



A study of Blood Pressure in school going children (5-15 years age group)

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Abstract: *Background:* Recording of blood pressure in children below 3 years of age is not carried out routinely. But measurement of blood pressure should be a routine part of clinical examination of children over 3 years of age. Routine measurement of blood pressure in infants, children and adolescents is needed for identification of affected children before the development of symptoms and will allow taking measure for prevention of complications due to hypertension. *Objective:* To determine the normal distribution of blood pressure in the pediatric population and relation with age, sex, weight, height & socioeconomic status of children. *Methodology:* This is a prospective cross-sectional study done from July 2017 to June 2018 with sample size of 532 school going children including both sexes. Between the age group of 5-15 year were included and grouped into three. Children with renal diseases and family history of hypertension were excluded. *Result:* This study showed that 0.9% of children had both SBP and DBP were above 95th percentile for age. For higher, middle and lower social class the prevalence was 1.7, 0.8 and 0.6 respectively. The prevalence is almost equal in both sexes. *Conclusion:* Measurements of blood pressure over a period of time in children should be done during the course of their continuous care and should not be ignored. Periodic health check-up with intervention is needed where there are established consistent and significant observations.

Keywords: Blood Pressure, School going children, hypertension, school health.

Original Research Article

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Article at a glance:

Study Purpose: Normal distribution of blood pressure in children has not been adequately studied in Bangladesh. Early detection of hypertension and its precipitating or aggravating factors is important to take measures to prevent.

Key findings: Children of Higher socioeconomic status with overweight and higher height have higher blood pressure than Lower socioeconomic status with lower weight and height in both sexes.

Newer findings: Diastolic blood pressure is higher in Higher social class than that of Lower social class in both sexes in 5-10 years age group.

Abbreviations:



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INTRODUCTION

It generally believed that hypertension is a disease of adulthood, and children do not suffer from hypertension. Recording of blood pressure in children below 3 years is not carried out routinely in our practice. But measurement of blood pressure should be routine part of clinical examination of children over 3 years old.¹ It is estimated that 1-3%

of children is hypertensive.² Hypertension is usually defined as the arterial blood pressure above the 90th percentile or age and sex and at least 3 separate examinations over a period of 6-12 months interval. Hypertension in children and adolescents has long been considered to be almost invariably secondary to other disease entities. Furthermore, evidence suggest that primary hypertension has its

origin in early life and those at risk may be identifiable in childhood or adolescence with an aim of preventing the later development of fixed hypertension, allowing time for surveillance and management.¹ so routine measurement of blood pressure in infants, children and adolescents is needed for identification of affected children before the development of symptoms and will allow to take measure for prevention of complications due to hypertension. To determine a case of hypertension it is necessary to know the normal distribution of blood pressure in relation to age, sex, weight, height & socioeconomic status of child. The normal distribution of blood pressure is available in various studies of western developed countries. This may be not applicable for our country. This is why studies should be carried out in our country to determine the normal distribution of blood pressure in our children. This type of study will help us in clinical practice to determine whether our children are hyper or normotensive. Otherwise, dependence on western standard may mislead us in considering childhood hypertension in our clinical settings. We shall try to find out relation of variables like age, sex, weight, height and socioeconomic status with blood pressure. We shall also try to identify asymptomatic hypertensive patients in children.

Objective

To determine the normal distribution of blood pressure in the pediatric population and relation with age, sex, weight, height & socioeconomic status of children.

RESULTS

Number of children in our study was 532 from different schools of Rajshahi city.

Table 1: Age and sex distribution

Age group	USC		MSC		LSC		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
5-8	14	16	24	28	12	10	50	54
9-11	13	21	52	28	31	19	96	68
12-15	33	22	85	41	43	40	164	103
Total	60	59	161	97	86	69	532	

USC= Upper social class, MSC= Middle social class, LSC= Lower social class.

METHODS

This cross-sectional analytical study was done in the department of Physiology in collaboration with department of Biochemistry, Rajshahi medical college, Rajshahi from July 2017 to June 2018. Data were collected from Rajshahi model family planning clinic, Gynae outdoor of Rajshahi medical college hospital. Healthy married women aged 20-45 years in Rajshahi City were study population and among them 184 women were selected according to eligibility criteria. OCP users women were recruited in one group (n=92), while OCP non-users women were enrolled in another group (n=92). After taking informed consent, complete history was collected and physical examination were done and recorded in a preformed data sheet. Then-whole blood (about 5 ml) was collected from anterior cubital vein by venipuncture technique using 21-gauge hypodermic needle and collect in a sterile container. It was allowed to clot and there after centrifuged at 1200x 9 for 5 min at room temperature (290C-310C). Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were estimated using Randox reagent kit using 2, 4-dinitrophenylhydrazine substrate, activity was determined far billiary integrity with Randox reagent kit using nithrophenyl phosphate substate. Data were analyzed by using SPSS software, version 20. The level of significance was set at 5% and p-value < 0.05 was considered statistically significant.

Table 2: Mean systolic and diastolic blood pressure in mm of Hg. with standard deviation (\pm SD) of boys- all social classes

Age group in year	Systolic BP				Diastolic BP			
	Min	Max	Mean	SD	Min	Max	Mean	SD
5-8	80	105	91.7	7.1	50	75	61.5	6.2
9-11	80	135	95.6	6.4	60	85	69.2	6
12-15	90	110	98	5.4	70	80	75.2	3.9

Here there is no significant difference in mean systolic and diastolic blood pressure of boys of all social classes.

Table 3: Mean systolic and diastolic blood pressure in mm of Hg. with standard deviation (\pm SD) of girls- all social classes

Age group in year	Systolic BP				Diastolic BP			
	Min	Max	Mean	SD	Min	Max	Mean	SD
5-8	80	125	92.5	7.9	50	85	62.7	7.3
9-11	85	130	96.3	6	60	85	70.3	6.7
12-15	90	140	97.4	8.6	70	90	74.3	4.6

Here there is no significant difference in mean systolic and diastolic blood pressure of girls of all social classes.

Table 4: Mean systolic and diastolic blood pressure in mm of Hg. in relation to weight in all social classes

Weight in KG	USC				MSC				LSC			
	Boys		Girls		Boys		Girls		Boys		Girls	
	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP
< 20	85	50	90	67.5	92.1	62.9	91.1	61.1	90	61	89.4	58.9
20-29	97.8	64.7	98.8	67.6	96.1	65.6	93.4	63.4	90.8	65.4	93.1	65.4
30-39	94.2	73.3	98.8	75.4	95.5	73.6	95.3	73.7	90	68.6	90.7	69.3
40-49	99.2	78.3	101.3	79	97.8	76	96.2	74.4	94	72.6	94.2	71.7
50-59	109.4	80	120	83.3	104.3	75.3	102.5	73.8	97.5	75	100.7	72.1

Here there is both systolic and diastolic blood pressure were found to rise consistently with increasing body weight.

SBP= Systolic Blood Pressure
DBP= Diastolic Blood Pressure

Table 5: Mean systolic and diastolic blood pressure in mm of Hg. in relation to height in all social class.

Height in CM	USC				MSC				LSC			
	Boys		Girls		Boys		Girls		Boys		Girls	
	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP
< 119	85	55	92.9	65.7	91.7	61.9	90	60	87.9	60	90.8	61.9
120-129	98.8	65.9	101.1	67.5	97.6	67	96.3	66.3	92.6	67.9	92.8	63.9
130-139	94	73	98.3	74.6	95.9	73.3	95.3	73.7	90.2	68.6	90.7	69.3
140-149	99.3	78.3	101	79	97.6	76.1	96.6	74.8	93.6	72.7	94.1	72
150-159	106.1	79.6	110	80.8	102.9	75.8	97.5	73.3	96.4	73.6	98.6	71.4

This table shows blood pressure increases progressively with the increase of height.

SBP= Systolic Blood Pressure
DBP= Diastolic Blood Pressure

Table 6: Comparison of blood pressure in different social classes - Boys

Age group	LSC			MSC			USC			Significance P-value
	No.	Mean BP	SD	No.	Mean BP	SD	No.	Mean BP	SD	
5-8	(S) 12	88.8	7.1	24	90.6	6.3	14	96.1	6.8	0.016
	(D) 12	59.2	5.1	24	61.3	6.1	14	63.9	6.6	0.140
9-11	(S) 31	91	4.5	52	98	6.4	13	97.3	3.9	0.000
	(D) 31	68.2	5.3	52	69.3	6	13	71.2	7.4	0.333
12-15	(S) 43	93.6	3.5	85	98.7	4.8	33	102	5.3	0.000
	(D) 43	72.3	2.7	85	75.3	3.6	33	78.5	3.2	0.000

Systolic blood pressure is significantly higher in all age group of boys in higher social class than other. Diastolic blood pressure is higher in higher social class than that of Lower social class in both sexes in 5-10 years age group only.

P value < 0.05 is considered significant
 S = Systolic
 D = Diastolic
 SD = Standard Deviation

Table 7: Comparison of blood pressure in different social classes - Girls

Age group	LSC			MSC			USC			Significance P-value
	No.	Mean BP	SD	No.	Mean BP	SD	No.	Mean BP	SD	
5-8	(S) 10	89	6.6	28	91.4	8.7	16	96.6	5.4	0.031
	(D) 10	60	4.7	28	61.4	7.8	16	66.6	6.5	0.032
9-11	(S) 19	92.9	4.5	28	95.7	3.8	21	100	7.6	0.000
	(D) 19	66.3	5	28	70.4	6.4	21	73.8	6.9	0.001
12-15	(S) 40	94.6	8.4	41	96.7	3.3	22	103.6	12.4	0.000
	(D) 40	71.5	3.6	41	74.1	2.9	22	79.5	4.3	0.000

Systolic blood pressure is significantly higher in all age group of girls in higher social class than other. Diastolic blood pressure is higher in higher social class than that of Lower social class in both sexes in 5-10 years age group only.

P value < 0.05 is considered significant
 S = Systolic
 D = Diastolic
 SD = Standard Deviation

Table 8: Blood pressure above 95th Percentile for age

Social class	Boys		Girls		Total
	No. of population	High BP	No. of population	High BP	
USC	60 (S)	1 (1.7%)	59 (S)	1 (1.7%)	2 (1.7%)
	60 (D)	1 (1.7%)	59 (D)	1 (1.7%)	2 (1.7%)
MSC	161 (S)	1 (0.6%)	97 (S)	1 (1.0%)	2 (0.8%)
	161 (D)	1 (0.6%)	97 (D)	1 (1.0%)	2 (0.8%)
LSC	86 (S)	0 (0.0%)	69 (S)	1 (1.4%)	1 (0.6%)
	86 (D)	0 (0.0%)	69 (D)	1 (1.4%)	1 (0.6%)
Total	307 (S)	2 (0.6%)	225 (S)	3 (1.3%)	5 (0.9%)
	307 (D)	2 (0.6%)	225 (D)	3 (1.3%)	5 (0.9%)

Here 0.9% of our children have systolic blood pressure above 95th percentile for age.

USC= Upper social class; S= Systolic; D= Diastolic
 MSC= Middle social class
 LSC= Lower social class

DISCUSSION

We have studied the normal distribution of blood pressure among 532 children of randomly selected three schools of Rajshahi city Corporation. Age and sex distribution as well as differentiation of social classes has been shown in Table 1. It is

assumed that children of different social classes will differ in their weight and height due to varying nutritional status. Also, they may differ in their food habits and physical activities. There may be racial differences as well with that of western population. Regarding difference in sex various studies in western countries show that there is no significant difference in diastolic blood pressure in boys and girls. Zinner S.H. *et al*³ showed no significant difference of blood pressure in boys and girls. The study of Task Force in USA also showed the same finding.⁴ In our study also we found no significant difference of blood pressure in boys and girls. But our children have blood pressure (about 5 mm of Hg both) lower than that of western children with comparing Table 2, 3 and USA task force data. This finding is consistent with the finding of Dr. Siraj's¹ study of blood pressure of Bangladeshi children. In our study, it is showed that both systolic and diastolic blood pressure in children increase progressively and consistently with the increase of age. The mean rise of blood pressure per year is on an average of 1.8 mm of Hg for systolic blood pressure and 0.9 mm of Hg for diastolic blood pressure in both sexes (table 2, 3). This is consistent with the finding of Forest H. Adams.⁵ Different studies showing role of age on blood pressure showed variable results. In Bogalosa Heart study⁶ it was observed that blood pressure rises with age. But after adjustment for the effects of height and weight, blood pressure levels appeared to have no relationship to age.

Plasma norepinephrine and renin increase or decrease respectively with age, cardiac output decreases with age in patients with systolic hypertension whereas systolic vascular resistance rises with age. In our observation (Table 4) both systolic and diastolic blood pressure were found to rise consistently with increasing body weight. Various studies have shown that body weight is an important determinant of blood pressure in an individual. Obese children have higher blood pressure than lean children.⁴ Age related increase in blood pressure is usually proportional to the gain in weight and height.⁷ Voors AW *et al* have stated that obese children have high pressure and childhood obesity predisposes to hypertension in adult.⁷ Among various determinants height is one of the most important one affecting blood pressure on an individual. In a study in British population,

showed that body size is a better criterion by which to judge the normality of blood pressure measurements because blood pressure of an individual increase progressively and linearly with the increase of the individual's height.⁷ In our study also shows blood pressure increases progressively with the increase of height (Table 5). Considering blood pressure in children of different socioeconomic classes, various literatures show variable findings regarding this issue. In our study there is significant difference (Table 6, 7). Systolic blood pressure is significantly higher in all age group of both sexes in higher social class than other. On the other hand, diastolic blood pressure is higher in higher social class than that of Lower social class in both sexes in 5-10 years age group. After that age there is no significant difference. Thus, our finding that higher blood pressure in higher socioeconomic status in comparison to lower socioeconomic status is consistent with the findings of Sing's and Gilbert's study^{8,9}. The cause of higher blood pressure in children of higher social class may be due to their increased weight and height, decreased physical activity or different food habit.

The number of children who have blood pressure above 95th percentile for age according to the 2nd Task force study, USA we found that 0.9% of our children have systolic blood pressure above 95th percentile for age. Among these, the finding was, in higher, middle and lower social class 1.7% & 1.7, 0.8 & 0.8 and 0.6 & 0.6 systolic and diastolic blood pressures respectively. The percentage was almost same in both sexes. Islam S,¹ in his study on Bangladeshi children, found that about 3% children are hypertensive. The incidence of childhood hypertension in our study than that the incidence of childhood hypertension is between 1-3%.¹⁰ So the finding of our study is consistent with this statement.

CONCLUSION

Measurements of blood pressure in children should be obtained during the course of their continuous care. Repeated measurements over a period of time, rather than a single, isolated determination, are required to establish consistent and significant observations. So routine blood pressure recording of children is strongly advocated in pediatric practice and it is necessary

to repeat these measurements over time to obtain a trend. Periodic health check up with intervention is needed where there are established consistent and significant observations.

Authors' contributions

AH, BA, EK: Concept and design, data acquisition and interpretation, drafting and final approval. RP, RA, BH: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work. SY: Principal guide.

Declarations

Funding

All the authors did not receive any financial support for the research, authorship and / or Publication.

Conflict of interest

There was declared no conflict of interest of the authors.

Ethical approval

Ethical approval of the study was obtained from the Ethical Review Committee, RMC, Rajshahi. The ethical issues were informed and addressed for future development of management to the participants' parents. Verbal consent had been given by the parents of the affected children. Consent for publication: Had been taken.

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