# A study of prevalence of hypertension and its determinants among school going children in Salem, India 

Arunkumar Raju ${ }^{1 *}$, Bharanidharan $\mathrm{S}^{2}$, Rajah $\mathrm{S}^{3}$<br>${ }^{1}$ Assistant Professor, ${ }^{2,3}$ Professor, Department of Paediatrics, Annapoorna Medical College, Salem, Tamil Nadu, INDIA. Email: arunkmrr@gmail.com


#### Abstract

Background: Primary hypertension among children is on rising trend in recent years due to changes in lifestyle and diet pattern. There is also an increase in childhood obesity in recent years. Hypertension in children are mostly asymptomatic but can lead to increased morbidity and mortality in adulthood. Hence the study was planned to estimate the prevalence of hypertension in school students and its relation with obesity and overweight. Methods: A descriptive cross-sectional study was done in 748 students between age 10 to 15 years. Weight and height were measured and body mass index was calculated. Blood pressure was measured thrice and lowest reading was taken. Family history of diabetes and hypertension was collected using a questionnaire sent to parents. Results: $2.8 \%$ children had hypertension and $10.8 \%$ had elevated blood pressure. $18.3 \%$ children were overweight and $8.6 \%$ were obese. Among overweight children $29.2 \%$ had elevated blood pressure and $5.2 \%$ had hypertension. $36.9 \%$ of obese students had elevated blood pressure and $20 \%$ were hypertensive. Obesity was significantly associated with hypertension. Conclusions: The prevalence of hypertension among study population was $2.8 \%$. Obesity was strongly associated with hypertension. Key Words: Blood pressure, Body mass index, Hypertension, Obesity, Overweight


*Address for Correspondence:
Dr. Arunkumar Raju, Assistant Professor of Paediatrics, Annapoorna Medical College, Salem, Tamil Nadu, INDIA.
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## INTRODUCTION

Changing social and economic environments has led to increase in metabolic diseases among adults and children. Early onset of metabolic diseases in children leads to increase in mortality and morbidity when they enter adulthood. Hypertension is one of the leading causes for cardiac and neurological disease in adults. Though most of hypertension in children are due to secondary causes, there is a recent increase in primary hypertension in
children. One of the most important factors leading to childhood hypertension is obesity and overweight. The present trend of eating energy dense food and low physical activity had led to increase of obesity among children. Obesity is a well known risk factor for metabolic diseases in both adults and children. In a recent article published in The New England Journal of Medicine based on data from the Global Burden of Disease study shows that obesity had doubled in more than 70 countries since 19801 . The study data shows that India and China had the highest number of obese children in the world in 2015. These children are at risk of developing metabolic disorders in early childhood. Childhood hypertension is mostly asymptomatic, hence remain undiagnosed till adulthood. Hence a study was planned to determine the prevalence of elevated blood pressure and hypertension among school children and to find the association of hypertension with body mass index, family history of hypertension and diabetes

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## METHODS

This cross-sectional descriptive study was done in a semi urban school in Salem, Tamilnadu between August and September 2019 after obtaining ethical clearance from Institutional Ethical Committee. A total of 748 students between age group of 10 and 15 years were studied. The study was done after taking appropriate permissions and consent from parents. Parents were asked to fill a questionnaire regarding child's bio-data and pre-existing illness in child. Parents were also asked about presence of hypertension and/or diabetes in any one/both parents and details regarding treatment, if any.

## Inclusion criteria

Children between 10 and 15 years

## Exclusion criteria

Children with pre-existing renal, adrenal, cardiac diseases.
Children on medications like anti epileptics, corticosteroids
Children with acute illness
Weight was measured with children standing on bare foot on electronic weighing scale with accuracy of 0.5 g .

Height was measured using a stadiometer with children standing bare foot touching the wall and head in Frankfurt plane. Body mass index (BMI) was calculated using the formula weight ( kg ) /Height ( m )2. Overweight is defined as BMI above adult equivalent of 23 cut-off line and obesity is defined as BMI above adult equivalent of 27 cut-off line by Indian Academy of Pediatrics BMI charts ${ }^{2}$. Blood pressure (BP) was measured by sphygmomanometer in right arm in seated position. Children were made to sit for 5 minutes before measurement and lowest of three readings were taken to minimize pseudo elevation of blood pressure due to anxiety. Normal blood pressure was interpreted against age and height using values given by Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents by American Academy of Pediatrics in $2017^{3}$. Elevated blood pressure was defined as $\mathrm{BP} \geq 90$ th percentile to $<95$ th percentile. Hypertension was defined as $\mathrm{BP} \geq 95$ th percentile. The terminology "pre hypertension" was changed to elevated blood pressure in the guidelines released in 2017.

## RESULTS

Out of 748 students studied, 416(55.6\%) were boys and 332(44.4\%) were girls. Based on BMI, 137 (18.3\%) children were overweight and $65(8.6 \%$ ) were obese. Among 137 overweight children, 82 were boys and 55 were girls. 42 boys and 23 girls were obese. Elevated blood pressure was noted in $81(10.8 \%)$ children. Hypertension was seen in $21(2.8 \%)$ children. Among boys, 51 had elevated blood pressure and 13 had hypertension. 30 and 8 girls had elevated blood pressure and hypertension respectively.

TABLE 1: SEX DISTRIBUTION OF OVERWEIGHT AND OBESITY

| Sex | Overweight $\mathrm{n}(\%)$ | Obese $\mathrm{n}(\%)$ |
| :---: | :---: | :---: |
| Boys $(\mathrm{n}=416)$ | $82(19.7 \%)$ | $42(10.1 \%)$ |
| Girls $(\mathrm{n}=332)$ | $55(16.6 \%)$ | $23(6.9 \%)$ |

TABLE 2: SEX DISTRIBUTION OF HYPERTENSION

| Sex |  |  |
| :---: | :---: | :---: |
| Boys $(\mathrm{n}=416)$ | Elevated blood pressure $\mathrm{n}(\%)$ | Hypertension $\mathrm{n}(\%)$ |
| Girls $(\mathrm{n}=332)$ | $51(12.3 \%)$ | $13(3.1 \%)$ |

Elevated blood pressure was seen in 17(3.1\%) children with normal weight, $40(29.2 \%)$ overweight and $24(36.9 \%)$ obese children. Hypertension was seen in $8(5.8 \%)$ overweight and $13(20 \%)$ obese children. None of the children with normal BMI had hypertension.

| TABLE 3: COMPARISON OF BMI AND HYPERTENSION |  |  |
| :---: | :---: | :---: |
| BMI | Elevated blood pressure $\mathrm{n}(\%)$ | Hypertension $\mathrm{n}(\%)$ |
| Normal $(\mathrm{n}=546)$ | $17(3.1 \%)$ | $0(0)$ |
| Overweight $(\mathrm{n}=137)$ | $40(29.2 \%)$ | $8(5.8 \%)$ |
| Obese $(\mathrm{n}=65)$ | $24(36.9 \%)$ | $13(20 \%)$ |

Family history of hypertension was seen in 214 (28.6\%) students. Among them, 25(11.7\%) had elevated blood pressure and $8(3.7 \%)$ had hypertension. Family history of diabetes was seen in 197 (26.3\%) students. $30(15.2 \%)$ among them had elevated blood pressure and $9(4.6 \%)$ had hypertension.

TABLE 4: COMPARISION OF HYPERTENSION IN PARENTS WITH BLOOD PRESSURE IN CHILDREN

| Family H/O hypertension | Normal blood pressure <br> $\mathrm{n}(\%)$ | Elevated blood pressure $\mathrm{n}(\%)$ | Hypertension <br> $\mathrm{n}(\%)$ |
| :---: | :---: | :---: | :---: |
| Present $(\mathrm{n}=214)$ | $181(84.6 \%)$ | $25(11.7 \%)$ | $8(3.7 \%)$ |
| Absent $(\mathrm{n}=534)$ | $465(87.1 \%)$ | $56(10.5 \%)$ | $13(2.4 \%)$ |

TABLE 5: COMPARISION OF DIABETES IN PARENTS WITH BLOOD PRESSURE IN CHILDREN

| Family H/O diabetes | Normal blood pressure | Elevated blood pressure | Hypertension |
| :---: | :---: | :---: | :---: |
| Present $(\mathrm{n}=197)$ | $158(80.2 \%)$ | $30(15.2 \%)$ | $9(4.6 \%)$ |
| Absent $(\mathrm{n}=551)$ | $488(88.5 \%)$ | $51(9.3 \%)$ | $12(2.2 \%)$ |

Obesity was significantly associated with hypertension( $\mathrm{p}=<0.00001$ ). Increased BMI (overweight and obesity) was also a significant risk factor for hypertension in children. Association of hypertension with family history of hypertension ( $\mathrm{p}=0.31$ ) and diabetes $(\mathrm{p}=0.09)$ was not statistically significant.

## DISCUSSION

Hypertension in children is largely underdiagnosed. This can lead to complications in young adults. Changing lifestyle and diet habits are fueling rise of hypertension among children. Globally the prevalence of hypertension is increasing. A meta-analysis of 47 studies published in 2019 suggests the prevalence of hypertension as $7.89 \%$ among children aged 14 years ${ }^{4}$. The prevalence of hypertension in our study was $2.8 \%$. Sabapathy et al also found a prevalence of hypertension of $2.7 \%$ among students studied in Bangalore ${ }^{5}$. In a study done by Narayanappa et al, the prevalence of hypertension was $2.4 \%{ }^{6}$. In a study by Sharma et al from Northern India, the prevalence was slightly higher at $5.9 \%{ }^{7}$. In a study by Patil et al from central India, the prevalence was $3.0 \% 8$. Sathyanarayana et al studied 514 children of $10-15$ years and observed pre hypertension in $11.5 \%$ and hypertension in $9.7 \%$ children ${ }^{9}$. Borah et al recorded blood pressure of 10,003 children and found a prevalence of hypertension in $7.6 \%$ children. ${ }^{10}$ The present study found a prevalence of overweight in $18.3 \%$ of children and obesity in $8.6 \%$ of children. Both overweight and obesity were comparable among boys and girls ( $19.7 \%$ vs $16.6 \%$ and $10.1 \%$ vs $6.9 \%$ ). Ramachandran et al also found similar pattern among 17.8\% overweight boys and $15.8 \%$ overweight girls in a study of 4700 children ${ }^{11}$. Khadilkar et al studied BMI of $10-15$ year old boys from schools in Pune and observed 19.9\% overweight and $5.7 \%$ obese children ${ }^{12}$. In a systemic review of multiple studies by Ranjani et al shows the prevalence of obesity in children around $4.6 \%$. the prevalence of overweight children rose from $9.7 \%$ in 2001 to $13.9 \%$ in $2010 .{ }^{13}$ Children with increased body mass index were more prone to develop hypertension than those with normal body mass index. In our study $20 \%$ of obese and $5.8 \%$ of overweight children were hypertensive. None of the children with normal BMI were hypertensive. $10.8 \%$ of children had blood pressure between 90 and 95th percentile limits for age and height. Elevated blood pressure was noted in $29.2 \%$ of overweight and $36.9 \%$ of
obese children. In total $35 \%$ of overweight and $56.9 \%$ of obese children had blood pressure readings outside the normal range. The association between obesity and hypertension is statistically significant. ( $\mathrm{P}=<.00001$ ). A similar association was demonstrated by Sharma et all in a study of school children in Shimla, India. Mohan et al observed in a study of both rural and urban children of Ludhiana, India that hypertension is present in $43.1 \%$ of obese children compared to $4.5 \%$ of normal BMI children. ${ }^{14}$ Brady et al postulated that dysfunctional adipocytes in obesity secretes pro-inflammatory adipokines which upregulate sympathetic nervous system leading to hypertension. ${ }^{15}$ Family history of hypertension and diabetes had no significant association with presence of hypertension in this study. Childhood hypertension was not associated with family history of hypertension but significant association was seen with diabetes in a study by Buch et al. ${ }^{16}$ Verma et al demonstrated a positive association of hypertension in parents with childhood hypertension. ${ }^{17}$

## CONCLUSION

The prevalence of overweight and obesity is high among school children in Salem and is same as national trends. The prevalence of hypertension among $10-15$ year old school children in Salem is $2.8 \%$. $10.8 \%$ children have elevated blood pressure. There is a strong association between obesity and hypertension in children. This study finds no association between family history of hypertension and/or diabetes with childhood hypertension.

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