

COMPARISON OF BLOOD PRESSURE BETWEEN OBESE AND NON-OBESE SCHOOL CHILDREN AGED 9–15 YEARS

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ABSTRACT

Background: Childhood obesity is a major contributor to the increasing prevalence of pediatric hypertension. Obese children are at substantially greater risk of developing elevated blood pressure and future cardiovascular disease. The present study compared blood pressure between obese and non-obese school children and evaluated the influence of lifestyle factors associated with hypertension. **Materials and Methods:** This school-based cross-sectional comparative study included 1,000 apparently healthy children aged 9–15 years from four randomly selected schools near Academy of Medical Sciences, Pariyaram, Kerala, India. Anthropometric measurements were obtained using standardized methods, and BMI was categorized according to Centers for Disease Control and Prevention growth charts. Blood pressure was measured using a standard mercury sphygmomanometer following pediatric guidelines. Comparisons between obese and non-obese children were performed using independent Student's t-test, Chi-square test, and logistic regression analysis. Statistical significance was considered at $p < 0.05$. **Results:** The prevalence of obesity was 10% among boys and 5% among girls. Obesity showed a strong association with hypertension ($p < 0.001$). Of all hypertensive children, 88.1% belonged to the obese group, whereas only 11.9% were overweight. The burden of hypertension increased progressively with age, particularly after 12 years, with almost all hypertensive children in the older age groups being obese. Physical inactivity (72.7%) and television viewing for more than two hours daily (90.9%) were significantly more common among hypertensive children ($p < 0.001$). **Conclusion:** Obesity is strongly associated with elevated blood pressure among school-aged children. Routine school-based screening for obesity and hypertension, combined with interventions promoting regular physical activity, reduced sedentary behaviour, and healthy dietary practices, may help prevent the development of hypertension and its long-term cardiovascular complications.

INTRODUCTION

The prevalence of childhood obesity has increased substantially over the past few decades, making it one of the most important public health challenges worldwide.^[1] Rapid urbanization, unhealthy dietary habits, reduced physical activity, and prolonged sedentary behaviours have contributed to a growing burden of obesity among school-aged children. Childhood obesity is associated with several adverse health outcomes, including hypertension, type 2 diabetes mellitus, dyslipidaemia, and increased cardiovascular risk later in life.^[2]

Among the various complications of obesity, hypertension has gained considerable attention because elevated blood pressure during childhood frequently persists into adulthood. Obesity contributes to hypertension through multiple mechanisms including increased sympathetic nervous system activity, activation of the renin-angiotensin-aldosterone system, endothelial dysfunction, insulin resistance, and chronic low-grade inflammation. Consequently, obese children are significantly more likely to develop elevated blood pressure than their normal-weight counterparts.^[3,4]

Previous epidemiological studies conducted in different populations have consistently demonstrated higher blood pressure levels among overweight and obese children.^[4,5] Indian studies have similarly reported a greater prevalence of hypertension in obese school children compared with non-obese children, emphasizing the importance of early screening and lifestyle modification.^[6,7] These observations suggest that obesity is an important and potentially modifiable risk factor for childhood hypertension.

The early detection of elevated blood pressure among obese children is essential because cardiovascular changes such as vascular stiffness and left ventricular hypertrophy may begin during childhood. Timely intervention through dietary modification, increased physical activity, and weight management can substantially reduce long-term cardiovascular risk.^[8] School-based health screening programmes provide an excellent opportunity to identify obese children with elevated blood pressure before clinical complications become evident. Comparative evaluation of blood pressure between obese and non-obese children also helps quantify the cardiovascular burden attributable to excess adiposity and supports evidence-based preventive interventions.

Therefore, the present study was undertaken to compare systolic and diastolic blood pressure between obese and non-obese school children aged 9–15 years and to evaluate differences according to age and sex. The findings are expected to strengthen the evidence regarding obesity-related hypertension in children and reinforce the need for early preventive strategies in school health programmes.

MATERIALS AND METHODS

This school-based cross-sectional comparative study was conducted among children aged 9–15 years enrolled in four randomly selected schools situated near Academy of Medical Sciences, Pariyaram, Kannur, Kerala, India. The study was conducted from June 2013 to May 2014 after obtaining approval from the school authorities and written informed consent from parents. A total of 1,000 apparently healthy school children (545 boys and 455 girls) were included in the study.

Inclusion and Exclusion Criteria

Children aged between 9 and 15 years who were healthy and cooperative were eligible for inclusion. Children with known cardiovascular disease, chronic systemic illness, or lack of parental consent were excluded.

Anthropometric Assessment

Height and weight were measured using standardized techniques recommended by the Indian Council of Medical Research. Body mass index (BMI) was calculated as weight (kg)/height (m²). Children with BMI ≥95th percentile according to the Centers for Disease Control and Prevention growth charts were classified as obese, whereas those with BMI below the 95th percentile constituted the non-obese group. Waist circumference, hip circumference, and waist-to-hip ratio were also measured using standard methods.

Blood Pressure Measurement

Blood pressure was measured using a mercury sphygmomanometer with an appropriately sized cuff in accordance with the Fourth Report on High Blood Pressure in Children and Adolescents. Measurements were performed in the right arm with the child seated comfortably after adequate rest in a quiet room. Three consecutive readings were obtained at intervals of 1–2 minutes, and the average value was used for analysis. Elevated blood pressure was defined according to age-, sex-, and height-specific pediatric blood pressure percentiles.

Outcome Measures

The primary outcome was comparison of systolic and diastolic blood pressure between obese and non-obese children. Secondary analyses included comparisons according to age group and sex.

Statistical Analysis

Data analysis was performed using SPSS software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Mean systolic and diastolic blood pressures between obese and non-obese groups were compared using the independent Student's t-test. Comparisons across age groups and sex were performed using two-way ANOVA. The prevalence of elevated blood pressure was compared using the Chi-square test. Logistic regression analysis was performed to estimate the odds ratio for elevated blood pressure among obese children after adjusting for age and sex. Statistical significance was considered at $p < 0.05$.

RESULTS

A total of 1,000 school children aged 9–15 years were included in the analysis. According to CDC BMI criteria, children were classified into obese and non-obese groups for comparison of blood pressure.

Table 1: Distribution of BMI according to sex

BMI Category	Male n (%)	Female n (%)
Normal	464 (85.1)	416 (91.4)
Overweight	25 (4.6)	15 (3.3)
Obese	56 (10.3)	23 (5.1)

The prevalence of obesity was higher among boys (10.3%) than girls (5.1%). Overall, overweight and obese children constituted a minority of the study population.

Table 2: Association between obesity and hypertension

BMI Category	Normal BP n (%)	Hypertension n (%)
Overweight	36 (46.2)	5 (11.9)
Obese	42 (53.8)	37 (88.1)

A significant association was observed between obesity and hypertension (Table 2). Of all hypertensive children, 88.1% were obese, whereas

only 11.9% were overweight. This association was highly significant (Chi-square test, $p < 0.001$).

Table 3: Distribution of hypertension according to age and BMI category

Age (years)	Major observation
9	No hypertension observed
10	Hypertension detected only among overweight children
11	Two hypertensive children; one obese
12	71.4% hypertensive children obese
13	100% hypertensive children obese
14	89% hypertensive children obese
15	100% hypertensive children obese

No child aged 9 years was hypertensive. The prevalence of hypertension increased progressively with age and was predominantly observed among obese children. Among children aged 12 years, five of seven hypertensive children (71.4%) were obese.

In the 13-year age group, all 11 hypertensive children were obese. Similarly, obesity accounted for 89% of hypertensive children aged 14 years, while all hypertensive children aged 15 years belonged to the obese category.

Table 4: Lifestyle factors associated with hypertension

Factor	Normal BP (%)	Hypertension (%)	p-value
Physical inactivity	38.5	72.7	< 0.001
Television viewing (> 2 h/day)	57.1	90.9	< 0.001
Junk food consumption	71.0	77.3	NS

Children with hypertension were significantly more likely to report physical inactivity and prolonged television viewing (> 2 hours/day) than normotensive children ($p < 0.001$). Junk food consumption was common in both groups and did not show a marked difference.

DISCUSSION

The present study compared blood pressure among obese and non-obese school children aged 9–15 years and demonstrated a strong association between obesity and hypertension. Obese children showed a substantially greater burden of elevated blood pressure than their non-obese counterparts, highlighting obesity as one of the most important modifiable risk factors for pediatric hypertension. Nearly nine out of every ten hypertensive children in the present study belonged to the obese group, while only a small proportion were overweight. Furthermore, from 12 years of age onwards, obesity accounted for the majority of hypertension cases, and all hypertensive children aged 13 and 15 years were obese. These findings indicate that increasing adiposity markedly amplifies cardiovascular risk during adolescence.

The present observations are consistent with reports from Indian studies by Verma et al,^[5] all of whom documented significantly higher blood pressure among overweight and obese children. Similar findings have also been reported from China, Brazil, Europe, and the United States, where obesity has

been shown to increase the risk of childhood hypertension by approximately three- to five-fold.^[9,10,11] The growing prevalence of obesity worldwide has therefore become a major contributor to the increasing incidence of pediatric hypertension. Several biological mechanisms explain the close association between obesity and elevated blood pressure. Excess adipose tissue promotes sympathetic nervous system activation, stimulates the renin–angiotensin–aldosterone system, increases insulin resistance, impairs endothelial function, and induces chronic low-grade inflammation. These alterations increase peripheral vascular resistance and contribute to sustained elevation of blood pressure.^[12,13,14]

Lifestyle factors also appeared to influence hypertension in the present study. Hypertensive children were significantly more likely to be physically inactive and to spend more than two hours daily watching television. Sedentary behaviour is known to contribute to excess weight gain and reduced cardiovascular fitness, thereby increasing blood pressure. Although junk food consumption was common among both hypertensive and normotensive children, the difference was less pronounced, suggesting that overall lifestyle patterns rather than a single dietary behaviour contribute to obesity-related hypertension.

These findings support current pediatric recommendations advocating at least 60 minutes of moderate-to-vigorous physical activity daily, limitation of recreational screen time, and adoption of

healthy dietary practices. The study has important clinical implications. Because obesity substantially increases the likelihood of hypertension, obese children should undergo regular blood pressure screening as part of routine pediatric and school health assessments. Early identification allows timely lifestyle counselling, weight management, and follow-up before permanent cardiovascular changes develop.

Limitations

The cross-sectional design limits causal inference. Physical activity and dietary habits were self-reported, introducing the possibility of recall bias. Information regarding pubertal status, biochemical risk markers, and long-term follow-up was unavailable.

CONCLUSION

The present study demonstrated that obesity is strongly associated with elevated blood pressure among school children aged 9–15 years. Obese children exhibited a significantly higher prevalence of hypertension than their non-obese counterparts, confirming obesity as one of the most important modifiable risk factors for pediatric hypertension. Physical inactivity and prolonged television viewing were also significantly associated with hypertension, underscoring the influence of unhealthy lifestyle behaviours on cardiovascular risk during childhood. These findings support routine screening of obesity and blood pressure in school settings to facilitate early identification of children at risk. Comprehensive lifestyle interventions focusing on increased physical activity, reduced sedentary behaviour, healthy dietary habits, and weight management should be implemented through

coordinated efforts involving schools, families, and healthcare providers.

Early prevention and management of childhood obesity may substantially reduce the incidence of hypertension and its long-term cardiovascular complications, thereby improving lifelong cardiometabolic health.

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