

## **Profile of Blood Pressure in Adolescent School Going Children of Guwahati City of India.**

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**Abstract:** Hypertension in children is an emerging public health issue attracting the attention of medical professionals worldwide. This analytical cross-sectional study was carried out over a period of one year from 1<sup>st</sup> August 2011 to 31<sup>st</sup> July 2012 in four schools in Guwahati. The objective was to study the profile of blood pressure in adolescent school going children and to find out the relation between age, gender, weight, height and body-mass index .500 subjects both male and female between the age group of 10-18 years were taken randomly and their weight, height, blood pressure and body-mass index were calculated using standard methods and the data that was obtained was analyzed statistically for both male and female separately. The blood pressure profile was analyzed for all the age groups and genders from 10- 18 years and the mean, standard deviation and percentile were calculated. The mean systolic and diastolic blood pressure was found to be more in males than females. The study also showed that the systolic and diastolic pressure peaked at the age of 14 years and remained static till 15 years and gradually started rising again from the age of 16 years onwards in males and in females there was gradual rise of systolic blood pressure at around 12 years and remaining static till around 15 years and then started rising again at around 16 years. The study showed an increase in systolic and diastolic blood pressure in relation to increase in body mass index in girls and an increase in both systolic and diastolic blood pressure were seen with the increase in body weight in boys. The blood pressure obtained from the present study provides normative blood pressure measurement table for Guwahati adolescents which include percentile for age, sex and height.

**Keywords:** systolic blood pressure, diastolic blood pressure, adolescents, body mass index.

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### **I. Introduction**

Hypertension in children is an emerging public health issue attracting the attention of medical professionals worldwide. Hypertension in children exhibits strong correlation with various factors, among which bodyweight assumes considerable significance. Excess weight resulting in hypertension in children deserves immediate attention even in large developing economies like India, China and Brazil. Data from diverse populations shows that the tracking of blood pressure from childhood into adulthood is very strong. In addition to aggravating cardiovascular morbidity and mortality burden, hypertension contributes significantly to other chronic diseases such as stroke and end-organ damage. Through adulthood, blood pressure is strongly and directly related to vascular as well as overall mortality. Recent advances have improved the understanding of pathophysiology of hypertension. Recognition of monogenic genetic disorders like Liddle's Syndrome, glucocorticoid-remediable aldosteronism and syndrome of apparent mineralocorticoid excess have been able to be diagnosed and treat effectively which were previously diagnosed as essential hypertension. While Worldwide literature reveals that late hypertension related cardiovascular events from essential hypertension do not usually occur in childhood, hypertensive children although usually asymptomatic, already manifest evidence of target organ damage. Upto 45% of hypertensive children have left ventricular hypertrophy and hypertensive children have increased intima-media thickness, a marker of early atherosclerosis . Primary hypertension during childhood often tracts into as adults. Similarly nearly half of hypertensive adults had a BP >90<sup>th</sup> percentile as children. There is also an association between childhood hypertension and early atherosclerosis in young adulthood. The phenomenon of BP tracking into adulthood and the demonstration of the beginning of hypertensive target- organ damage during childhood, together with the increased prevalence of childhood essential hypertension, have raised concern of an impending epidemic of cardiovascular morbidity and mortality. Under this background this study was undertaken with the objective to study the profile of blood pressure in adolescent school going children and to find out the relation between age, gender, weight, height and body-mass index .

### **II. Methods**

The study was conducted in four schools in Guwahati. This study was an analytical cross-sectional study during the period of one year from 1<sup>st</sup> August 2011 to 31<sup>st</sup> July 2012. Written consent was taken from the concerned authorities and legal guardians. The proposed format was submitted to and passed by the Ethical

Committee of Gauhati Medical College and Hospital. The Study population included a total of 500 students, of both sexes of 10-18 years who were selected randomly from Ulubari higher secondary school, Gopal Boro higher secondary school, Holy child high school and Kendriya Vidyalaya, Khanapara, of Guwahati city. Study population that have been excluded were subjects with heart disease, subjects with history of intake of drugs like sympathomimetic drugs, NSAIDs, acute or chronic use of cocaine, cyclosporine etc.

#### **Data Collection Methods:**

The data has been collected by providing a standard proforma to the students:

- Date of birth was taken as per information provided in the standard proforma and has been counted as a rounded year.
- Height (in centimeters) was taken with an anthropometric rod. The subject was made to stand with bare feet on a flat floor against a wall with feet parallel and with heels, buttocks, shoulder and occiput touching the wall. The head was asked to hold erect so that the lower rim of the orbit and the auditory canal were in a horizontal plane (Frankfurt Plane). With the help of a wooden spatula, the top most point of the vertex was identified on the wall and the height was taken and plotted on the percentile charts.
- Weight, was taken using an electronic weighing machine. Each subject was asked to stand straight on the platform with standard minimum cloth, with no part of the body touching the wall or any other support, and without any socks and shoes.
- Body mass index (BMI) is calculated by the formula  $\text{weight in kilogram}/\text{height in (meters)}^2$  and compared with the percentile charts given by WHO. BMI more than 95<sup>th</sup> percentile was taken as obesity and that between 85<sup>th</sup> and 95<sup>th</sup> was considered as being overweight.

#### **Steps Of Measuring Blood Pressure**

- Every subject was explained about the procedure and all the efforts were made to eliminate the factors which might affect the blood pressure readings like anxiety, fear, stress, crying, laughing and recent activities etc.
- The subject should be calm and at rest for 15-20 mins.
- Should be in sitting position with the arm at the level of the heart
- An appropriate size cuff was taken which had an inflatable bladder, the width of which at least that is at least 40% of the arm circumference at a point midway along the upper arm. The inflatable bladder should cover at least two-thirds of the upper arm length and 80-100% of its circumference. The cuff should be tied 2.5 cms above the cubital fossa in the upper limb.
- The systolic pressure is measured by palpatory method.
- The bladder is inflated again to 10mmHg above the systolic pressure
- The bladder is then deflated 2-3mmHg at a time until the korotkoff sound is first heard. This is the systolic pressure. Deflation is continued till the sound disappears.
- Record the level of mercury column at which the sound disappears. This is the diastolic pressure. A set of three readings were taken at an interval of two minutes and the average of the three readings was taken finally.

While obtaining the blood pressure the same parameters are applied in the thigh as in upper limb. The stethoscope was placed in the popliteal artery with the subject in prone or lateral position and blood pressure was recorded in the similar way as the upper limb.

**Definition Of Hypertension :** The Fourth Report of the National High Blood Pressure Education Program (NHBPEP) Working Group on High Blood Pressure in Children and Adolescents (2004) has recommended the following definition:

1. Pre-hypertension is defined as an average systolic or diastolic pressure that are  $> - 90^{\text{th}}$  percentile but  $< 95^{\text{th}}$  percentile for age, sex and height on at least three occasions.
2. Hypertension is defined as average systolic and/or diastolic pressure levels that are greater than or equal to 95<sup>th</sup> percentile for age, sex and height on at least three occasions.
3. When blood pressure reading is above or equal to the 95<sup>th</sup>, one could further divide hypertension into :  
Stage1: Here blood pressure readings are between 95<sup>th</sup> and 99<sup>th</sup> percentiles plus 5 mm hg.  
Stage2: Here blood pressure readings are 5mm or more above the 99<sup>th</sup> percentile.

#### **Data Management And Statistical Analysis**

The data collected were scrutinized individually and analyzed manually. Blood pressure percentile was estimated in relation to sex, age and height by using the following formula:

1. Standard deviation(SD)=  $SD = \left( \frac{\sum x^2 - n\bar{x}^2}{2} \right)^{1/2}$

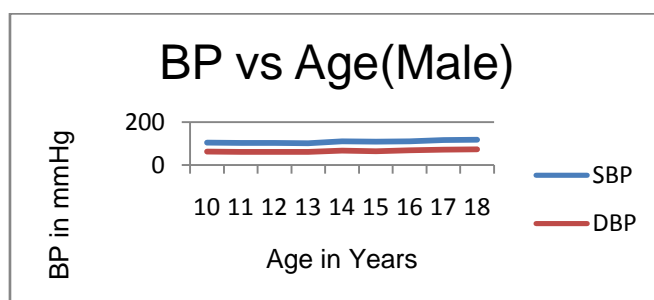
2. Percentile  $P_n = \left\{ \left( x \frac{n}{100} - f_o \right) / f_m \right\} + b$

3. p value is obtained by performing t-test at 0.05 level of significance with 34 degree of freedom.

### III. Results

The present study was carried out in 500 students of four schools of Guwahati. The results are shown below:

Graph 1 shows that systolic and diastolic pressure peaked at the age of 14 years and remained static till 15 years and gradually started rising again from the age of 16 years onwards in males



Graph 2 shows gradual rise of systolic and diastolic blood pressure at around 11-12 years and remaining static till around 15 years and then started rising again at around 16 years in females.

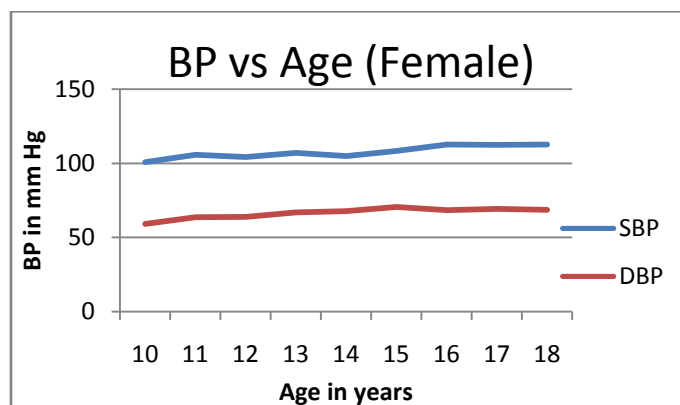


Table1 shows Gradual increase in systolic and diastolic blood pressure was seen with increase in height in boys and girls.

Distribution of BP according to Height						
Height in cm.	BOYS			GIRLS		
	No. of cases	SBP(mean)	DBP(mean)	No. of cases	SBP(mean)	DBP(mean)
125-130	3	104.33	63.0	2	107.0	63.0
130-135	8	99.5	61.25	7	112.57	67.14
135-140	12	106	65.08	19	105.17	61.16
140-145	25	103.32	63.12	26	102.93	62.68
145-150	31	107.26	65.26	51	107.49	66.52
150-155	40	105.1	61.43	64	106.25	66.03
155-160	48	107.65	66.27	46	108.68	68.72
160-165	41	108.61	66.61	23	112.56	69.87
165-170	19	114.16	70.32	9	108.11	68.11
170-175	16	115.31	70.5	-	-	-
175-180	7	117.14	70.28	-	-	-
180-185	3	117.33	73.33	-	-	-

Table 2 shows gradual increase in systolic and diastolic blood pressure was seen in boys as well

as girls according to increase in weight.

<b>Distribution of BP according to Weight</b>						
Weight in Kg	BOYS			GIRLS		
	No. of cases	SBP(mean)	DBP(mean)	No. of cases	SBP(mean)	DBP(mean)
20-30	18	102.67	62.5	12	102.25	60.67
30-40	69	102.41	61.36	88	105.4	64.46
40-50	117	109.15	66.76	118	108.91	67.58
50-60	40	114.75	70	19	104.95	67.79
60-70	9	120.22	76.44	7	110.57	70.71
70-80	-	-	-	1	130	80
80-90	-	-	-	2	130	82

Table 3 shows increase in systolic and diastolic pressure with body mass index in boys.

Age in years	Body weight(mean)	SD	Body Height(mean)	SD	BMI	MSBP	MDBP
10	36.63	7.91	142.08	9.1	18.35	104.14	63.73
11	39.5	8.22	147.73	9.6	17.99	103.51	62.55
12	39.73	7.86	149.08	8.96	17.96	103.42	61.88
13	40.55	7.83	152.22	9.01	17.77	101.77	61.84
14	44.67	7.68	157.87	7.28	17.85	111.08	67.32
15	46.34	8.89	154.73	5.31	18.04	109.5	64.89
16	46.89	6.04	159.27	8.59	18.51	110.33	68.26
17	49.06	4.64	164.89	7.17	18.07	115.48	71.24
18	52.26	7.76	169.78	7.64	18.30	117.61	73.04

Table 4 shows increase in systolic and diastolic blood pressure in girls with increase in body mass index.

Age in years	Body weight(mean)	SD	Body Height(mean)	SD	BMI	MSBP	MDBP
10	34.97	6.39	142.22	8.62	17.34	110.87	59.17
11	38.83	7.21	147.68	5.96	17.9	105.8	63.63
12	40.44	6.04	148.84	5.92	18.27	104.26	63.84
13	42.92	7.08	150.72	7.38	18.87	107.12	66.76
14	44.24	8.26	153.26	5.17	18.98	107.97	67.69
15	46.85	12.45	152.22	6.03	20.09	108.14	70.46
16	47.64	10.43	154.19	6.02	19.67	112.57	68.29
17	45.17	7.94	156.00	8.13	18.73	112.36	69.29
18	43.51	5.06	157.31	13.9	17.84	112.59	68.53

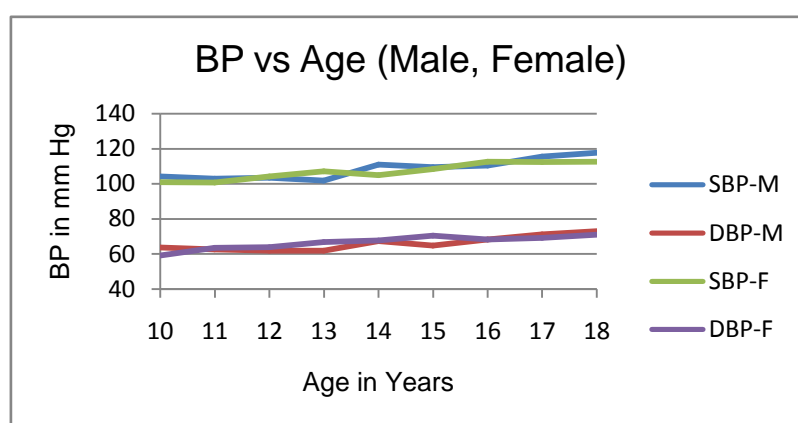
Table 5 - Age wise, percentile values of systolic and diastolic blood pressure for boys.

Age in years	Systolic						Diastolic					
	10	50	75	90	95	99	10	50	75	90	95	99
10	98	102	109	111.8	113.9	118.74	56.2	62	67	71.8	72	86.22
11	94.8	100	104	116.8	123.6	127.44	54	60	62	70.4	84.8	89.44
12	90	102	110	112	121	130	56	62	64	68	74	80
13	92.8	100	103	110	114.4	126.6	58.4	61	63	66	68	83.84
14	91.6	102	110	120	120	123.2	60	68	72	78	80	83.72
15	98.6	105	112.5	130	130	130	60	70	80	80	83.4	84
16	98	110	122	130	130	138	57	70	72	80	80	80
17	99.4	110	120	123.8	129.3	137.3	59.4	69	73	81.2	87.9	90
18	99.2	110	120	130	131.2	135.04	59.6	68	70	80	82	88.4

**Table 6:** Age wise, percentile values of systolic and diastolic blood pressure for girls.

Age in years	Systolic						Diastolic					
	10	50	75	90	95	99	10	50	75	90	95	99
10	90.4	100	104	109.6	110	110	54.4	60	60.5	62	63.8	64
11	99.6	103	108	116.4	124.4	129.42	99.6	103	108	116.4	124.4	129.42
12	94	100	109	120	124	128.8	94	100	109	120	124	128.8
13	96	103	110	125.4	130	130	60	63	75.5	80	80.7	87.36
14	91.6	102	110	120	120	123.7	60	68	72	78	80	83.72
15	98.6	105	112.5	130	130	130	60.9	70	80	80	83.4	84
16	98	110	122	130	130	138	57	70	72	80	80	80
17	99.4	110	120	123.8	129.3	137.3	59.4	69	73	89.2	87.9	90
18	99.2	110	120	130	131.2	135.04	59.6	68	70	80	82	88.4

**Graph 3** shows both systolic and diastolic pressure is high in case of females at around 12 to 13 years and in case of males systolic and diastolic pressure showed an increasing trend from 16 years onwards.



**Incidence Of High Blood Pressure:** In the present study the overall incidence of hypertension in adolescents of 500 students was found to be 18%.

Total no. of subjects	Total no. of male with BP above 90 <sup>th</sup> percentile.	Total no. of females with BP above 90 <sup>th</sup> percentile.
500	46	45

Percentage of subjects with BP above 90 <sup>th</sup> percentile is	Percentage of males with BP above 90 <sup>th</sup> percentile is	Percentage of females with BP above 90 <sup>th</sup> percentile is
18%	9.2%	9.0%

#### IV. Discussion

Jaddou et al<sup>3</sup>, 2002, in Jordan showed that 3.6% of the study population had suspected high blood pressure i.e., more than 90<sup>th</sup> percentile. Present study, 2012, showed an incidence of 18% to be hypertensive i.e., more than 90<sup>th</sup> percentile.. This may be due to small sample size (7260 against 500 samples), ethnic differences in blood pressure value, difference in study design, no population chart was available for the present study.

Verma et al<sup>4</sup>, 1995, showed that among girls, systolic blood pressure showed a steep rise between 11-13 years of age while in boys this increase was seen between 12-13 years. This increase was statistically significant ( $p < 0.001$ ) in both sexes. Jaddou, et al<sup>3</sup> 2001, Differences in diastolic values were significantly higher in girls in the age group of 10, 11 and 12 years, and were significantly higher in boys of 16 year age group. Present study, 2012, showed that systolic and diastolic pressure peaked at the age of 14 years and remained static till 15 years and gradually started rising again from the age of 16 years onwards in males. Both systolic and diastolic blood pressure increased at around 11-12 years and remaining static till around 15 years and then started rising again at around 16 years in females. These findings were comparable with that of other findings.

Verma et al<sup>4</sup>, 1995, showed that systolic and diastolic blood pressure did not show any statistically significant difference between the two sexes. Jaddou, et al<sup>3</sup> 2001, showed that average increases in male and female diastolic blood pressure was almost the same in the earlier age periods, and remained so through the age

periods for females, but this increase was doubled for males at 14 years and older. **Present study, 2012**, showed that boys had systolic and diastolic blood pressure more than the girls. The present study was comparable with other studies. But the rise in females was more in the early age group i.e., around 12 yrs. of age may be due to sexual maturation in females during that period.

Jaddou, et al<sup>3</sup>,2001, showed positive association of Systolic and Diastolic blood pressure with body weight. Mogra et al<sup>5</sup>, 2012, showed that subjects with normal body weight had normal systolic (100-110mm Hg) and diastolic (60-70 mmHg) blood pressure while obese and overweight children were having higher blood pressure ranging from 60-90mmHg (diastolic) and 100-160mmHg (systolic) respectively. Present study showed that both systolic and diastolic blood pressure increased with weight. The findings were comparable with the findings of other studies.

Jaddou, et al<sup>3</sup>,2001, showed that both Systolic and Diastolic blood pressure had direct relationship with height. Shaikh Wasim A et al<sup>6</sup>,2010 showed that both systolic and diastolic had direct relationship with height. Ahmed et al<sup>7</sup>, 2015, showed that systolic blood pressure height value correlated strongly with systolic blood pressure percentile both in boys and girls. Similar results were obtained with diastolic blood pressure – height status and diastolic blood pressure percentile. Present study, 2012 showed an increase in systolic blood pressure with increase in height. The increase was noticed to be increasing from 155 centimeters onwards. This was comparable with other findings.

Verma et al<sup>4</sup>,1995, to assess the correlation of obesity and elevated blood pressure, body mass index (BMI) was calculated for all children. Five per cent of the total children were classified as obese. The mean systolic and diastolic blood pressure of the obese children was significantly higher. Mogra, et al<sup>5</sup>, 2012, prevalence of obesity and overweight is one of the leading causes of high blood pressure among children. Present study, 2012, showed increase in both systolic and diastolic blood pressure with an increase in body mass index in both the sexes. This study was comparable with other studies.

Ahmed et al<sup>7</sup>,2015 found that prehypertension was found in 18.3% of boys and 17.81% of girls.

Present study,2012 found that prehypertension was found in 18% of study population of which 9.2% was boys and 9% was girls.

## V. Conclusion

The blood pressure obtained from the present study provides normative blood pressure measurement table for Guwahati adolescents which include percentile for age, sex and height. There were variations noticed in various parameters may be due to small sample size and short time period of study.

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