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# Prevalence of pre-hypertension and hypertension in asymptomatic urban school going children of Mangalore and its correlation with BMI

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***Abstract:*** *There is increasing evidence of high BP among asymptomatic children. This has been associated with life style influenced co-morbid conditions like obesity. This cross sectional non interventional observational study was designed to determine the prevalence of pre-hypertension and hypertension in school going children aged 13-17 years in an urban city. Anthropometric & BP measurements were taken as per standard methods. Agarwal charts were used to estimate BMI for age and sex. The average of 3 BP measurements were compared to age, sex and height percentile standards given by the report of Fourth task force on hypertension control in children. Spearman correlation was applied for independent variable (BMI) with dependent variables. Non parametric tests Mann-Whitney and Kruskal-Wallis tests were used to determine the association of gender and BMI with outcomes like average DBP, average SBP, pre-hypertension and hypertension. Prevalence of hypertension was 6.75% and 8.4% for pre-hypertension among the 785 studied, 10.5% boys and 8.5% girls were overweight and 5.8% boys and 5.1% girls were obese. In girls, increasing BMI was associated significantly ($p<0.0001$) with average SBP and average DBP in both pre-hypertension and hypertension groups but in boys only DBP was found to be significantly ($p<0.0001$) associated with BMI. A higher prevalence of pre hypertension and hypertension seen in our study group compared to similar studies in the state. Children with higher BMI were associated with pre-hypertension or hypertension.*

***Key Words:*** *adolescents; obese; overweight; target organ damage (TOD)*

## I. Introduction

By the year 2020, India will have the highest number of deaths due to cardiovascular disease [1]. This epidemic has been associated with obesity, dyslipidemia, increased salt intake [2, 3] and documented even in populations with moderate physical activity like military recruits [4]. Adult cardiovascular disease including hypertension has its roots in childhood. There are growing numbers of reports of clinically asymptomatic children showing high blood pressure (BP) readings probably secondary to life style changes and changing socioeconomic dynamics of the community [5, 6]. The present study was conducted in an urban school of south India to determine the prevalence of pre-hypertension and hypertension in clinically asymptomatic children.

## II. Methods

We conducted this cross sectional community based study from December 2009 to March 2010, wherein 800 children aged 13-17 years were screened from an urban school. A written informed consent from the head of the institution and verbal consent from the subjects were obtained prior to recruitment into the study. Ethical clearance was obtained from institutional ethical committee. Anthropometric measurements like weight and height were measured as per standard methods by co investigators after checking for reliability and inter observer correlation. Agarwal charts of BMI for age and sex were used as reference standards. Children with BMI above 95$^{th}$ percentile were considered obese and those between 85$^{th}$ and 95$^{th}$ percentile were considered overweight [7]. BP was measured by 3 co-investigators separately using a mercury sphygmomanometer. The average of the 3 measurements of BP were compared to age, sex and height percentile standards given by the report of Fourth task force on hypertension control in children [8]. Hypertension was diagnosed if BP either systolic, diastolic or both was more than 95$^{th}$ percentile for age, sex and height percentile. Pre-hypertension was diagnosed if BP was between 90$^{th}$ and 95$^{th}$ percentile [9]. Children with BP above 90$^{th}$ percentile for the age, sex and height were reevaluated after 3 months. Statistical analysis was done using SPSS software version 17. Spearman correlation was done to determine the correlation of independent variable (BMI) with dependent variables. After applying Komogorov-Smirnov test, non

parametric tests Mann-Whitney and Kruskal-Wallis tests were used to determine the association of gender and BMI with outcomes like average DBP, average SBP, pre-hypertension and hypertension.

## III. Results

Among the 800 children recruited, complete data was available in 785. Among them, 726 (92.5%) were boys. Prevalence of hypertension (SBP, DBP or both) was 6.75% and 8.4% for pre-hypertension (SBP, DBP or both). 5.2% (n=38) of the boys and 5.1% (n=3) of the girls were pre-hypertensive and 4.7% (n=34) boys and 3.4% (n=2) of the girls were hypertensive. 10.5% (n=76) boys and 8.5% (n=5) girls were overweight and 5.8% (n=42) boys and 5.1% (n=3) girls were obese. Among the boys, significant correlation was found between BMI with average SBP and BMI with average DBP in the normal BP group and no significant correlation with pre-hypertension and hypertension groups. In boys, with increasing BMI the average DBP were significantly ($p<0.0001$) higher both in pre hypertension and hypertension groups (*table 3*). 17.5% of the boys in obese group were having hypertension and in the overweight group 12.5% had pre-hypertension and 22.2% had hypertension. In girls, with increasing BMI the average SBP and the average DBP were significantly ($p<0.0001$) higher in both pre-hypertension and hypertension groups (*table 4*). All the girls in obese group (100 %) were in the pre-hypertension or hypertension group of SBP and 66% of the overweight girls were in pre-hypertension or hypertension groups of average DBP.

**Table 1: Distribution of BP in the study population**

| | Boys | | | | Girls | | | |
|---|---|---|---|---|---|---|---|---|
| | Categorized SBP | | Categorized DBP | | Categorized SBP | | Categorized DBP | |
| | Frequency | % | Frequency | % | Frequency | % | Frequency | % |
| **<90** | 654 | 90.1 | 655 | 90.2 | 54 | 91.5 | 53 | 89.8 |
| **90-95** | 38 | 5.2 | 8 | 1.1 | 3 | 5.1 | 3 | 5.1 |
| **>95** | 34 | 4.7 | 63 | 8.7 | 2 | 3.4 | 3 | 5.1 |
| **Total** | 726 | 100 | 726 | 100 | 59 | 100 | 59 | 100 |

**Table 2: Distribution of BMI in the study population**

| | Boys | | Girls | |
|---|---|---|---|---|
| **Valid** | **Frequency** | **%** | **Frequency** | **%** |
| **5-85** | 608 | 83.7 | 51 | 86.4 |
| **85-95** | 76 | 10.5 | 5 | 8.5 |
| **>95** | 42 | 5.8 | 3 | 5.1 |
| **Total** | 726 | 100 | 59 | 100 |

**Table 3: Relationship of BMI with BP among boys**

| BMI | DBP | | |
|---|---|---|---|
| | **<90 (n=654)** | **90-95 (n=8)** | **>95 (n=63)** |
| **5-85** | 85.9% | 87.5% | 60.31% |
| **85-95** | 9.3% | 12.5% | 22.22% |
| **>95** | 4.7% | 0% | 17.5% |

**p<0.0001 (Kruskal-Wallis Test)*

**Table 4: Relationship of BMI with BP among girls**

| BMI | BP | | | | | |
|---|---|---|---|---|---|---|
| | <90% | | 90-95% | | >95% | |
| | Avg SBP | Avg DBP | Avg SBP | Avg DBP | Avg SBP | Avg DBP |
| **5-85** | 88.9% | 90.5% | 7.4% | 7.5% | 3.7% | 1.9% |
| **85-95** | 100% | 33.3% | 0% | 33.3% | 0% | 33.3% |
| **>95** | 0% | 66.7% | 50% | 0% | 50% | 33.3% |

**p<0.0001 (Kruskal-Wallis Test)*

## IV. Discussion

Adult studies have established association of hypertension with Target Organ Damage (TOD) like increased left ventricular mass [10] or arterial wall changes [11, 12] and screening for TOD has become an established practice in preventive care [13]. Recent data suggest that TOD may begin at pre-hypertensive levels of blood pressure [14]. The etiology of hypertension is multifactorial, and life style changes are just one among them. In India, with recent changes in the socioeconomic dynamics, the life styles of urban and rural population are hardly different and that would probably explain the rising prevalence of chronic diseases like hypertension in this population. There is limited data regarding pre-hypertension among the pediatric population especially in the urbanized regions of the country. As we gather more evidence of high blood pressure readings in asymptomatic children, it might be imperative to screen children with pre-hypertension for TOD to prevent future cardiovascular disease. We found a hypertension prevalence of 6.75% and 8.4% for pre-hypertension, much higher compared to 2.9% & 2.8% respectively in the neighboring district [15]. We found that subjects in the obese and overweight groups had higher average BP which was similar to other researchers [16]. A German study found weak correlation of DBP with relative obesity [17]. This increasing trend of high BP measurements should be a warning call for a more organized screening of the adolescent population and follow them for TOD. With ever increasing pressure to perform well in academics, physical activities in schools have taken a back seat. Researchers have found a definite relation of poor physical activity with high BP readings [18] and with risk of metabolic syndrome [19]. Mangalore being a coastal town fish is a popular part of the diet we anticipated a lower prevalence of hypertension as fish consumption is associated with lower BP readings [20]. But contrary to our expectation we noted a higher prevalence of BP in the asymptomatic adolescent population compared to a similar study from Mysore where fish consumption is far lesser. As a complete biochemical profile and detailed diet history were not available, we are unable to conclude for or against fish based diet. Hence balanced physical activity and healthy diet modifications is the need of the hour and must be encouraged in schools. We could not follow the student population beyond 3 months due to logistic reasons. The relatively small sample size and a short follow up were the limitations in our study. A larger sample and longer follow up of the BP and BMI in the study group would reinforce our findings.

## V. Conclusion

A higher prevalence of pre-hypertension and hypertension was seen in our study group. Children with higher BMI were associated with pre-hypertension or hypertension. In developing countries like India, we urgently need school screening programs to identify pre-hypertension and hypertension in asymptomatic children. This can be achieved by government sponsored national programs, mandatory BP measurements by local physicians at office visits and regular school physical screening programs.

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