

## Original Research Article

# A study of blood pressure in rural and urban school children

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### ABSTRACT

**Background:** Hypertension is one of the most common diseases worldwide. Early diagnosis of Hypertension is an important strategy in its control. The purpose of this study was to determine the prevalence of hypertension and risk factors among school going children and to find its relationship with regard to age, sex, height, weight and BMI criteria and comparing the values with available standards.

**Methods:** It is a prospective cross-sectional study done in the age group of 10 to 16 years. Children were selected from urban and rural areas in and around Mysore city. Blood pressure measurements were taken by mercury Sphygmomanometer as per recommendation of American Heart Association. Three readings of blood pressure were recorded for each subject and were correlated with age, gender and anthropometry. All the statistical operations were done through SPSS.

**Results:** The present study was conducted amongst children in the age group of 10-16 years in rural and urban schools. A total of 2000 children were included in the study. BP measurements of 1000 subjects in three urban school children and 1000 school children in one rural school children in Mysuru district were done. In rural school children prevalence of systolic hypertension was 2.8% in males and 0.9% in females. In urban school children prevalence of systolic hypertension was 2.1% in males and 1.2% in females.

**Conclusions:** Blood pressure measurement in children is pivotal in clinical examination. Periodic measurement of blood pressure would identify hypertension at an early age. Further studies are needed to know the exact prevalence of hypertension and long term follow up studies are required to know the effect and risk factors associated in children with sustained hypertension.

**Keywords:** Blood pressure, Diastolic BP, Hypertension, School children, Systolic BP

### INTRODUCTION

Hypertension is of importance mainly as a risk factor for cardiovascular and cerebrovascular diseases and efforts have been made to reduce the blood pressure level than to prevent their development. In the recent years a great number of studies of blood pressure have appeared for the most part these studies have attempted to standardize to the technique of measurement and to establish value of blood pressure measurement for the purpose clinical diagnosis. Comparatively few studies have considered

blood pressure and its relation to the increasing age or adolescent period and aetiology and incidence of hypertension in this age group.

Although it is obviously better to prevent than to cure a disease. It is only recent years that interest has been focused on primary prevention of high blood pressure. High blood pressure in the adult population has been shown to relate to the risk of stroke, renal disease and occlusive atherosclerotic vascular disease. Studies in the childhood have described the tracking characteristic of

childhood blood pressure and their relationship to the changes in body size. Blood pressure responses during exercise and mental stress have been identified as important predictors of subsequent blood pressure levels in the adolescent and young adults.

## METHODS

It is a prospective cross-sectional study done in the age group of 10 to 16 years. Study was cleared by Institution Ethical Committee. The study was done for a period of 12 months. Children were selected from Urban and Rural areas in and around Mysore City. Out of 20 affluent schools in Mysore City and Rural areas, 3 schools were selected based on simple random sampling method. A total of 2000 children were included in the study. BP measurements of 1000 subjects in three urban school children and 1000 school children in one rural school children in Mysuru district were done.

All children were subjected to thorough clinical examination to rule out pathological conditions that are associated with hypertension. Inclusion criteria includes all school children in the age group of 10-16 years and the exclusion criteria includes children with any of chronic systemic disease, unwilling for study and children below 10 years and above 16 years.

Data was collected in a pretested proforma meeting the objective of the study. Informed consent was taken from the parents of all children before measuring blood pressure. Blood pressure was measured in all 10 to 16 years school children between 8 a.m. to 11 a.m. in sitting position after 10 minutes of rest. BP was measured after applying an appropriate sized cuff on the right arm encircling 2/3<sup>rd</sup> circumference of the arm with lower edge 2.5 cm above the cubital fossa (as per WHO guidelines).<sup>1</sup>

Permission was taken from each Head of the Institution before examining school children. The age of the school children was obtained from the school records. The name and other particulars were entered in a pretested proforma. 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 a sliding stadiometer (Johnson and Johnson) with an accuracy of 0.1 mm. Weight was recorded using a spring balance (bathroom scale) calibrated to 0.5 Kg accuracy. Blood pressure was recorded as per American Heart Association Guidelines.<sup>2</sup>

Systolic blood pressure was determined as appearance of 1<sup>st</sup> Korotkoff sounds and diastolic blood pressure was taken at the point of muffling of heart sounds (4<sup>th</sup> Korotkoff sounds). Three measurements were taken at an interval of five minutes each and mean of these readings were taken as average systolic blood pressure and average diastolic blood pressure. Blood pressure values were compared to the values given by the Update of 1987

task force report of the National High Blood Pressure Education Programme Co-ordinating Committee (1994).<sup>2</sup>

Children were classified into three groups as per guidelines of the above committee. If BP >95<sup>th</sup> Percentile, 90-95<sup>th</sup> Percentile, <90<sup>th</sup> Percentile, then it is considered as Hypertension (HTN), Prehypertension (PHTN), Normotensive (N) respectively. Blood pressure was compared to age, sex and height Percentile in each age group. The blood pressure levels were checked by another examiner to rule out intra-observer variations. Only after alleviating the anxiety and explaining the procedure the blood pressure was recorded. In those children whose systolic and or diastolic BP value was found to be more than 95<sup>th</sup> percentile for age, sex and height, two sets of BP reading were taken at an interval of 4 weeks. If systolic and or diastolic BP was found to be persistently more than 95<sup>th</sup> percentile for age, sex, and height then child was classified as having sustained hypertension.

After recording weight and height of the school children BMI was calculated using formula  $BMI = \text{weight (Kg)}/\text{height (m}^2\text{)}$ . If BMI >95<sup>th</sup> percentile, 85-95<sup>th</sup> percentile, <85<sup>th</sup> percentile then it is considered as Obese (OB), Over weight (OW), Normal (N) respectively. Those children who had sustained hypertension were subjected to further investigations with informed parental consent. Investigations were done after taking consent from the parents in a format, after explaining the parents about the need for investigations and treatment aspects. Following investigations were done; lipid profile, blood urea/serum creatinine, urine albumin, urine sugar, urine microscopy and Ultrasonography of abdomen.

The following statistical tests were used: prevalence rate, frequency distribution and Pearson's correlation. The Pearson's correlation co-efficient was estimated to study, the extent of relation between the measurements such as, systolic and diastolic blood pressure with age, weight, height and BMI. In rural school children, systolic BP correlation co-efficient of systolic BP and BMI was 0.415 ( $P < 0.05$ ), which was highly significant. A similar observation is seen with the diastolic BP measurements also. In urban school children, systolic blood pressure correlation co-efficient with BMI was 0.215 ( $P < 0.05$ ) was significant. All the statistical operations were done through SPSS software.

## RESULTS

The present study was conducted amongst children in the age group of 10-16 years in rural and urban schools. A total of 2000 children were included in the study. BP measurements of 1000 subjects in three urban school children and 1000 subjects in one rural school children in Mysore district were taken. Prevalence of systolic prehypertension and hypertension in rural school children in 10-16 years age group varies from 0.4-7.8% and 0.4-6.5% respectively as shown in Table 1.

**Table 1: Prevalence of systolic hypertension in rural school children.**

Age (years)	Normal	PHTN	HTN	Total
10	254 (99.2%)	1 (0.4%)	1 (0.4%)	256
11	179 (100.0%)	0	0	179
12	78 (95.2%)	4 (4.8%)	0	82
13	66 (85.7%)	6 (7.8%)	5 (6.5%)	77
14	183 (93.0%)	5 (2.5%)	9 (4.5%)	197
15	137 (96.5%)	3 (2.1%)	2 (1.4%)	142
16	63 (94.0%)	3 (4.5%)	1 (1.5%)	67
Total	968	22	18	1000

Likewise, prevalence of systolic Prehypertension and hypertension in urban school children in 10-16 years age group varies from 1-1.9% and 0.4- 4.3% respectively as shown in Table 2.

**Table 2: Prevalence of systolic hypertension in urban school children.**

Age (years)	N	PHT	HT	Total
10	235 (99.6%)	0	1 (0.4%)	236
11	212 (98.6%)	0	3 (1.4%)	215
12	197 (93.8%)	4 (1.9%)	9 (4.3%)	210
13	98 (98.0%)	1 (1.0%)	1 (1.0%)	100
14	72 (100.0%)	0	0	72
15	112 (95.7%)	2 (1.7%)	3 (2.6%)	117
16	50 (100.0%)	0	0	50
Total	976	7	17	1000

Prevalence of systolic hypertension in rural and urban school children according to sex is as described in Table 3 and Table 4.

**Table 3: Prevalence of systolic hypertension in rural school children according to sex.**

Sex	Normal	PHTN	HTN	Total
Male	441 (95.5%)	8 (1.7%)	13 (2.8%)	462
Female	519 (96.5%)	14 (2.6%)	5 (0.9%)	538
Total	960	22	18	1000

**Table 4: Prevalence of systolic hypertension in urban school children according to sex.**

Sex	Normal	PHTN	HT	Total
Males	549 (97.2%)	4 (0.7%)	12 (2.1%)	565
Females	427 (98.2%)	3 (0.7%)	5 (1.2%)	435
Total	976	7	17	1000

In rural school children, prevalence of systolic hypertension was 2.8% in males and 0.9% in females. In urban school children, prevalence of systolic hypertension was 2.1% in males and 1.2% in females.

Distribution of prevalence of diastolic hypertension in rural and urban school children is as described in Table 5 and Table 6.

**Table 5: Prevalence of diastolic hypertension in rural school children.**

Age (years)	Normal	PHTN	HTN	Total
10	253 (98.4%)	2 (8%)	1 (0.4%)	256
11	179 (100%)	0	0	179
12	79 (96.4%)	3 (3.6%)	0	82
13	72 (93.5%)	5 (6.5%)	0	77
14	191 (97.0%)	6 (3.0%)	0	197
15	137 (95.4%)	4 (2.8%)	1 (0.7%)	142
16	66 (98.5%)	1 (1.5%)	0	67
Total	977	21	2	1000

**Table 6: Prevalence of diastolic hypertension in urban school children.**

Age (years)	Normal	PHT	HT	Total
10	232 (98.3%)	3 (1.3%)	1 (0.4%)	236
11	206 (95.8%)	8 (3.7%)	1 (0.5%)	215
12	200 (95.2%)	5 (2.4%)	5 (2.4%)	210
13	97 (96.0%)	2 (2.0%)	1 (1.0%)	100
14	72 (100.0%)	0	0	72
15	111 (94.9%)	4 (3.4%)	2 (1.7%)	117
16	50 (100.0%)	0	0	50
Total	267	22	11	1000

Prevalence of diastolic prehypertension and hypertension in rural school children in 10-16 years age group varies from 0.8-6.5% and 1.3-3.7% respectively as shown in Table 5. Likewise, prevalence of diastolic prehypertension and hypertension in urban school children in 10-16 years age group varies from 1.3-3.7% and 0.4-2.4% respectively as shown in Table 6. Diastolic prehypertension was predominantly seen in the 13 years age group (6.5%).

**Table 7: Distribution of rural school children according diastolic blood pressure and sex.**

Sex	Normal	PHTN	HTN	Total
Male	451 (97.6%)	10 (2.2%)	1 (0.2%)	462
Female	522 (97.1%)	11 (2.0%)	5 (0.9%)	538
Total	973	21	6	1000

**Table 8: Distribution of urban school children according diastolic blood pressure and sex.**

Sex	Normal	PHT	HT	Total
Males	549 (96.8%)	15 (2.7%)	3 (.5%)	567
Females	422 (97.4%)	7 (1.6%)	4 (0.9%)	433
Total	971	22	7	1000

Distribution of rural and urban school children according diastolic blood pressure and sex is as described in Table 7 and Table 8. In rural school children, prevalence of

Diastolic hypertension was 0.2% in males and 0.9% in females. In urban school children, prevalence of Diastolic hypertension was 0.5% in males and 0.9% in females.

**Table 9: Risk factors observed in children with sustained hypertension.**

Age (years)	OW	OB	FH of HTN	Lipid profile (TG >95 <sup>th</sup> percentile)	USG abdomen	Total
10	-	1	-	1	N	2
12	2	1	-	3	1 (Bilateral Hydronephrosis)	4
13	3	2	2	4	N	9
15		1	-	-	N	1

Risk factors observed in children with sustained hypertension is as described in Table 9. One child in the age group of 10 years who was obese had serum triglyceride level >95<sup>th</sup> Percentile with normal ultrasonography abdomen. Another child in the age group of 12 years had bilateral hydronephrosis on

ultrasonography abdomen. Two other children in the same group had serum triglyceride level >95<sup>th</sup> Percentile but with normal ultrasonography abdomen. Three children had serum triglyceride level >95<sup>th</sup> Percentile but with normal ultrasonography abdomen but with family history of hypertension.

**Table 10: Pearson correlation matrix of age, weight, height, BMI, systolic and diastolic blood pressure for rural school children.**

		Age	Weight	Height	BMI	Sys BP	Dia BP
Age	Pearson correlation	1.000	0.595	0.670	0.323	0.298	0.230
	Sig.	-	0.000	0.000	0.000	0.000	0.000
Weight	Pearson correlation	0.595	1.000	0.798	0.808	0.552	0.464
	Sig.	0.000	-	0.000	0.000	0.000	0.000
Height	Pearson correlation	0.670	0.798	1.000	0.320	0.492	0.412
	Sig.	0.000	0.000	-	0.000	0.000	0.000
Bmi	Pearson correlation	0.323	0.808	0.320	1.000	0.415	0.351
	Sig.	0.000	0.000	0.000	-	0.000	0.000
Sys BP	Pearson correlation	0.298	0.552	0.492	0.415	1.000	0.677
	Sig.	0.000	0.000	0.000	0.000	-	0.000
Dia bp	Pearson correlation	0.230	0.464	0.412	0.351	0.677	1.000
	Sig.	0.000	0.000	0.000	0.000	0.000	-

**Table 11 : Pearson correlation matrix of age, weight, height, BMI, systolic and diastolic blood pressure for urban school children.**

		Age	Weight	Height	BMI	SBP	DBP
Age	Pearson correlation	1.000	0.613	0.620	0.355	0.194	0.067
	Sig.	-	0.000	0.000	0.000	0.000	0.035
Weight	Pearson correlation	0.613	1.000	0.759	0.782	0.421	0.289
	Sig.	0.000	-	0.000	0.000	0.000	0.000
Height	Pearson correlation	0.620	0.759	1.000	0.206	0.428	0.318
	Sig.	0.000	0.000	0.000	0.000	0.000	0.000
BMI	Pearson correlation	0.355	0.782	0.206	1.000	0.215	0.117
	Sig.	0.000	0.000	0.000	-	0.000	0.000
Sys BP	Pearson correlation	0.194	0.421	0.428	0.215	1.000	0.490
	Sig.	0.000	0.000	0.000	0.000	-	0.000
Dia bp	Pearson correlation	0.067	0.289	0.318	0.117	0.490	1.000
	Sig.	0.035	0.000	0.000	0.000	0.000	-

The Pearson's correlation matrix of age, weight, height, BMI, systolic and diastolic blood pressure for Rural and Urban School Children is as described In Table 10 and Table 11. Pearson's correlation co-efficient of systolic BP and BMI in rural school children was 0.415 (P <0.05) which was highly significant. The Pearson's correlation co-efficient of systolic BP and BMI in Urban school children was 0.215 (P <0.05) which was significant. In our study an association was found between Blood Pressure and BMI in the age group of 10-16 years. Therefore, it is necessary to advise families of overweight and obese children to modify their lifestyle habits with diet, exercise and the reduced salt intake so as to accustom their children to a healthy life for the maintenance of blood pressure.

## DISCUSSION

The present study is a cross sectional study done in three urban schools in Mysore and one rural school at Suttur. Prevalence of hypertension in the present study was 1.7% in urban school children and 1.8% in rural school children. A wide range of prevalence of hypertension has been recorded in different studies ranging from 1.1% to 16.2%.<sup>3,4</sup> A study done by Londe et al showed a prevalence of 2.4% in the age group of 4-15 years.<sup>5</sup> In another study by Buch et al, prevalence of hypertension in males was 6.74% and in females was 6.13%.<sup>6</sup> In a study by Kileoyne et al among children in age group of 14-16 years, the prevalence of systolic hypertension was 1.2% and diastolic hypertension was 2.4%.<sup>7</sup>

This diversity of prevalence of hypertension is mainly due to different criteria adopted for defining hypertension and basic racial subgroups related to geographic factors.<sup>8</sup>

The hypertensive children in the present study were adolescents of 10-16 years age group. The elevation of blood pressure in adolescents has also observed in various other studies although exact reasons for the same are not clear.

Systolic hypertension was predominantly seen in 13 years age group (6.5%) urban school children and 4.5% in 14 years age group in rural school children which was similar to other study such as NHNES-III.<sup>9</sup> A study done by D. Laroia et al., in 1989 showed more prevalence older age group (SD±8.58 at 14 years).<sup>10</sup>

Present study shows that prevalence of systolic BP was higher in males (2.8%) compared to female (0.9%) which was similar to the study done by Kardar P et al, with prevalence of hypertension in males of about 3.8% when compared to a prevalence of 2.9% in females.<sup>11</sup> Present study shows a prevalence of systolic hypertension in obese school children of 27.2% which was similar to other studies. Gupta and Ahmad have also reported the prevalence of sustained hypertension in obese children which was 20 times more when compared to controls.<sup>12</sup> As in adult the relationship between hypertension and

obesity in childhood has been noted though less extensively evaluated.

## CONCLUSION

Hypertension is a major risk factor for cardiovascular and cerebrovascular disease. In the present study prevalence of hypertension was 1.7% in urban school children and 1.8% in rural school children. Obesity is an important risk factor for cardiovascular complications. In the present study prevalence of hypertension was high in obese school children. Further studies are needed to know the exact prevalence of hypertension and long term follow up studies are required to know the effect and risk factors associated in children with sustained hypertension.

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