



# PREVALENCE OF HYPERTENSION AND ITS RELATIONSHIP WITH OVERWEIGHT AND OBESITY IN ADOLESCENTS AND YOUNG ADULTS

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## ABSTRACT

**Background:** The rate of obesity is rapidly rising, and impacting quality of life, psychosocial situation, and health of the affected individual. The purpose of this study was to determine the role of elevated Body Mass Index (B.M.I.) in occurrence of prehypertension and hypertension and their relationship with family history of hypertension among adolescent college students in Hyderabad, Telangana, India.

**Methods:** 1611 students aged between 17 to 25 years of two colleges which were randomly selected in Moinabad area in outskirts of Hyderabad, were classified as overweight and obese based on their BMI (BMI  $\geq$  25kg/m<sup>2</sup> and 30 kg/m<sup>2</sup> respectively). Subjects were categorised as prehypertensive and hypertensive based on their Blood pressure reading.

**Results:** Prevalence of overweight, obesity, prehypertension and hypertension were 9.15 % 2.11%, 26.95% and 4.86% respectively. Prehypertension and hypertension in males was 35.29% and 6.64% respectively and in females was 9.64% and 1.18% respectively. Prevalence of overweight in hypertensive individuals was 16.09 % (  $p < 0.05$  ) when compared in normotensive individuals 5.91%. Prevalence of obesity in hypertensive individuals was 4.22 % (  $p < 0.05$  ), when compared with normotensive individuals was 1.12%. Prevalence of family history of hypertension in hypertensive individuals was 43.86%.

**Conclusion:** Prevalence of prehypertension and hypertension were 26.95% and 4.86 % respectively. Our results reinforced that overweight and obesity were to be significantly associated with hypertension.

**Keywords:** Adolescents, Hypertension, Overweight, Obesity, Renin-angiotensin-aldosterone system (R.A.A.S.)

## INTRODUCTION

Malnutrition is rapidly growing problem worldwide, particularly malnutrition resulting in obesity is pandemic universally. Lack of physical activity and sedentary lifestyle after invention of

electronic gadgets is responsible for overweight and obesity. The consequence of obesity is an alarming increase not only in adults, but also in children. Previous studies have documented that hypertension may begin in adolescence, perhaps

even in childhood.<sup>1,2</sup> Clinical studies have already confirmed a strong association between obesity and hypertension<sup>3</sup>, with visceral obesity being the most important risk factor<sup>4</sup>. Various mechanisms such as activation of the renin-angiotensin-aldosterone system, oxidative stress, sympathetic overdrive, chronic vascular inflammation and endothelial dysfunction, lead to structural changes such as thickening of the intima and media of the vessel wall in the development of hypertension<sup>5,6</sup>. Obesity is one of the main factors, in addition to family history of hypertension, contributing to increase in the prevalence and rate of diagnosis of hypertension in children and adolescents. The consequence of adolescent obesity was reported in a study which showed that B.M.I. greater than the 75<sup>th</sup> percentile in adolescence usually lead to an increased risk of death from cardiovascular disease in adulthood<sup>7</sup>.

The overall imbalance between unhealthy diet intake and physical activity leads to obesity which ultimately contributes to high blood pressure and high cholesterol. It is multifactorial disease and changes in the levels of blood pressure and blood lipids differ by age, sex, and race/ethnicity and are influenced by body fat and dietary patterns. These risk factors need to be monitored and evaluated in childhood and adolescence. Identifying and modifying the risk factors in early age reduces the incidence in adolescents and adult. Prevalence of hypertension varies across countries and states. The prevalence of hypertension in India is reported as ranging from 10 to 30.9%<sup>8</sup>. This study was conducted to observe the prevalence and risk factors for hypertension in adolescents and young adults from Hyderabad, Telangana.

## METHODOLOGY

**Study design:** The present study is a cross sectional study done on 1611 adolescents and young adults of both sexes in the age group 17 to 25 years from two colleges which were randomly selected around Moinabad village in the outskirts of Hyderabad, Telangana, India.

Individuals on bed rest for more than 15 days during the last 6 months, due to any sickness and with any form of chronic systemic disease and those who are noncompliant and unwilling for the study were excluded for study.

Approval for the study from institutional ethical committee was taken. At the time of the initiat-

ing the study each participant was informed about the study protocol and written consent was obtained. Study was conducted from 1<sup>st</sup> October 2011 to 31<sup>st</sup> March 2012 excluding exam period and vacation time. As far as possible, the free time or physical activity periods were used for this study, so that their routine classes were unaffected.

The exact age of students was verified from college records. Subjects were explained about study in their regional language (Telugu). A semi-structured pre-test questionnaire was administered to each student by first author with the help of class representative and asked to fill. Unsatisfactory or incomplete answers were confirmed by telephonic contact or repeating the questionnaire. This was done on an individual basis as subjects filled out forms.

Questionnaire asks for the participant's age, gender, race/ethnicity, height, weight, address, and a checklist of risk factors. The risk factors included elevated BMI, family history of hypertension, smoking, and alcohol consumption. Children those who were having positive family history of hypertension, findings were reconfirmed by interviewing parents about their present health condition, medication and the physician.

All anthropometric measurements were taken by trained investigators. Height and weight were measured, using seca stadiometer with beam balance, with sensitivity of 0.1 cm and 0.1 kg respectively. Zero error was set after every 10 measurements. Height was measured without any footwear. The student stood straight with heels, buttocks, back touching the vertical limb of the instruments and stretching upwards to the fullest extent with arms hanging on the side. The head was aligned so that the lower rim of the orbit and the auditory canal were in the horizontal plane (Frankfurt plane). Mild upward pressure was exerted on the mastoid region bilaterally. Weight was measured without any footwear with minimal clothing. BMI was calculated by taking person's weight in kilograms dividing it by square of his/her height in meters (kg/m<sup>2</sup>) and as per WHO definition of overweight and obesity, students were identified as overweight and obese if BMI was more than 25 and 30 respectively.<sup>9</sup> BMI was selected as an index for categorising overweight and obese, as it provides the most useful population-level measure as it is the same for both sexes and for all ages of the adults.

Subjects were made comfortable and were explained about procedure to alleviate anxiety. Brachial artery BP was recorded on seated participants after they had rested 5 minutes by using mercury sphygmomanometer. An appropriately sized cuff was placed on the right arm; pulse occlusion pressure was determined; and the cuff was inflated to 20mm Hg above that pressure. For each student, the blood pressure was measured thrice in the same visit with a minimum of thirty minutes rest between each determination and mean blood pressure was calculated. The systolic blood pressure was determined by the onset of the “tapping” Korotkoff-1 sound and the diastolic at its disappearance (Korotkoff-5). Students were considered hypertensive if the systolic blood pressure is more than or equal to 141mm Hg and diastolic blood pressure is more than equal to 91 mm of Hg. Prehypertension was considered if systolic blood pressure was between 121 and 140mm of Hg and diastolic blood pressure was between 81 and 90 mm of Hg. Students found to have hypertension on first visit were contacted to undergo a second set of blood pressure measurements at least four weeks later. Three further sets of reading were taken on second visit, or 4 weeks later after the first measurement. The prestated norms were then used to conclude the presence or absence of hypertension. Blood pressure recordings were taken by a single observer. Subjects were divided into 2 groups based on their age i.e.17-19 years age group (adolescent) and 20-25 years age group (young adults) and their frequencies of overweight, obesity and prehypertension and hypertension were compared.

**Statistical Analysis:** Data was collected and recorded on a pre-designed proforma and entered in excel database. All the entries were verified for any possible key-board error. Association of each of the categorical with hypertension (outcome variable) is assessed with chi-square test. Variables showing statistically significant association with the outcome variables ( $P < 0.05$ ) were considered as statistically significant. Data analysis was performed using Epi Info 7 program (CDC Atlanta).

**RESULTS**

Overall 1611 students aged between 17 to 25 years were assessed. Of which 49 individuals were excluded from the study for various reasons. Of all the participants, 1054 (67.47%) were males and 508 (32.52%) females. The descriptive data is given in table 1. Overweight was found to be 9.14% and obesity was 2.11%. The prevalence of overweight in males was 8.63% and in females was 10.28%.The prevalence of obesity in males was 1.80% and in females was 2.75%. Total prevalence of prehypertension and hypertension was 26.95% and 4.86 % respectively. The prevalence of prehypertension was more in males (35.29%) than compared to females (9.64%).The prevalence of hypertension was more in males (6.64%) than compared to females (1.18%).

Among the individuals who were overweight (143), 63(44.05%) had blood pressure of prehypertension values (p value=0.003) and 17(11.08%) had hypertension (p value=0.0059).

**Table 1 showing descriptive data of the study**

Age groups (Years)	Sex (M/F)	Total	OW(%)	Obesity(%)	PHTN(%)	HTN(%)	Normotensive(%)
17-19	M	810	64(7.90)	16(1.98)	274(33.83)	51(6.30)	485(59.88)
	F	384	36(9.38)	10(2.60)	42(10.94)	06(1.56)	336(87.50)
20-25	M	244	27(11.07)	03(1.23)	98(40.16)	19(7.79)	127(52.05)
	F	124	16(12.90)	04(3.23)	07(5.65)	00(0)	117(94.35)
Total		1562	143	33	421	76	1065

M-Male, F-Female, OW-Overweight, PHTN-Prehypertension, HTN-Hypertension, SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure, BMI-Body Mass Index

**Table 2 showing relationship between variables**

Variable	Prehypertension (n=421)	Hypertension (n=76)	Normotension (n=1065)
Overweight (143)	63(44.05%)(P=0.003)	17(11.88%)(P=0.0059)	63(44.05%)
Obesity (33)	11(33.33%)(P=0.97)	10(30.30%)(P<0.05)	12(36.36%)
F/h Hypertension(757)	194(25.63%)(P=0.77)	24(3.17%)(P=0.106)	539(71.20%)

Each p value was calculated by using chi-square analysis and degree of freedom (n-1). For eg. p value =0.003,group of subjects who were overweight and had prehypertension were compared with group of subjects who had only prehypertension.

Among the individuals who were obese (33), 11(33.33%) had blood pressure of prehypertension values and 10(30.30%) had hypertension (p value<0.05). Among the 421 students who had prehypertension, 194 (25.63%) were having positive family history of hypertension. 24 (3.17%) students who had hypertension were having positive family history of hypertension. We observed prevalence of prehypertension increases with age (26.47% in age group 17-19 years (of both sexes) vs 28.53% in 20-25 years group (of both sexes)). Similarly prevalence of hypertension increased with age (4.77% in age group 17-19 years vs 5.16% in 20-25 years group).

In our study, we also observed significant high prevalence of prehypertension and hypertension in overweight students or in other words about 55% of overweight students had blood pressure values of prehypertension and hypertension range and about 63% of obese students had blood pressure values of prehypertension and hypertension range (Table 2). This observation shows that there is significant relationship between overweight, obesity and hypertension.

Prevalence of overweight in hypertensive individuals was higher (22.36%) when compared in normotensive individuals (5.91%). Prevalence of obesity in hypertensive students was higher (13.15%) when compared in normotensive children (1.12%). Prevalence of positive family history of hypertension in hypertensive children was 31.57%.

## DISCUSSION

We determined the prevalence and risk factors for hypertension among college students in the present prospective cross sectional study in Hyderabad. We concluded that prevalence of prehypertension and hypertension was higher in 20-25 years age group when compared with 17-19 years age group and is associated with overweight and obesity.

The unique feature of Hyderabad is that it is a cosmopolitan and fastest developing economic city in India. The prevalence rates of hypertension have been so variable among different studies from different countries<sup>10,11</sup> and from India also.<sup>12,13</sup> The overall prevalence of prehypertension and hypertension in our study was 26.95% and 4.86%. Similar study was done on prevalence of hypertension in Gujarati school going and adolescents in Anand district, and their prevalence of prehypertension and hypertension was 10.8%

and 9.2% respectively<sup>14</sup>. A previous study on American Indian adolescents from New York by Jennifer drukteinis et al found higher prevalence of hypertension (15%) and prehypertension (35%) when compared to our study.<sup>15</sup> The difference may be due to difference in life style, dietary patterns, and physical activity between the two populations. A fall in prevalence on repeated evaluation has been noticed by Gupta<sup>6</sup> and Ahmed and Verma et al<sup>13</sup>, so we did blood pressure measurement on different occasions to reduce false positives. Burke et al also has recommended serial measurement to reduce the effect of regression to mean and increase predictive values.<sup>16</sup>

We observed in our study the prevalence of prehypertension and hypertension increases with age (26.47% in age group 17-19 years age group vs 28.53% in 20-25 years age group and 4.77% in age group 17-19 years vs 5.16% in 20-25 years age group respectively). Studies in the past have demonstrated that age appropriate blood pressure values tend to be more among boys than girls throughout childhood and adolescents.<sup>1,17</sup> Soudarssanane MB et al from India also gives same opinion of increase in hypertension with increase in age.<sup>18</sup> In their study on adolescent and young adults, they found a significant increasing trend of BP was seen only among males. We found almost similar observation.

The prevalence rates of overweight and obesity in our study were 9.15% and 2.11%. Similar study done in rural area of Bangalore in college students found prevalence of overweight and obesity to be 6.1% and 7.2% respectively<sup>19</sup>.

The present study found significant rise of hypertension with obesity in both the sex groups, around 30% of obese students in our study had hypertension and 33.33% of obese students had prehypertension. Around 44.05% of overweight students had prehypertension and 11.08% of students who were overweight had hypertension. This association also demonstrated in many studies.<sup>1,20,21</sup> The Framingham study also showed increased prevalence of obesity in subjects with hypertension as well as increase in BP in established obesity.<sup>22</sup> Many studies from India had similar observations.<sup>12,13,18</sup> Similar observations were also reported among adolescent population in Hungary<sup>23</sup> and France<sup>24</sup> and such association in early childhood with rise in systolic blood pressure alone was reported by British cohort.<sup>25</sup>

Family history of hypertension was significant risk factor for hypertension as evident in many

studies like Zambian study<sup>26</sup> which showed that parental history before age of 60 was related to offspring hypertension. Studies from India like Verma et al<sup>13</sup>, Soudarssanane et al<sup>18</sup> and Gupta and Ahmed<sup>12</sup> have also reported similar observations. The awareness that essential hypertension has its origin in childhood and adolescence has resulted in increased emphasis on screening. The Indian Paediatric Nephrology Group recommends annual measurement of blood pressure in all children more than 3-year-old, who are seen in clinics or hospital settings.<sup>27</sup>

Obesity is a major risk factor for various disorders including angina, diabetes mellitus, osteoarthritis, and hyperlipidemia that result in morbidity and mortality. Today about 70 % of deaths occur in India because of cardiovascular pathologies.<sup>28</sup> Even a small increase in BMI of high risk individual can increase mortality by several fold, therefore it is very essential to start the preventive measures early in life i.e. in preventive childhood and adolescence. Our data of prevalence of obesity and hypertension can help to initiate preventive measures.

Our study has number of limitations. All BP recordings were taken by a single observer, which may be a source of bias. We have not studied or adjusted for factors such as physical activity, diet and salt intake. We also did not look for how many individuals require antihypertensive medications, do they develop any cardiovascular disease or other morbidities. These areas are open for further research.

## CONCLUSION

The result of our study confirms that there is increasing prevalence of hypertension with increase in age and is associated with overweight and obesity. Children and adolescents should be considered as priority population for interventional strategies. Prevention may be achieved through physical activity and diet control. There is an urgent need for initial prevention and treatment of obesity in children. Obesity, family history of hypertension are risk factors for adolescent hypertension. Findings of our study suggest a need for larger population based studies to accurately estimate the prevalence and risk factors for hypertension among adolescents and young adults in our country.

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