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Original Research Article

Prevalence and Risk Factors for Hypertension among Urban School Children–A Cross Sectional Study from South India

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Abstract: Hypertension in adult population is associated with an increased incidence of stroke, coronary artery disease, congestive heart failure and chronic kidney disease. The best predictor of adulthood hypertension is blood pressure in childhood. Hypertension origin is possibly in childhood especially with multiple risk factors including obesity, diet, academic stress, sedentary habits apart from hereditary risk factors. A cross-sectional survey was done in 20 urban schools to determine the prevalence of hypertension among school children between 9 to 12 years and to study the determinants. 2050 students in the age group of 9 to12 years were recruited. Demographic details and anthropometric measurements were obtained. Blood pressure was measured at 0, 5 & 30 minutes and average of three readings were taken as the true blood pressure. Risk factor assessment was done between high blood pressure and factors like body mass index, socio economic status, and family history of hypertension, diabetes, renal disease and ischemic heart disease. Statistical analysis was done using SPSS software for windows 11. Hypertension is an important health problem in school children with a prevalence of 2.84%. Prevalence was higher in children from higher socio economic strata. 37% of the obese children were found to be hypertensive. There was significant correlation between hypertension ($p<0.05$), body mass index, obesity and family history of hypertension. Overweight and obesity are associated with increased incidence of hypertension in children. Measurement of Blood Pressure should be made an integral part of physical examination in children. Life style modification should be advised in obese pre hypertensive and hypertensive children
Keywords: Hypertension, Pre hypertension, prevalence, overweight, obesity, body mass index

INTRODUCTION

As per the recent WHO statistics the burden of non communicable diseases (NCDs) is increasing globally and is the major contributor of morbidity and mortality. The largest proportion of NCD deaths is caused by cardiovascular diseases (CVD) and high blood pressure is one of the leading risk factors. Nearly 1 billion adults (more than a quarter of the world's population) had hypertension in 2000 and this is predicted to increase to 1.56 billion by 2025 [1]. As the origin of adult hypertension can be in childhood or adolescence, preventive intervention from early life may reduce the risks of cardiovascular disease and target organ damage during later life and hence the importance of screening of blood pressure early in life [2, 3].

The best predictor of blood pressure in adult life is the blood pressure in childhood [2, 3]. The incorporation of blood pressure measurement into pediatric physical examination enables the identification of significant asymptomatic hypertension. Increasing evidence indicates that essential hypertension begins to develop during the first two decades of life [4]. Even a small increment in blood pressure can have substantial effect on hypertension

related morbidity and mortality. So greater attention to blood pressure control early in life may ultimately lead to a considerable improvement in cardiovascular health [5-7]. The second task force report of 1987 and the working group update in 1996 provided blood pressure norms for children and adolescents. In August 2004, the fourth report on the diagnosis, evaluation and treatment of Blood Pressure in children and adolescents was established[8]. To parallel the changes in nomenclature for the adult hypertension as published in the seventh report of the Joint National Committee JNC 7, the task force has added new staging to pediatric hypertension definition [8, 9].

Normal blood pressure is defined as systolic and diastolic blood pressures below the 90th percentile for age sex and height. Pre hypertension is defined as an average systolic or diastolic blood pressure equal to or more than the 90th percentile but less than the 95th percentile. Stage 1 Hypertension is defined as average systolic or diastolic blood pressure between the 95th percentile and upto 5mm Hg greater than 99th percentile for age, sex and height. Stage 2 Hypertension is defined as average systolic or diastolic blood pressure greater than 5mm Hg above the 99th percentile for age, sex and height [8-10].

The present study is conducted among school children aged between 9 to 12 years in Thiruvananthapuram city, Kerala to find out the prevalence of hypertension and to determine whether any relationship exists between high blood pressure and factors like socio economic status, family history of hypertension, diabetes, renal disease, ischemic heart disease and body mass index.

MATERIALS AND METHODS

A cross sectional study was conducted among school children between 9 to 12 years of age in 20 schools in the urban areas of Thiruvannthapuram City. A total of 2050 students were enrolled into this study. Children with renal, cardiac or liver diseases from history or examination and those already on antihypertensive medications at the time of study were excluded. Family history of hypertension, diabetes mellitus, kidney disease and ischemic heart diseases was collected. The socio-economic status of the family was assessed by Modified Kuppuswami scale which takes in to account parameters like education, occupation and income of parents. Weight was taken using floor type weighing machine and height by using stadiometer. Body mass index (BMI) was calculated using the formula, weight (Kg) / height (m^2) and compared with Center for Disease Control (CDC) centile chart. BMI more than 95th percentile was taken as obese and between 85th and 95th percentile as overweight.

A brief introduction was given to children regarding the importance of blood pressure measurement and the procedure of examination was explained. After a short medical history and a thorough physical examination children with suspected systemic illnesses were excluded. During the morning hours, after 15 minutes of rest, blood pressure was measured using a recently calibrated standard clinical sphygmomanometer in a controlled environment in a separate silent room using standard protocol for BP measurement as given below.

Child was seated in a comfortable position with the right arm fully exposed and appropriate sized cuff applied at the heart level. Different cuff sizes appropriate for the age groups were selected so that the bladder width was approximately 40% of the child's arm circumference and bladder cuff covered 80 to 100% of the circumference. The arm circumference was measured at a point midway between the olecronon and the acromion. The stethoscope was placed over the brachial artery proximal and medial to the cubital fossa and below the bottom edge of the cuff, approximately 2 cm above the cubital fossa. The cuff was inflated to a pressure of 20-30mm above the systolic blood pressure assessed by palpatory method. The cuff was deflated at a rate of 2-3 mm of Hg per second. Systolic BP corresponded to phase I Korotkoff sounds. The disappearance of the sounds (Korotkoff phase V) was taken as the diastolic blood pressure. If the same was not appreciated, the muffling (Korotkoff phase V) was taken as the diastolic BP [9].

Three readings were taken and the mean was recorded as child's blood pressure. The classification according to the JNC 7 guide lines and Fourth report on high blood pressure in children from the National high blood pressure education program was followed [9]. Children with blood pressure above 95th percentile, 2 more values were taken on subsequent visits and if all the three recordings were high, a diagnosis of hypertension was made and was referred to Pediatric Nephrology Clinic for further evaluation. All the above data were entered in a preset proforma and evaluated.

STATISTICAL METHODS

Data was entered into Microsoft Excel for WINDOWS and analyzed by SPSS for Windows 11.

RESULTS

Of the 2050 school children, 2043 fulfilled the inclusion criteria. 1289 (63.09%) were males and 754 (36.91%) were females in the study population. Mean systolic and diastolic blood pressures in different age groups ranged between 97- 102 mm of Hg systolic and 62- 66 mm of Hg diastolic (Table 1). With increasing age, there was increase in both systolic and diastolic blood pressures. Both systolic and diastolic BP showed significant correlation with height, weight and Body mass index .The systolic and diastolic blood pressure percentiles in different age groups of boys and girls are shown in table 2, figure 2 a &b, table 3 and figure 3a&b respectively. Overall prevalence of hypertension in the present study is 2.84%. 2.26% had stage 1 hypertension and 0.58% had stage 2 hypertension. Prevalence of isolated systolic hypertension was 1.59% and that of isolated diastolic hypertension was 1.37%. Pre-hypertension was observed in 14.44%. Adolescents having blood pressure above 120/80 mm of Hg were also included in this pre hypertension category. 2.15% (n 44) of the children were overweight and 1.32% (n= 27) were obese in the study population. 37.03% obese children (11/27) and 15.9% (7/44) of overweight children had hypertension (Figure 3 a & 3b).There was positive correlation of hypertension with weight and body mass index (Pearson's Correlation coefficient 0.505, 0.428 respectively). Hypertension was found in 0.98% children from the lower socio-economic group, 1.62% from the middle class and 3.05% from the upper socio-economic strata.

The prevalence of hypertension among children of hypertensive parents was 8.13%, while only 2.12% children of normotensive parents had hypertension. There was statistically significant correlation between hypertension in parents and children (P<0.000). Statistically significant positive correlation was obtained between childhood hypertension and family history of ischemic heart disease (P <0.005)

One-third of the hypertensive children came for re-evaluation. Detailed assessment including four limbs BP measurement, cardio vascular system` examination and basic investigations like hemogram, urinalysis, renal function test, lipid profile, chest X-ray, 14 lead ECG and abdominal sonogram were done. No cause for secondary hypertension could be demonstrated in any of the children and were labeled as primary hypertension. They were advised therapeutic life style modification including diet, exercise and regular follow up.

DISCUSSION

Many studies have been conducted worldwide to detect the normal distribution of blood pressure in children and prevalence of hypertension among them. Systemic hypertension is an important condition in childhood with estimated prevalence of 1-2% in the developed countries. Similar studies are lacking from India, but small surveys in school children suggest a prevalence ranging from 2-5% [11].

In our study it was observed that there is a gradual increase in systolic and diastolic blood pressure in children as age advances. This is in agreement with the National task force committee. Indian studies by Mangal *et al*. [12] and Loria D *et al*. [13], Verma M *et al*. [14], Agarwal *et al*. [15], Londe *et al*. [16] and Rames *et al*. [17] also noted similar findings. It was observed that age and height are important determinants of blood pressure. From this study, age specific 50th, 90th, 95th and 99th percentiles of systolic and diastolic blood pressure were derived (table .1 & table 2).

The prevalence of hypertension in our study is 2.84%. This is comparable to studies by Pileggi *et al* [18] (3-5%). A wide range (2.3-16.7%) in the prevalence of hypertension has been recorded in different studies. This diversity in prevalence was attributed to varying age groups taken for those studies, different criteria adopted for defining hypertension and basic differences between racial sub groups in terms of geographic, dietary and cultural factors. In western literature a low prevalence of hypertension is reported by Londe *et al*. [16] (2.4%) but Antal M *et al*. [19] reported a high prevalence (7.5% in boys and 1.1% in girls) .Indian studies also noted a low prevalence of hypertension by C.K. Chabar *et al*. [20] (1.39%), Y. Sachdev *et al*. [10] (0.54%), M. Verma *et al*. [15] (1.1%), N.K. Anand *et al*. [21] (0.46%), Loria *et al*. [13] (2.93%). In contrast, Chadha *et al*. [22] (11.9% in boys and 11.4% in girls), Gupta *et al*. [10] (11.7%) noted a high prevalence of hypertension. In our study prevalence of systolic hypertension is 1.59% and diastolic hypertension is 1.37%. Among boys the prevalence is 1.25% for systolic hypertension and 0.83% for diastolic hypertension .In girls it is 0.34% and 0.54%.respectively.

The prevalence of stage 1 hypertension is 2.26% and that of stage 2 hypertension is 0.58%. Another 14.44% had pre-hypertension. Adolescents having blood pressure >120/80 mm of Hg, but below the 95th percentile are also included in this category. The epidemic of overweight and obesity is increasing the

prevalence of pre hypertension and hypertension among children and adolescents. Measurement of blood pressure in children requires adaptation to the age and size of the child. Interpretation must be related to normative values specific for age, sex, and height [23]. The positive correlation between the body mass index with both systolic and diastolic blood pressures obtained in our study is similar to the observations from other studies worldwide [11]. The systolic blood pressure had more significant correlation than diastolic blood pressure. The prevalence of overweight was 2.15 % and Obesity 1.32%. Prevalence of Obesity is much lower compared to other studies like Pileggi *et al*. [18] (11.1%), Sidhu S. *et al*. [24]. Chhatwal *et al*. [25] reported a prevalence of 14.2% obesity in Indian children. A study by Subramanyanm V [26] from Chennai reported prevalence of 6% obesity in affluent adolescent girls.

37.03% of the obese children are hypertensive in our study. When compared to other studies prevalence of hypertension in obese children is high in our study .Graf C *et al*[27] reported a prevalence of hypertension of 11% and Ye D *et al* [28] 12,5% among obese children. There is positive correlation between hypertension and higher socio economic status. 3.05% Children from higher socio economic strata had hypertension whereas only 0.93% of children belonging to lower socio economic group. In our study statistically significant association was found between childhood hypertension and parental hypertension (p value 0.000). There is significant correlation of blood pressure in children with coronary artery disease in their parents (p value 0.020). Statistically significant positive correlation was obtained between childhood hypertension and family history of Ischemic heart disease. No significant correlation was found between childhood hypertension and family history of diabetes and renal disease in our study.

Table-1: Mean systolic & diastolic blood pressure in the study population

Age group	Mean SBP±SD	Mean DBP±SD
9 years (n=454)	97.07±8.78	62.47±8.74
10 years (n=373)	101.25±9.52	67.90±6.574
11 years (n=601)	101.50±11.73	67.81±9.58
12 years (n=612)	102.88±11.31	66.22±9.14

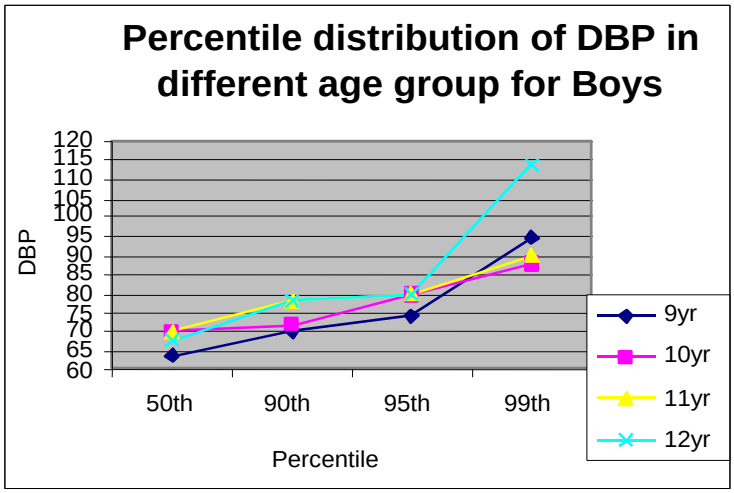


Fig-1a

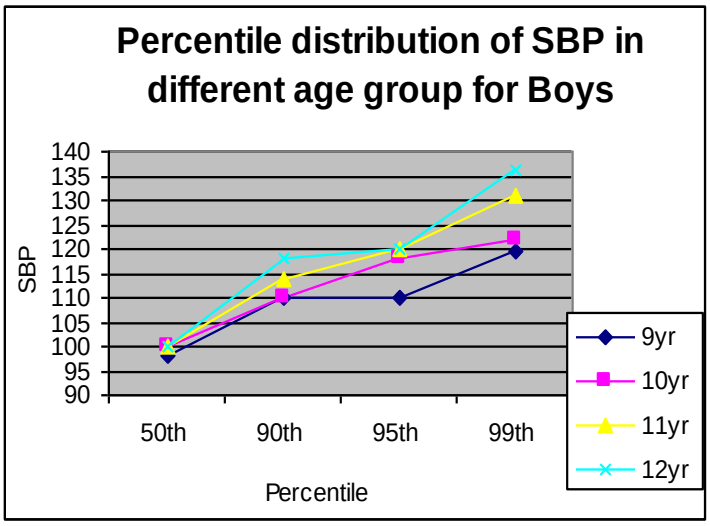


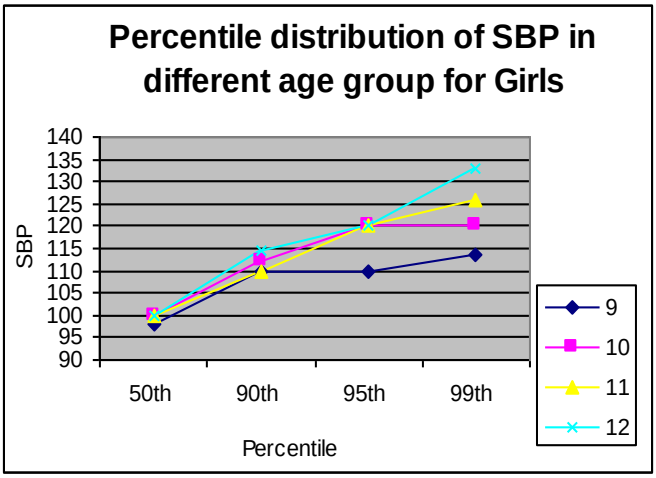
Fig-1b

Table-2: Blood pressure percentiles boys (systolic & diastolic)

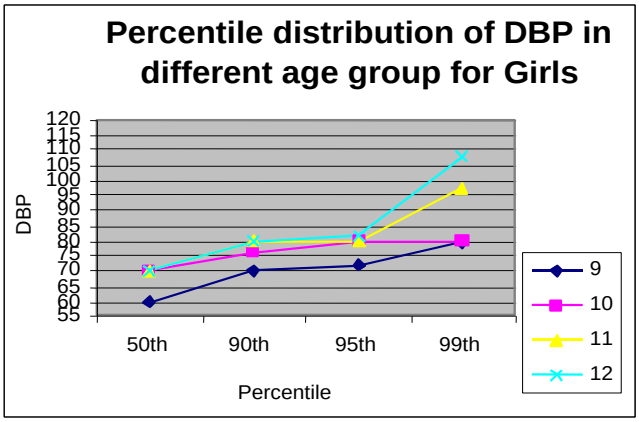
Age	50th	90th	95th	99th
9 years SBP	98	110	110	119
DBP	64	70	74	94
10 years SBP	100	110	118.2	122
DBP	70	72	80	88
11 years SBP	100	114	120	131
DBP	70	78	80	90
12 years SBP	100	118	120	136
DBP	68	78	80	114

Table-3: Blood pressure percentiles girls (systolic& diastolic)

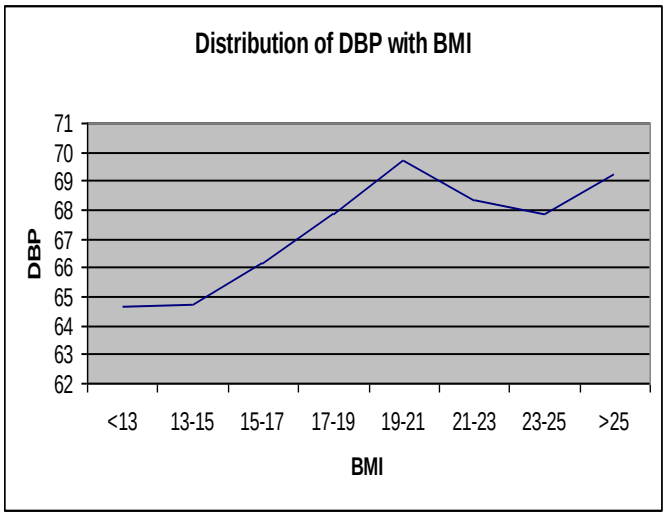
Age	50th	90th	95th	99th
9 years SBP	**98**	**110**	**110**	**114**
DBP	**64**	**70**	**74**	**94**
10 years SBP	**100**	**112**	**120**	**120**
DBP	**70**	**72**	**80**	**88**
11 years SBP	**100**	**110**	**120**	**126.08**
DBP	**70**	**78**	**80**	**90**
12 years SBP	**100**	**114.4**	**120**	**132.88**
DBP	**68**	**78**	**80**	**114.03**



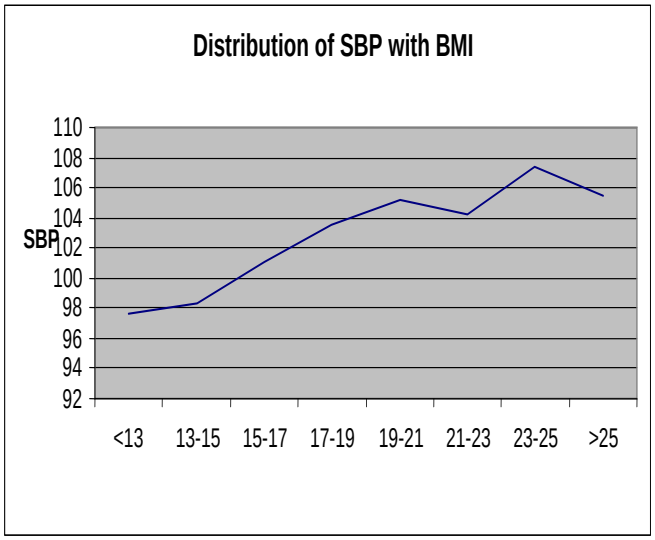
Fig–2a



Fig–2b



Fig–3a: BMI & (Systolic Blood pressure



Fig−3: b BMI & Diastolic Blood Pressure)

CONCLUSION

The prevalence of hypertension in our study is 2.84% with prevalence of stage 1 hypertension being 2.26% and that of stage 2 hypertension 0.58%. Another 14.44% had pre-hypertension. Over one third of obese children (37.03%) are hypertensive in our study. The significant predictors of hypertension we identified include overweight, family history of hypertension, coronary artery disease and higher socio economic status reflecting sedentary life style and dietary pattern favouring fatty and junk food. Out of this obesity and overweight are potentially modifiable with relatively inexpensive treatments and preventive program.

In view of the current economic growth and demographic transition happening in India, this observation is of utmost importance. The fast life, sedentary life style and dietary pattern starting in childhood is going to increase the burden of non-communicable disease related morbidity and mortality in India. Early diagnosis of hypertension is an important strategy in its control, effective treatment and prevention of complications. Preventive measures should target to increase the physical activity, decrease the salt intake, reduce obesity and promote awareness about hypertension and related risk behaviors.

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