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Original Research Article

# An Observational Study of Incidence of Hypertension in Correlation with BMI among School Going Children

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**Abstract**

**Introduction:** In recent decades, the prevalence of hypertension (HTN) has gained international recognition as a risk factor for chronic renal disease and cardiovascular disorders. It also contributes significantly to disability and death. More than 1 billion adults globally suffered from hypertension in 2015, with the majority living in low- and middle-income nations. Since paediatric hypertension symptoms are typically non-specific, many kids with essential hypertension probably don't have any symptoms at all. The most typical use of BMI is to evaluate overweight and obesity, which are caused by a more sedentary lifestyle, decreased physical activity, and higher calorie intake. According to estimates from the International Obesity Task Force (IOTF) and the International Association for the Study of Obesity (IASO), 200 million school-age children are overweight or obese and have a high BMI. Up to 85–95% of adolescents have essential hypertension. Understanding these factors, we carried out a study with the primary goal of determining the prevalence of hypertension among urban school-age children aged 6 to 17 and the secondary goal of assessing the relationship between hypertension and BMI.

**Material and Methods:** An observational cross-sectional survey was carried out in an urban school in Rourkela, Odisha, between January 2023 and December 2023, with 986 pupils who met the study's inclusion and exclusion criteria. The study included children of any gender who were between the ages of 6 and 17. Using the IAP BMI for age and sex chart, their BMI was computed after their height and weight were recorded, and they were then classified as normal weight, underweight, overweight, and obese. In accordance with standard procedure, blood pressure was measured.

**Results:** The majority of participants were in the 10-11 years age group, with a mean age of 11.23±3.45 years. Males constituted a higher percentage (53.85%) than females (46.15%), except in the 6-7 years age group. Weight distribution showed that most children had a weight of 12-30kg, with mean weights of 39.38±18.07kg for females and 41.31±18.08kg for males. The majority of children had a height of 1.21-1.40m, with mean heights of 1.41±0.17m for females and 1.43±0.17m for males. Normal BMI was observed in 45.84% of children, while 23.12% were underweight, 16.94% overweight, and 14.10% obese. The study found no significant correlation between BMI and gender but a significant correlation between BMI and age ($r=0.54$, $P<0.001$) and also between BMI and systolic hypertension ($r=0.46$) as well as diastolic hypertension ($r=0.33$).

**Conclusion:** The study was conducted to evaluate the incidence of hypertension in correlation with BMI among urban school-going children. This observational study conducted among school-going children in the Urban School of Rourkela, Odisha has provided valuable insights into the incidence of hypertension in correlation with BMI. The findings reveal a substantial prevalence of hypertension among the studied population, with notable correlations between BMI, age, gender, and various hypertension indicators.



## Introduction

High blood pressure (BP), also known as hypertension (HTN), is a recognised risk factor for chronic kidney disease and cardiovascular diseases worldwide. It also contributes significantly to disability and death. [1–3] More than 1 billion adults globally suffered with hypertension in 2015, with the majority living in low- and middle-income nations. [2,4] Many children with essential hypertension are likely to have no symptoms at all because the signs of paediatric hypertension are typically non-specific.

The prevalence of prehypertension and chronic hypertension in Indian school-age children is not well documented. [5–9]

The most widely used metric for evaluating overweight and obesity is the body mass index, or BMI. This metric, which is related to nutritional status, is generally higher in children who are overweight or obese. Increased calorie intake, less physical activity, and a more sedentary lifestyle are the main causes of these people's elevated BMI. Because obesity-related hypertension frequently coexists with other obesity-related diseases, the link between obesity and hypertension is complex.

In general, BMI-measured obesity, is a substantial risk factor for hypertension, and as BMI rises, the prevalence of hypertension tends to rise as well. The development of metabolic syndrome and a number of non-communicable diseases, including cancer, heart disease, stroke, diabetes, mental illnesses, and respiratory issues, are significantly influenced by having a high body mass index. [10–13] According to estimates from the International Obesity Task Force (IOTF) and the International Association for the Study of Obesity (IASO), 200 million school-age children are overweight or obese and have a high BMI. Up to 85–95% of adolescents have essential hypertension.

Higher rates of left ventricular hypertrophy, left atrial dilatation, and decreased left ventricular systolic and diastolic performance were associated with hypertension brought on by a high body mass index.

Since there is a paucity of data regarding the incidence of hypertension in correlation with BMI in school children, this study has been undertaken to determine the incidence of hypertension in correlation with BMI among school going children.

## Material and Methods

**Study design:** Observational cross-sectional study.

**Study duration:** January 2023 to December 2023.

**Study Area:** Urban school of Rourkela, Odisha.

**Study Population:** The study was conducted on urban school going children of Rourkela.

**Sample size:** Sample size of 986 children was taken by simple random sampling method.

### Inclusion Criteria

- Urban School children age between 6 to 17 years irrespective of gender were included as our study subjects.
- Children whose parents had given consent in presence of school teacher.

### Exclusion Criteria

- Present or past history suggestive of cardiovascular, respiratory, chronic liver disease, endocrine or any other systemic illness i.e.-Diabetes mellitus, CKD, AGN, chronic GI symptoms, NS on steroid therapy or children with major congenital anomalies.
- Those on drugs medication which may alter BP or chronic use of drug that may affect the normal weight, height such as antihistamines, alpha- adrenergic agents (nasal decongestant and cough medication), Steroid and caffeine.
- Children whose parents did not give consent in presence of school teacher.

### Methodology

In students who fulfilled the inclusion criteria were selected for the study. The data of the patient collected using a proforma. First section of proforma contained details of student like name of school, class studying, name, and age, gender with detailed history given by the patient or his/her attendant. Second section contained anthropometry, any drug history, and present/past illness.

## Result

**Study design:** An observational cross-sectional study on 986 urban school going children of age group 6 to 17 years.

**Table 1: Gender Frequency Distribution In Relation To Age in Years of Study Population**

| Age (years) | Sex | | Total n, (%) | Mean age ± SD: |
|---|---|---|---|---|
| | Male n, (%) | Female n, (%) | | |
| 6-7 | 82 (46.33) | 95 (53.67) | 177 (100) | 11.23±3.45 |
| 8-9 | 94 (55.95) | 74 (44.05) | 168 (100) | |
| 10-11 | 139 (62.33) | 84 (37.67) | 223 (100) | |
| 12-13 | 65 (51.18) | 62 (48.82) | 127 (100) | |
| 14-15 | 74 (53.24) | 65 (46.76) | 139 (100) | |
| 16-17 | 77 (50.66) | 75 (49.34) | 152 (100) | |
| Total | 531 (53.85) | 455 (46.15) | 986 (100) | |

On the above table shows that out of 986 children in study population, from 531 males (53.85% of total)

majority of them are under the category of 10-11 year 139(62%) followed by 94 (56%), 82 (46%), 77 (51%), 74 (53%), 65 (51%) of 8-9 year, 6-7 year,16-17 year,14-15 year, 12-13 years respectively. Out of 455 females (46.15% of total), majority of children were under the age group of 6-7 years, n=95 (54%) followed by 84 (38%), 75 (49%), 74 (44%), 65 (47%), 62 (49%) of age group 10-11, 16-17, 8-9, 14-15, 12-13 years respectively. The mean age of the children who participated in the study was 11.23±3.45 years.

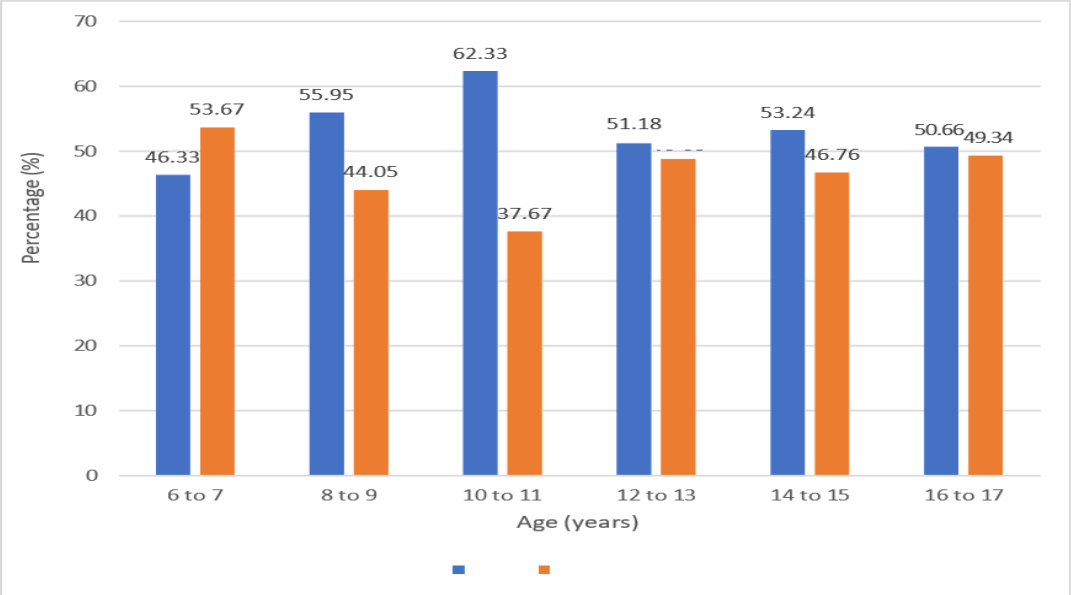


**Figure 1: Gender Frequency Distribution In Relation To Age in Years of Study Population**

**Table 2: Gender Frequency Distribution In Relation To Weight of Study Population**

| Weight (kg) | Male | | Female | |
|---|---|---|---|---|
| | Frequency (n) | Percentage (%) | Frequency (n) | Percentage (%) |
| 12-30 | 196 | 36.91 | 189 | 41.54 |
| 31-50 | 168 | 31.64 | 131 | 28.79 |
| 51-70 | 127 | 23.92 | 109 | 23.96 |
| 71-90 | 38 | 7.16 | 25 | 5.49 |
| >90 | 2 | 0.37 | 1 | 0.22 |
| Total | 531 | 100 | 455 | 100 |

**Mean weight±SD, male: 41.31±18.08kg, female: 39.38±18.07kg**

Out of 986 children the majority of male (36.91%, n=196) and female (41.54%, n=189) children had 12-30kg weight. The mean weight of female children was 39.38±18.07kg whereas, in male children, the mean weight was 41.31±18.08kg. The distribution of subjects according to weight and sex is shown in Table 2 and Figure 2.

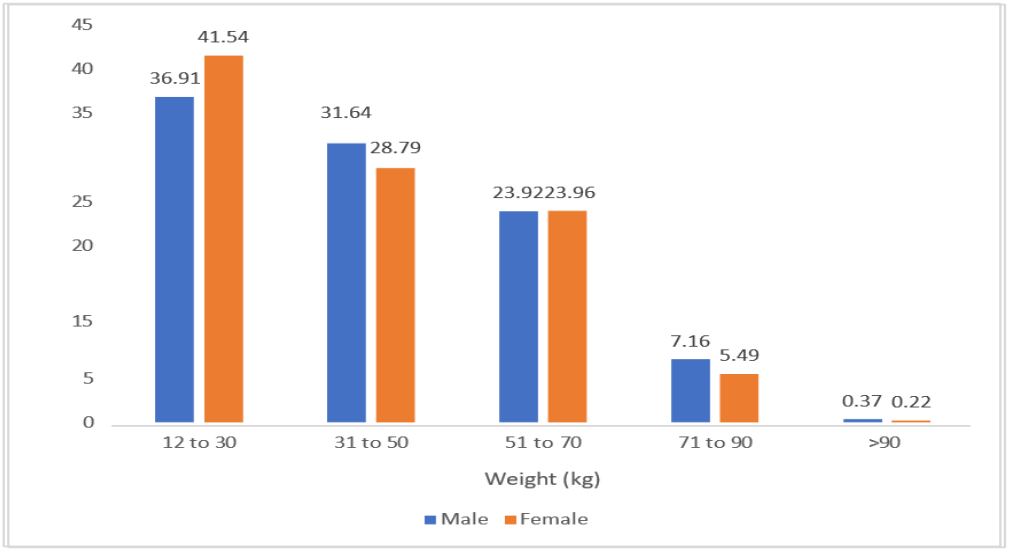


**Figure 2: Gender Frequency Distribution In Relation To Weight of Study Population**

**Table 3: BMI frequency Distribution according to age of study population**

| Age (years) | BMI n, (%) | | | | Total n, (%) | P-value |
|---|---|---|---|---|---|---|
| | Underweight | Normal | Overweight | Obese | | |
| 6-7 | 68 (38.42) | 70 (39.55) | 21 (11.86) | 18 (10.17) | 177 (100) | <0.001 |
| 8-9 | 55 (32.74) | 49 (29.17) | 37 (22.02) | 27 (16.07) | 168 (100) | |
| 10-11 | 66 (29.60) | 117 (52.47) | 12 (5.38) | 28 (12.56) | 223 (100) | |
| 12-13 | 26 (20.47) | 41 (32.28) | 23 (18.11) | 37 (29.13) | 127 (100) | |
| 14-15 | 12 (8.63) | 82 (58.99) | 34 (24.46) | 11 (7.91) | 139 (100) | |
| 16-17 | 1 (0.66) | 93 (61.18) | 40 (26.32) | 18 (11.84) | 152 (100) | |
| Total | 228(23.12%) | 452(45.84%) | 167(16.93%) | 139(14.09%) | 986(100%) | |

The distribution of subjects according to age and BMI is depicted in Table 3 and Figure 3. BMI was found to significantly correlated with age (r=0.54, P<0.001) with 167 (16.93%) and 139 (14.09%) study population being overweight and obese respectively.

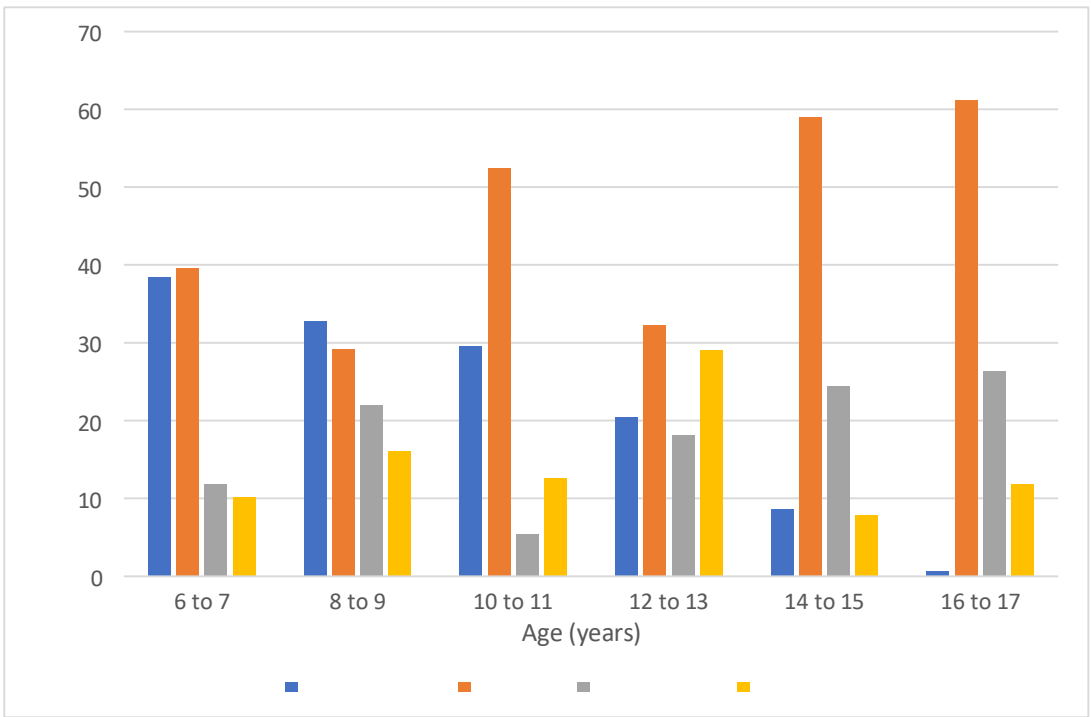


**Figure 3: BMI frequency Distribution according to age of study population**

In the study population of 986 children of which 167 were overweight and 139 were obese, systolic hypertension observed in 36 (22%) in overweight, 50(36%) in obese children. A significant positive correlation was observed between BMI and systolic hypertension (r=0.46, P<0.0000) (Table 4).

**Table 4: Correlation between BMI categories and systolic hypertension**

| BMI | Systolic hypertension | | |
|---|---|---|---|
| | Yes n, (%) | No n, (%) | Total n, (%) |
| Underweight | 42 (18.42) | 186 (81.58) | 228 (100) |
| Normal | 52 (11.50) | 400 (88.50) | 452 (100) |
| Overweight | 36 (21.56) | 131 (78.44) | 167 (100) |
| Obese | 50 (35.97) | 89 (64.03) | 139 (100) |
| Total | 180 (18.26) | 806 (81.74) | 986 (100) |

**Table 5: Correlation between BMI Categories and Diastolic Hypertension**

| BMI | Diastolic hypertension | | |
|---|---|---|---|
| | Yes n, (%) | No n, (%) | Total n, (%) |
| Underweight | 33 (14.47) | 195 (85.53) | 228 (100) |
| Normal | 51 (11.28) | 401 (88.72) | 452 (100) |
| Overweight | 33 (19.76) | 134 (80.24) | 167 (100) |
| Obese | 40 (28.78) | 99 (71.22) | 139 (100) |
| Total | 157 (15.92) | 829 (84.08) | 986 (100) |

**P < 0.0000, Significant, Chi-Square Test**

In the study population of 986 children of which 167 were overweight and 139 were obese, diastolic hypertension observed in 33 (20%) in overweight, 40(29%) in obese children. A significant positive correlation was observed between BMI and diastolic hypertension (r=0.33, P<0.0000) (Table 5).

## Discussion

Our study's objectives are to identify the prevalence of hypertension and assess its relationship to BMI in children enrolled in school. From January to December 2023, a total of 986 youngsters aged 6 to 17 were the subject of this study. Participants in our study had an average age of 11.23±3.45 years, with a considerable representation in the 10–11 year age group (22.62%, n=223), followed by the 6-7 year age group (17.95%), the 8–9 year age group (17.04%), and the 16–17 year age group (15.42%). This suggests that a wide variety of youngsters were included in the study, thereby capturing the crucial developmental time whereby lifestyle and health patterns are formed. Chen C. et al. found comparable results when they included children in the same age group as the current study.

The gender distribution of our study showed a somewhat higher percentage of male participants (53.85%), indicating that possible gender-related differences in the distribution of BMI and prevalence of hypertension should be taken into account. Males were more prevalent than females in every age category, with the exception of those aged 6-7. These results are comparable to those of the study by Chiolero A et al., Wang et al., and Chen C. et al., which included children in the same age group as the current study.

The average height and weight of the male and female children in our study fell into the 1.21–1.40 m height and 12–30 kg weight groups. The average weight of male children was 41.31±18.08 kg, while the average weight of female children was 39.38±18.07 kg. In contrast, the average height of male children was 1.43±0.17 meters, while the average height of female children was 1.41±0.17 meters. Numerous further research show that obesity and hypertension are becoming more common in India. For example, a Delhi study found that the prevalence of chronic hypertension was 8.4% in urban areas and 5.7% in rural areas. Obesity rates among schoolchildren in rural and urban areas were 2.7% and 11%, respectively.

The strength of the study was adequate sample size and uniform application of the protocol. Moreover, we included wide range of age groups in the study. In this study AAP 2017 classification was used. This observational study reveals a concerning incidence of hypertension among school-going children and establishes a significant correlation between BMI and blood pressure. The findings of this study underscore the need for comprehensive health education programs in schools to promote healthy lifestyle choices and prevent the development of obesity-related conditions, including hypertension. Regular monitoring of blood pressure and BMI in school health check-ups can aid in early identification and intervention for at- risk children. Collaborative efforts between schools, parents, and healthcare providers are essential to implement effective strategies for promoting healthy behaviors and addressing the growing public health concern of childhood hypertension.

## Conclusion

The purpose of the study was to assess the prevalence of hypertension among urban school-age children in relation to their BMI. The incidence of hypertension in connection to BMI has been better understood because to this observational study that was carried out among school-age children at the Urban School of Rourkela, Odisha. The results show that hypertension is quite common in the population under study, and there are significant relationships between BMI, age, gender, and other hypertension markers. The age distribution emphasises the significance of early monitoring and intervention by highlighting the susceptibility of the 6-7 year age group to both systolic and diastolic hypertension. When evaluating cardiovascular health, it is important to take into account both anthropometric parameters, as evidenced by the prevalence of hypertension in children who are taller and heavier. The study shows a strong positive association between BMI and hypertension, highlighting the part that high BMI plays in raising the risk of hypertension in kids enrolled in school. The link between systolic and diastolic hypertension and being overweight or obese emphasises this linkage even more. According to the gender-based analysis, there are subtle differences in the incidence of hypertension and weight distribution, with men typically showing a higher prevalence. However, there was no discernible relationship between gender and BMI, highlighting the necessity of a thorough method of determining cardiovascular risk.

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