to, computer games, video games, internet gazing, television and movie viewing overemphasis on academic excellence, unscientific urban planning and increasing automated transport. TV also affects by heavy marketing of colas and other fatty foods.

Unhealthy eating habits and sedentary life styles are the important culprits. We also identified significant relationship between hypertension in children and family history of diabetes mellitus and IHD. There are studies like Gambian study which observed direct relationship between familial history of Diabetes mellitus and stroke with Obesity and stroke in adolescents and adults. The study of hypertension in children is utmost importance as it is the best predictor of hypertension in later life as evidenced by the phenomenon of "tracking." Studies have demonstrated target organ damage among asymptomatic hypertensive children. Hence healthy behavioural changes among pre-hypertensive are important. So early detection and management can reduce long term morbidity and mortality in later on. Children found with hypertension should be followed up and investigated thoroughly to rule out any underlying disorders. The Indian Paediatric Nephrology Group recommends measurement of blood pressure in all children annually more than 3-year-old, who are seen in clinics or hospital setting.36

#### **CONCLUSION**

This study revealed that prevalence of hypertension and prehypertension was significantly more in overweight and obese children compared to normal children indicating obesity as an important risk factor for hypertension. The prevalence of overweight and obesity is higher in urban than rural children. Recent change in lifestyle in urban areas like sedentary pursuits unhealthy dietary habits are the major culprits for this increasing trend in urban area. So early intervention strategies for promoting healthy eating habits, physical activities and health education should be undertaken from school age group in order to prevent morbidities of obesity such as hypertension.

The limitations of the study were as the study population was selected school wise; the number of students in each age group is different. Food habits and exercise habits of children were assessed by perception and not by direct observation. This may have made some differences in the risk factors assessed. The quantity of intake of specific food was also not considered in the study.

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