

## Association Of Heart Rate And Blood Pressure With BMI In Children

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**Abstract:** Background: As childhood obesity is a single marker of the child at risk for development of various non-communicable diseases later in life, we have conducted a cross sectional study of 2000 school going children from age group 7-11 years to find the prevalence of obesity & its association with heart rate & blood pressure. Method: Schools were selected based on simple random sampling method. Prevalence of childhood obesity was calculated based on BMI using NCHS guidelines. Resting Blood Pressure (B.P) was determined using mercury manometer with appropriate sized cuffs, by auscultatory method. Heart rate was recorded in each child after 5 min of rest for 1 minute and comparison was done between normal and obese children. In those children who were categorized as overweight and obese. Result: The prevalence of over-weight and obesity was 15.5% and 8.1% respectively. Overall, males were slightly more obese than Females. We found 303 overweight children with 5.6% hypertension among them and 12.34 % incidence of hypertension in 162 obese children. The incidence of hypertension in normal children was 0.78%.The mean heart rate in normal, overweight & obese children were 97.37, 100.54, & 106.71 respectively. Conclusion: The fact that obese children have higher cardio-vascular risk factors like hypertension and increased heart rate when compared to non obese children has been reinforced by the present study. These children are at a higher risk of "childhood onset of adult diseases". Thus, timely intervention will result in decreased adulthood morbidity and mortality due to obesity in these children.

**Key Words:** Childhood obesity, BMI, Hypertension, Heart rate

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**Introduction:** The WHO refers Obesity as a global epidemic because of rapid increase in the number of overweight and Obese individuals in last 20 years<sup>1</sup> Overweight and Obesity in children and adolescent is defined by CDC and American medical association as BMI between 85-95centile and BMI > 95<sup>th</sup>centile respectively for children aged 2-18 years<sup>2</sup>. Excess body fat negatively affects child's health and wellbeing. Overweight and obesity represent a rapidly growing threat to the health of population in an increasing number of countries<sup>3</sup> & now they are so common that they are replacing more diseases as the most significant causes of ill health in children<sup>4</sup>. Childhood obesity is a single marker of the child at risk for development of various non-communicable diseases later in life.

The co-morbidities of obesity includes coronary heart disease, hypertension, stroke and certain types of cancers, NIDDM, gall bladder disease, dyslipidemia, osteoarthritis, gout and pulmonary diseases including sleep apnoea<sup>5</sup>. Some of the other disorders would include liver diseases, early puberty and menarche, eating disorders such as anorexia and bulimia, skin infections and asthma

and other respiratory problems<sup>5</sup> In addition the obese suffer from social bias, prejudice and discrimination on the part, not only of the general public but also of health professional and this may make them reluctant to seek medical assistance<sup>5</sup>. Obese children are often sufferers from teasing by their peers. Some are harassed or discriminated by their own family. This may lead to low self esteem and depression<sup>6</sup>.

Arterial hypertension is significantly related to overweight and obesity. Their correlation may be traced in childhood. Recent studies show that the prevalence of childhood hypertension is increasing and increasing rates of hypertension are largely attributable to the childhood obesity epidemic<sup>7</sup>. The fundamental cause of obesity epidemic are sedentary life style; high fat and energy dense diets, both resulting from changes taking place in society and the behaviour patterns of communities; as a consequence of increased urbanization and industrialisation and the disappearance of traditional life style. While there is evidence that certain genes have an influence on BMI and body fat<sup>8</sup>. The present study is conducted in children in age group 7 to 11 years belonging to

schools in Kolhapur city to determine the prevalence of childhood obesity.

As childhood obesity can lead to high blood pressure and heart disease; so in present study, heart rate and blood pressure is determined in obese children to assess the cardiovascular function. So that, the necessary steps can be taken to prevent the childhood onset of adult diseases.

**Aim :** To study, the correlation between BMI and HR, BP in Children of age group 07-11 years

**Objectives:**

1. To study the prevalence of obesity in school going children aged 07-11 years
2. To study the Heart rate and blood pressure in obese children age group 07-11 years
3. Correlation of Heart rate, Blood pressure and BMI in children, age group 07-11 years.
4. To predict the cardiovascular risk in obese children and to counsel them to prevent it.

**Materials and Method:** A cross sectional study was conducted in 5 schools of Kolhapur city after taking clearance from Dr. D. Y. Patil Medical College ethical committee and permission from authority of schools. Children between the age group of 7-11 years were included.

Children diagnosed to be obese due to endogenous causes on clinical examination were excluded. The age of the children was obtained from the school records. The height was measured by making the child to stand upright, barefoot on the ground with heels, buttocks and shoulder touching the wall and head in Frankfurt plane.

The height was measured using sliding stadiometer (Johnson and Johnson) with an accuracy of 0.1mm. Weight was recorded using spring balance (bathroom scale) calibrated to 0.5kg accuracy.

Body Mass Index (BMI) was calculated based on the formula- $BMI = \text{Weight in kg} / \text{Height in m}^2$  Children were categorized based on BMI as per National Centre for Health Statistics guidelines<sup>9</sup> with respect to their age and sex.

**CATEGORY BMI**

Normal 5th – 85th percentile  
Overweight 85th – 95th percentile

Obese > 95th percentile

Resting Blood Pressure (B.P) was determined using mercury manometer with appropriate sized cuffs (covering 2/3<sup>rd</sup> of right arm) , by auscultatory method in right arm supine after a 5 minute resting period. Systolic B.P was determined by the onset of “tapping” Korotkoff’s sounds (K1) and Diastolic B.P, as the disappearance of the Korotkoff’s sounds (K5) as per Update on 1987 Task force report, National high blood pressure education programme committee.<sup>10</sup>

For each subject B.P was recorded. Children with a systolic or diastolic B.P >90th centile but < 95th centile with respect to their age, sex and height were classified as having Pre-hypertension. Children with systolic or diastolic B.P >95th centile with respect to their age, sex and height were designated as having Hypertension as per Update on 1987 Task force report, National High blood pressure education programme coordinating committee<sup>11</sup>. Heart rate was recorded in each child after 5 min of rest for 1 minute and comparison was done between normal and obese children. In those children who were categorized as overweight and obese, cardiovascular risk factors were analyzed by Tukey Test.

**Result & Discussion:** Over-weight and obesity represent a rapidly growing threat to the health of population in an increasing number of countries. Indeed, these are now so common that they are replacing the traditional diseases as the most significant causes of ill health.

The age group included in the study was between 7-11yrs. Here, the prevalence of over-weight and obesity was 15.5% and 8.1% respectively. Overall, males were slightly more obese than Females this may be partly due to the fact that males were more in number as then females in our study sample.

Study done by Subramanyam.V.et al in 1998 at Chennai included 610 girls and found 9.67% overweight and 6.23% obese.

Study done by Kapil<sup>12</sup> et al in 2001-2002 at delhi included 870 children and found a incidence of

7.4% Obese. Study done by Khadilkar V.V. et al<sup>13</sup> in 2004 at Pune included 1128 boys and found an incidence of 19.9% overweight and 5.7% Obese and found an incidence of 17.7% overweight and 4.99% obese children.

In our study done in Kolhapur found an incidence of 15.15% overweight and 8.1% Obese ,which correlates with above studies.

This may be due to fact that in India, the available studies were done in metro cities, where there was total adoption of western culture, availability of fast food centers and sedentary lifestyle behaviors. The schools selected in the previous studies were

on the basis of school fees of approximately Rs.1000 to 2000 per month. western culture has grown rampantly in last Kolhapur, being a major city in western Maharashtra where the traditional cultures and practices are still prevalent but adaption to decade with availability of number of fast foods like Burger, pizza etc.

Hence the prevalence of overweight and obesity has correlated with other studies done in metro cities. The prevalence of obesity in America and other developed countries is much higher as shown in table no.1. As in developed countries children has more sedentary lifestyle and more availability of fast foods.

**Table 1: Prevalence of Obesity in children in various studies**

Study done by	Age Group (Yrs)	Total	BMI criteria	Prevalence of obesity	
				Overweight	Obese
1) G. Kapoor et al, Delhi (1991)	11-18	253	> 25 – Overweight > 30 – Obese	-	2.7%
2)Subramanyam.V et al, 1998. Chennai	10-15	610 (Girls)	85th -95th centile – Overweight > 95th centile – Obesity	9.67%	6.23%
3)NHANES 1999-02. United States	6-19	4018	85th -95th centile – Overweight > 95th centile – Obesity	31%	16%
4)Kapil U et al (2000-2001), Delhi	10-16	870	25 – Over weight > 30 – Obese	24.7%	7.4%
5)NFI 2002, Delhi	4-18	5000	> 25 – Over weight > 30 – Obese	27.3%	1.7%
6)Khadilkar V.V. et al,2004. Pune	> 10-15	1228 (Boys)	> 25 – Over weight > 30 – Obese	19.9%	5.7%
7)Ambily.G.Unnithan et al,Kerala(2008)	10-15	3886	85-95- over weight >95- Obese	17.73	4.99%
<b>Present study</b>	<b>7-11</b>	<b>2000</b>	<b>85-95- over weight &gt;95- Obese</b>	<b>15.15%</b>	<b>8.1%</b>

The relationship between BMI & hypertension cannot be characterized by threshold effect but indeed represents a continues relationship. The prevalence of hypertension increases progressively as BMI increases from 5th centile to 95th centile. Others studies have shown that prevalence of hypertension in normal children varies from 0.04% to 4.52%. Gupta et al<sup>14</sup>studied 3861 children with age group 5-15 years and found 292 obese children of which

3.4% had hypertension and 0.16% hypertensive children were non obese.

Verma et al<sup>15</sup>studied 2560 children with age group 5-15 years and found 131 obese children of which 13.7% had hypertension and 0.04% hypertensive children were non obese.

Scrof J.M. et al<sup>16</sup>studied 5102 children at Housten USA, with age group 10-19 years and

found 1020 obese children of which 10.7% had hypertension and 2.6% hypertensive children were non obese.

**Table 2: Incidence of pre hypertension and hypertension in obese and non obese children in our study**

		Pre hypertension	Hypertension
Normal	1535(76.75%)	13(0.84%)	12(0.78%)
Over weight	303(15.15%)	23(7.54%)	17(5.6%)
Obese	162(8.1%)	18(11.11%)	20(12.34%)

Another study done by Mohan B et al<sup>17</sup> in 2004 at Ludhiana included 2397 children with age group 11-17 years .He found 217 overweight children with 15.33% hypertension among them and 43.1 % incidence of hypertension in 58 obese children. The incidence of hypertension in normal children was 4.52%. The incidence of hypertension in his study was higher probably because the group include was pre-adolescent and adolescent.

Another study done by Boyd G.S et al<sup>18</sup> included 497 obese children in 2004 at Philadelphia found an incidence of 6.8% pre-hypertension and 27.9% hypertension In the present study we included 2000 children with age group 7-11 years .We found 303 overweight children with 5.6% hypertension among them and 12.34 % incidence of hypertension in 162 obese children. The incidence of hypertension in normal children was 0.78%.

**Table 3: Mean heart rate in normal, over weight and Obese children**

	Mean heart rate	SD
Normal	97.37	11.11
Over weight	100.54	10.32
Obesity	106.71	9.48

Several studies proved that Obesity leads to increased sympathetic activity and decreased activity of parasympathetic system. This leads

to increased risk for cardiac dysfunction in adulthood as it causes increased heart rate and Hypertension.

Yalcini et al<sup>19</sup>. reported data indicating no differences in sympathetic activity but reduced parasympathetic nervous system activity between Obese and normal weight.

Rabbia et al<sup>20</sup>. Showed that children who were recently Obese had significantly increased sympathetic activation, but children who had been Obese for 4 years were no different than healthy controls, which suggests that the duration of obesity might be a factor explaining the differences seen in studies assessing sympathovagal balance.

As the BMI increases, there is increase in sympathetic activity leading to increase in heart rate and blood pressure.BMI is directly proportional to obesity. Hence, in obesity there is increase in heart rate and blood pressure.

In our study there was a similar finding that heart rate increases as one moves from normal weight to overweight and then to Obese. The previous study and the present study shows that there is a positive correlation between BMI and Blood pressure and Heart rate. With an increase in BMI the Blood pressure increases and also there is an increase in Heart rate. This is due to increase sympathetic activation.

Thus, in obese children there is risk of hypertension which can lead to cardiac disease in future. If the obesity is prevented in early childhood this risk can be eliminated. So, if we regularly calculate BMI in children they can be advised to reduce BMI with application of different measures to prevent future cardiac disease.

**Conclusion:** Childhood obesity is in increasing trend from past 20 years in both developing and developed countries.The prevalence of childhood obesity in school children in Kolhapur city is 8.1% .

Heart rate and Blood Pressure were increased in overweight and Obese children as compared to normal children.The fact that obese children

have higher cardio-vascular risk factors like hypertension and increased heart rate when compared to non obese children has been reinforced by the present study. These children are at a higher risk of “childhood onset of adult diseases”. Thus, timely intervention will result in decreased adulthood morbidity and mortality due to obesity in these children.

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