Prevalence of hypertension and prehypertension in schoolchildren from Central India

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ABSTRACT

Background : **Epidemiological transition with increasing burden of cardiovascular risk factors is evident not only in adults but also in children. The data on the prevalence of prehypertension and hypertension in children show large regional differences in India and such data are not available from Central India. We, therefore, conducted a large cross-sectional study in Indore to determine the distribution of blood pressure (BP) and the prevalence of hypertension and prehypertension among schoolchildren.**

Methods : **A total of 11,312 children (5305 girls, 6007 boys) aged 5–15 years, drawn from 80 government and private schools in equal proportion, were evaluated. Anthropometric measurements were obtained and BPs were measured using The Fourth Report on The Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents as reference standard. BP $\geq 90^{th}$ to $<95^{th}$ percentile for given percentile of height was considered as prehypertension, whereas any BP $\geq 95^{th}$ percentile was defined as hypertension. Multiple linear regression analysis was used to find out the determinants of hypertension in these children.**

Results : **Prehypertension was detected in 6.9% and 6.5% and hypertension was found in 6.8% and 7.0% of boys and girls, respectively. Height and weight were found to be a significant predictor of systolic and diastolic BP among both boys and girls.**

Conclusions : **Our results show a high prevalence of prehypertension and hypertension in Indore schoolchildren with age and height being significant determinants. This highlights the need for routine BP measurements in children by pediatricians when they treat them for intercurrent illnesses or vaccinate them. It should also be mandatory as a part of school health checkup programs to detect childhood hypertension for further counseling and therapy.**

Keywords : Blood pressure, pediatric hypertension, school health checkup

INTRODUCTION

It has been shown that even a slight elevation of blood pressure (BP) in childhood is likely to elevate the risk of hypertension by several folds in adult population.[1-4] Epidemiological transition with increasing burden of cardiovascular risk factors such as obesity and hypertension is already evident not only in adult population but also in pediatric population in developing countries including India.[5-11] The survey data show large variation in the prevalence of prehypertension and hypertension among the children from various part

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of India.[3,5,6] Further, large studies on the prevalence of pediatric hypertension from Central India are lacking.

The present study was conducted as part of the Indian Council of Medical Research (ICMR) Jai Vigyan Mission mode project on "Community Control of Rheumatic Fever/ Rheumatic Heart Disease" (2007–2014). Our primary aim was to know about the distribution of BP in schoolchildren aged 5–15 years and secondarily to find out the prevalence of prehypertension and hypertension among them. The Fourth Report on The Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents was used as reference standard.[12]

METHODS

Study sample

The sample size was calculated using the formula from the WHO STEPwise approach to chronic disease surveillance ($N = Z^2 \times P\,[1\text{-}P]/e^2$),[13] where N = sample size, Z = level of confidence, P = baseline level of the selected indicator, and e = margin of error. P was estimated at 0.50 (recommended by the STEPS survey guidelines when the estimated baseline is unknown), Z = 1.96 (at 95% confidence interval), and e = 0.05; thus, the estimated sample size was $n = 1.96^2 \times 0.5\ (1\text{–}0.5)/0.05^2 = 384$. This basic sample size was adjusted for design effect for age–sex estimates, 5–15 years' age range (1-year intervals), and the required sample size was, therefore, $n = 384 \times 2 \times 11 = 8448$.

We studied a total of 11,312 children (5305 girls, 6007 boys) from 80 schools located in 43 out of total 69 municipal wards of Indore. Schools were selected to represent students attending government schools and private schools in equal proportions. The protocol was approved by the Institutional Ethics and Scientific Committee.

Blood pressure measurement

The mercury BP instrument used in our study was new leak proof and their accuracy was checked with standard mercury manometer (Baumanometer, W. A. BAUM Co., Inc., New York, USA) kept for calibration purposes.

The children were evaluated by a team consisting of two specially trained pediatricians, two research assistants, and a social worker who visited the school at least a week before the examination date. The preexamination visit was intended to familiarize with the teachers and students and to discuss and schedule the plan of examination.

All children were clinically examined in a comfortable position in a noise-free room during morning hours. Weight was measured using a calibrated scale and height using a stadiometer. BP measurement was carried out using mercury sphygmomanometer, following standard guidelines in sitting position. At least 5 min of rest in sitting position was provided before taking BP. Children were asked to sit on appropriate sized chairs, allowing for comfortable sitting with back supported, legs uncrossed and touching the ground, and arm supported during measurements. Observers and children were instructed to keep silence. The right arm was selected for BP measurement for consistency. Appropriate BP cuff was selected covering at least 40% of arm circumference with midline of cuff positioned over the arm following palpation of the brachial artery in the antecubital fossa. BP was measured in each child three times at a minimum interval of at least 5 min in between successive measurements on the same day. The onset of the first Korotkoff sound was taken as systolic BP (SBP) and end of Korotkoff sounds as diastolic BP.[14] In circumstances where Korotkoff sounds were heard till 0 mmHg, the BP measurement was repeated with less pressure on the head of the stethoscope. In the event of persistence of very low fifth Korotkoff sounds, fourth Korotkoff sounds (muffling of the sounds) were recorded as the diastolic BP.[14-16]

Statistical method

First readings of both SBP and diastolic BP were discarded to lessen the effect of anxiety on BP. A mean of the second and third values, for both SBP and diastolic BP, was computed and taken as BP of the child and used for further analysis. Body mass index (BMI) was calculated based on height and weight data for every child in the entire cohort [Table 1]. Data from The Fourth Report on The Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents were considered as reference value for defining prehypertension and hypertension.[12]

BP ≥90th to <95th percentile was considered as prehypertension, and BP ≥95th percentile was considered as systemic hypertension. Further, hypertension was classified as Stage I (≥95th to ≤99th percentile plus 5 mmHg) and Stage II (>99th percentile plus 5 mmHg). We added 5 mm to observed ≥95th and ≥99th-percentile values to define Stage I and Stage II hypertension more clearly since the difference between the 95th and 99th percentiles is only 5–10 mmHg which is not large enough. Further, children were considered to have prehypertension if they were found to have SBP >120 mmHg and/or diastolic BP >80 mmHg, even if this value is <90th percentile of BP for each year of age group.[12]

Multiple linear regression with stepwise forward elimination was used to assess the determinants of SBP and diastolic BP in the reference sample. Separate analyses were performed for sex, SBP, and diastolic BP. The results suggested that age and height were the principle determinants of SBP and height was the principle determinants of diastolic BP in our study sample. To evaluate BP levels at specific height percentiles for 1-year age groups, we first converted height percentiles to the z-score scale.

Table 1: Distribution of anthropometric variables according to age and gender

Age (Years)	Girls				Boys			
	n	Height Mean±SD	Weight Mean±SD	BMI Mean±SD	*n*	Height Mean±SD	Weight Mean±SD	BMI Mean±SD
5	486	106.94±6.48	15.39±3.04	13.46±2.63	364	107.99±5.89	15.06±2.45	12.87±1.39
6	498	111.5±6.5	16.73±3.52	13.4±2.22	599	112.77±6.82	16.91±4.09	13.25±3.15
7	492	116.49±6.76	17.96±3.37	13.31±2.85	706	117.88±7	18.74±3.83	13.38±1.72
8	762	122.47±6.54	20.66±4.86	13.66±2.39	892	122.9±7.15	20.67±4.39	13.57±1.89
9	644	127.33±7.01	22.62±5.17	13.84±2.33	652	128.91±6.93	23.66±5.48	14.1±2.2
10	554	132.36±8.56	25.51±6.96	14.38±2.73	644	132.75±7.6	25.12±6.15	14.13±2.69
11	490	137.16±8.5	27.72±7.42	14.55±2.61	531	136.73±7.67	27.23±6.35	14.44±2.32
12	476	140.95±7.6	30.05±6.88	15.01±2.69	502	140.9±8.15	29.23±7.12	14.6±2.67
13	400	147.03±7.12	34.89±7.05	16.05±2.55	457	147.49±8.5	33.38±7.96	15.18±2.44
14	347	150.05±7.51	38.81±7.72	17.17±2.77	390	153.44±9.49	37.98±9.5	15.96±2.81
15	156	150.49±6.66	40.46±9.01	17.79±3.36	270	158.66±8.11	42.71±9.99	16.84±3.11
Total	5305	128.58±15.29	24.64±9.31	14.41±2.86	6007	130.29±15.84	24.91±9.45	14.18±2.59

SD- standard deviation; BMI - Body mass index

Table 2: Blood pressure levels for boys by age and height percentiles

Age	BP Percentile ↓	Systolic BP (mmHg) ← Percentile of Height →							Diastolic BP (mmHg) ← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
5	50th	95	96	96	96	96	97	97	44	45	45	46	46	47	47
	90th	105	106	106	106	106	107	107	54	54	55	55	56	56	56
	95th	108	108	109	109	109	109	110	56	57	57	58	58	59	59
	99th	114	114	114	114	115	115	115	61	62	62	63	63	64	64
6	50th	94	95	96	96	97	98	98	49	49	50	50	50	51	51
	90th	105	106	106	107	108	108	109	62	62	62	62	63	63	63
	95th	108	109	109	110	111	111	112	65	65	66	66	66	67	67
	99th	114	114	115	116	117	117	118	72	72	72	73	73	73	73
7	50th	95	95	96	98	99	100	101	49	49	50	51	51	52	52
	90th	106	107	108	109	111	112	112	62	62	63	64	64	65	66
	95th	110	110	111	113	114	115	116	66	66	67	67	68	69	69
	99th	116	117	118	119	120	121	122	73	73	74	74	75	76	76
8	50th	95	96	98	99	101	102	103	49	50	51	52	53	54	55
	90th	106	107	109	110	112	113	114	63	63	64	65	67	68	68
	95th	110	110	112	113	115	116	117	66	67	68	69	70	72	72
	99th	116	116	118	119	121	122	123	74	74	75	77	78	79	79
9	50th	98	99	100	101	103	104	105	49	50	51	53	55	57	58
	90th	110	111	112	113	115	116	117	63	64	66	68	70	72	73
	95th	113	114	115	117	118	119	120	68	69	71	72	74	76	77
	99th	120	121	122	123	125	126	127	76	77	78	80	82	84	85
10	50th	98	99	101	103	104	106	107	52	52	53	54	56	57	57
	90th	110	111	113	114	116	118	119	67	67	68	69	71	72	72
	95th	114	115	116	118	120	121	122	71	72	73	74	75	76	76
	99th	120	121	122	124	126	127	128	79	79	81	82	83	84	84
11	50th	99	100	102	103	104	106	107	52	53	54	56	57	58	59
	90th	110	111	112	114	115	116	117	67	68	69	71	72	73	74
	95th	113	114	115	117	118	119	120	72	72	74	75	76	78	78
	99th	119	119	121	122	124	125	126	80	81	82	83	85	86	87
12	50th	101	102	102	103	104	104	105	52	53	54	56	57	59	60
	90th	113	113	114	115	115	116	116	67	68	69	71	72	74	75
	95th	116	117	117	118	119	119	120	71	72	73	75	77	78	79
	99th	123	123	124	124	125	126	126	79	80	81	83	85	86	87
13	50th	101	102	103	104	106	107	107	53	53	55	56	57	59	59
	90th	112	113	114	115	116	118	118	68	68	70	71	72	74	74
	95th	115	116	117	118	120	121	121	72	73	74	75	77	78	79
	99th	121	122	123	124	125	127	127	80	81	82	83	85	86	87
14	50th	107	107	108	108	109	110	110	54	55	57	59	61	63	64
	90th	118	119	119	120	121	122	122	68	69	71	73	75	77	78
	95th	121	122	123	123	124	125	125	72	73	75	77	79	81	82
	99th	128	128	129	130	130	131	131	80	81	83	85	87	89	90
15	50th	106	106	107	107	107	108	108	56	57	59	61	63	65	66
	90th	119	119	119	120	120	120	121	70	71	73	75	77	78	80
	95th	122	122	123	123	124	124	124	73	75	76	78	80	82	83
	99th	129	129	129	130	130	131	131	81	82	83	85	88	89	90

Table 3: Blood pressure levels for girls by age and height percentiles

Age	BP Percentile ↓	Systolic BP (mmHg) ← Percentile of Height →							Diastolic BP (mmHg) ← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
5	50th	93	94	94	95	96	97	97	48	48	49	49	50	51	51
	90th	103	104	104	105	106	107	107	60	60	60	61	62	62	63
	95th	106	106	107	108	109	110	110	63	63	64	64	65	66	66
	99th	111	112	113	113	114	115	115	69	69	70	71	71	72	72
6	50th	93	94	94	95	96	97	97	51	51	51	52	52	53	53
	90th	105	105	106	107	107	108	108	63	63	63	63	64	64	64
	95th	108	108	109	110	111	111	112	66	66	66	67	67	67	68
	99th	114	115	115	116	117	117	118	72	72	73	73	73	74	74
7	50th	94	94	95	96	96	97	98	53	53	54	54	54	54	54
	90th	103	104	105	105	106	107	107	65	65	65	65	65	65	66
	95th	106	107	107	108	109	109	110	68	68	68	68	69	69	69
	99th	111	112	112	113	114	115	115	74	74	74	75	75	75	75
8	50th	95	96	97	99	100	102	102	53	54	54	55	56	56	57
	90th	107	107	109	110	111	113	113	66	67	67	68	69	69	69
	95th	110	110	112	113	115	116	117	70	70	71	72	72	73	73
	99th	116	116	118	119	121	122	123	77	77	78	78	79	80	80
9	50th	97	98	100	101	103	104	105	54	55	56	56	57	58	58
	90th	109	110	111	113	115	116	117	68	69	69	70	71	71	72
	95th	112	113	115	116	118	119	120	72	73	73	74	75	75	76
	99th	119	119	121	122	124	126	126	80	80	81	81	82	83	83
10	50th	98	99	101	103	105	107	108	56	57	58	58	59	60	61
	90th	110	111	113	115	117	119	120	70	70	71	72	73	74	75
	95th	114	115	117	119	121	123	124	74	74	75	76	77	78	79
	99th	121	122	123	125	127	129	130	81	82	83	84	85	86	86
11	50th	98	100	102	104	106	108	110	58	59	60	61	62	63	64
	90th	111	112	114	116	119	121	122	72	73	74	75	76	77	77
	95th	114	115	118	120	122	124	125	76	76	77	78	80	80	81
	99th	121	122	124	126	129	131	132	83	84	85	86	87	88	88
12	50th	100	101	102	104	106	108	109	62	62	62	63	63	63	63
	90th	111	112	114	116	118	120	121	76	76	76	76	77	77	77
	95th	115	116	118	120	121	123	124	80	80	80	80	81	81	81
	99th	121	122	124	126	128	130	131	87	87	88	88	88	88	88
13	50th	105	105	106	107	107	108	108	61	61	61	61	61	61	61
	90th	117	117	118	118	119	120	120	74	75	75	75	75	75	75
	95th	120	120	121	122	122	123	123	78	78	78	79	79	79	79
	99th	126	127	127	128	129	129	130	86	86	86	86	86	86	86
14	50th	109	110	110	110	111	111	111	65	65	65	65	65	65	65
	90th	123	123	123	124	124	125	125	79	79	79	79	79	79	79
	95th	127	127	127	128	128	128	129	83	83	83	83	83	83	83
	99th	134	134	134	135	135	136	136	90	90	91	91	91	91	91
15	50th	107	108	109	110	111	112	112	64	64	65	65	65	65	66
	90th	120	121	122	123	124	125	126	78	78	79	79	79	79	80
	95th	124	125	126	127	128	129	129	82	82	83	83	83	83	83
	99th	131	132	133	134	135	136	136	90	90	90	90	91	91	91

Table 4: Prevalence of Prehypertension and Hypertension in Study Cohort

Age (Years)	Normal (%)		Pre-HTN (%)		HTN Stage I (%)		HTN Stage II (%)		Total	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
5	310 (85.2)	414 (85.2)	24 (6.6)	41 (8.4)	30 (8.2)	31 (6.4)	0 (0)	0 (0)	364	486
6	502 (83.8)	413 (82.9)	51 (8.5)	37 (7.4)	46 (7.7)	43 (8.6)	0 (0)	5 (1)	599	498
7	619 (87.7)	422 (85.8)	17 (2.4)	19 (3.9)	70 (9.9)	45 (9.1)	0 (0)	6 (1.2)	706	492
8	755 (84.6)	631 (82.8)	86 (9.6)	67 (8.8)	50 (5.6)	61 (8)	1 (0.1)	3 (0.4)	892	762
9	593 (91)	564 (87.6)	30 (4.6)	50 (7.8)	29 (4.4)	30 (4.7)	0 (0)	0 (0)	652	644
10	555 (86.2)	511 (92.2)	50 (7.8)	3 (0.5)	37 (5.7)	40 (7.2)	2 (0.3)	0 (0)	644	554
11	441 (83.1)	442 (90.2)	59 (11.1)	41 (8.4)	31 (5.8)	7 (1.4)	0 (0)	0 (0)	531	490
12	444 (88.4)	423 (88.9)	22 (4.4)	38 (8)	36 (7.2)	15 (3.2)	0 (0)	0 (0)	502	476
13	387 (84.7)	352 (88)	33 (7.2)	9 (2.3)	37 (8.1)	39 (9.8)	0 (0)	0 (0)	457	400
14	334 (85.6)	279 (80.4)	38 (9.7)	40 (11.5)	18 (4.6)	28 (8.1)	0 (0)	0 (0)	390	347
15	251 (93)	145 (92.9)	2 (0.7)	0 (0)	16 (5.9)	11 (7.1)	1 (0.4)	0 (0)	270	156
Total	5191 (86.4)	4596 (86.6)	412 (6.9)	345 (6.5)	400 (6.7)	350 (6.6)	4 (0.1)	14 (0.3)	6007	5305

Table 5: Age and Sex Specific Regression Coefficients

BP	Age	Boys			Girls		
		α	β	σ	α	β	σ
SBP	5	96.107	0.427	7.8013	95.289	1.189	7.73706
	6	96.222	1.076	8.4053	95.246	1.136	8.89119
	7	97.711	1.88	9.0975	95.716	1.113	7.51115
	8	99.174	2.362	8.6768	98.905	2.12	8.66965
	9	101.383	2.048	9.3547	101.302	2.411	9.0966
	10	102.635	2.55	9.217	102.755	2.957	9.70966
	11	103.027	2.195	8.2156	104.12	3.417	9.5618
	12	103.16	1.017	9.0397	104.334	2.882	9.2577
	13	104.198	1.956	8.5123	106.669	1.072	9.10832
	14	108.384	1.139	9.1082	110.378	0.575	10.47583
	15	107.084	0.601	9.7719	109.912	1.568	10.27855
DBP	5	45.68	0.759	7.3085	49.453	0.94	9.0881
	6	49.892	0.477	9.7566	51.855	0.545	9.05599
	7	50.515	1.144	10.2566	53.728	0.196	8.94799
	8	51.819	1.738	10.63	54.838	1.015	10.14509
	9	53.339	2.92	11.6285	56.286	1.091	10.75889
	10	54.481	1.691	11.6638	58.493	1.469	10.7973
	11	55.52	2.062	11.877	61.06	1.561	10.5766
	12	55.696	2.494	11.77269	62.54	0.38	10.8303
	13	56.002	1.992	11.74261	61.175	0.16	10.5751
	14	58.894	3.002	11.18293	65.135	0.153	10.95954
	15	61.288	3.003	10.38971	64.847	0.418	10.91172

SBP- Systolic blood pressure; DBP - Diastolic blood pressure

Table 6: Blood pressure prevalence from various parts of India

Ref. No.	Authors	Sample size	D.B.P. Measurement	B.P. Measurement	B.P. definition	Prehypertension			Hypertension (%)			Age group
						Boys	Girls	Total	Boys	Girls	Total	
06	Borah *et al.*	10003	4th korotkoff	Single day	Reference no.12	Not reported			7.3	7.8	7.6	5-14 years
19	Krishna *et al.*	6320	Not defined	Single day	Reference no.12	Not available			Not available			7-18 years
20	Prabhjot *et al.*	1000	Not defined	Single day	Reference no.15	Not reported			8.33	6.52	7.5	6-14 years
21	Buch *et al.*	1249	5th korotkoff	Single day	Reference no.12	Not reported			6.74	6.13	6.48	6-18 years
22	Sharma *et al.*	1085	5th korotkoff	Single day	Reference no.12	12.46	11.46	12.3	4.7	6.8	5.9	11-17 years
23	Chadha *et al.*	10215	5th korotkoff	Single day		Not reported			11.9	11.4		5-14 years

We then regressed BP on height for each 1 year for male and female groups. Separate analyses were performed for SBP and diastolic BP thus:

- $SBP_{(age)} = \alpha_1 + \beta_1$ (z height) + e_1 (Equation 1)
- Diastolic $BP_{(age)} = \alpha_2 + \beta_2$ (z height) + e_2 (Equation 2).

As the third step, we estimated the 95th and 90th percentiles for BP at specific height percentiles for each 1-year sex-pooled group. For instance, the 95th percentile of SBP for a child with height corresponding to the 90th percentile for the age group was estimated thus:

95th percentile of SBP (for age-specific 90th percentile of height) = $\alpha_1 + \beta_1$ (1.28) +1.645 σ

where σ^2 was estimated from the residual mean square from the regression model represented by Equation 1.

The corresponding 90th percentile of SBP for the child would be:

90th percentile of SBP (for age-specific 90th percentile of height) = $\alpha_1 + \beta_1$ (1.28) +1.28 σ.

Similarly, percentile of diastolic BP was calculated using the regression model in Equation (2). All statistical analyses were performed using the SPSS 23 version (IBM Corp, USA) and Microsoft Excel (Microsoft Corp, USA).

RESULTS

Age- and gender-specific distributions of anthropometric variables (weight, height, and BMI) in the study group are shown in Table 1. The age-specific BP distribution for boys and girls based on height percentile is shown in Tables 2 and 3. Cutoff values of height percentiles can be found in supplementary appendix [Supplementary Table 1].

Data from The Fourth Report on The Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents were considered as reference value for defining target BP, prehypertension, and hypertension. Prehypertension was detected in 6.9% and 6.5% of boys and girls, respectively, whereas hypertension was found in 6.8% (Stage I: 6.7%; Stage II: 0.1%) of boys and 7.0% (Stage I: 6.6%; Stage II: 0.3%) of girls [Table 4].

On regression analysis, age and height were the principle determinants of SBP and height was the principle determinants of diastolic BP in our study

sample. Age- and sex-specific regression coefficients are presented in Table 5.

DISCUSSION

Primary hypertension in children was once considered a rarity and has emerged as an important public health problem world over.[17] The prevalence of hypertension in children is high in India compared to developed countries like the USA where the prevalence of elevated BP was found to be 2.7%–3.7% in different population-based surveys.[18] Similarly, the prevalence of childhood hypertension has varied between different populations within India [Table 6].[6,19-23] We have shown the distribution of normal BP in a large cohort of children between ages of 5 and 15 years and the prevalence of prehypertension and hypertension among them from Indore district of Madhya Pradesh situated in Central India. Prehypertension was detected in 6.9% and 6.5% of boys and girls, respectively, whereas hypertension was found in 6.8% of boys and 7.0% of girls. With this prevalence, one out of every ten children would require some intervention to control hypertension, to reduce the risk associated with elevated BPs during childhood.[24,25] Chadha *et al.*, in a sample of 10,215 schoolchildren from New Delhi, reported a much higher prevalence of hypertension (11.9% for boys and 11.4% for girls) which is not duplicated in other studies from Amritsar, Assam, Shimla, Surat, or by us at Indore.[6,20,21-23] Using similar cutoff criteria of hypertension, Borah *et al.* from Assam reported hypertension in 7.6% of schoolchildren with a higher prevalence among girls, similar to our findings.[6] Sharma *et al.* from Shimla reported a 5.9% prevalence of hypertension and 12.3% prevalence of prehypertension in school-going children aged 11–17 years.[22] However, for defining stages of hypertension, they did not add 5 mmHg to the 95th and 99th percentile values as adopted in The Fourth Report on The Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents.

Differences in the prevalence of hypertension among these studies could partly be attributed to selection of different cutoff points for defining hypertension, age difference, differences in the study design, the number of visits made for measurement of BP, and method of averaging BP taken between different visits. For example, we have discarded the first BP readings to lessen the effect of anxiety and taken the average of the second and third BP readings in consideration, whereas Borah *et al.* have used a mean of three measurements of BP.[6]

We classified BP as normal, prehypertension, or hypertension based on a single BP reading on a planned school visit. Multiple studies have shown that repeated measurements on different occasions lead to a reduction in proportion of hypertensive patients.[10,26] However, multiple readings of BP taken on the same day were also considered appropriate in a series of epidemiological surveys.[27]

Children born to hypertensive parents are known to have a higher prevalence of hypertension. Further subclinical endothelial dysfunction has been reported in normotensive children of hypertensive parents.[28] There is a high prevalence of hypertension in India affecting one-fourth of adult population.[29] We have, however, not obtained a family history in our cohort and, therefore, do not know if parental hypertension in these children contributed to a higher prevalence of prehypertension and hypertension found in our study. Our study cohort had equal representation from relatively richer and economically deprived children; thus, any possible effect of socioeconomic status of the parents on BP is unlikely.[30-33] We have not performed detailed anthropometric measurements besides height, weight, and BMI and thus do not have information on the prevalence of central obesity in our study population that could have a bearing on observed BP. We have not evaluated the salt intake and other dietary habits and physical activities in our cohort. This could be considered in design of future studies specifically for the assessment of BP in children.

Despite these limitations, to conclude, there is a high prevalence of prehypertension and hypertension in our cohort. Thus, children should have BP recorded during school health checkups as a routine and further routine BP measurements should invariably be done when children come in medical contact for concurrent illnesses and for vaccination. Those who show elevated BPs should be counseled along with their parents and should be periodically followed by pediatricians and family practitioners for further therapy.

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Conflicts of interest

There are no conflicts of interest.

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SUPPLEMENTARY TABLE

Supplementary Table 1: Height percentile by age and sex

Sex	Age	Height percentiles						
		5	10	25	50	75	90	95
Girls	5	96.35	99	103	107	110	115	118
	6	101	103.9	107	111	116	119.1	121
	7	105	107.3	112	117	121	125	128
	8	112.15	115	118	122	126	131	134
	9	116	119	122	127	132	136	138
	10	120	122	127	132	137	144	148
	11	124	127	131	136.5	142.25	148.9	152
	12	128	130	136	141	146	150	153.15
	13	134.05	138	143	148	152	155	158
	14	138	142	146	150	155	160	162
	15	139.85	142.7	146	150	155	159	163
Boys	5	98	101	104	108	112	115	117
	6	101	104	109	113	118	121	123
	7	105.35	109	113.75	118	122	126.3	129
	8	112	114	118	123	127	132	135
	9	119	121	124	128	133.75	138	141
	10	121	123	127	132	137	142.5	145
	11	125	128	131	136	141	147	151
	12	129	131	135	140	146	151	155
	13	135	137	141	147	153	159	162
	14	140	142	147	153	160	166.9	171
	15	144	149	154	159	164	170	172