RESEARCH PAPER

Blood Pressure Distribution in Indian Children

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Objective: To determine blood pressure distribution in schoolchildren and to derive population specific reference values appropriate for age, gender and height status.

Design: Cross sectional observational study.

Setting: Schools in Ernakulam district, Kerala, India, during 2005-06.

Methods: Stratified random cluster sampling method was used to select the children. Blood pressure and anthropometric data were collected from 20,263 students of 5-16 years age. Three readings of blood pressures of each child were taken by mercury sphygmomanometer and mean was taken for analysis. Blood pressure percentiles in relation to gender, age and height were estimated from a non-overweight population of 18,931 children using polynomial regression models.

Results: Children from study population have higher diastolic pressures for both sexes than international standard across all age groups. For systolic blood pressure, girls showed higher values than the international standard while for boys, the difference appears to be minimal.

Conclusions: Blood pressure distribution in children from our study population demonstrates a different pattern in comparison to existing international reference. Higher blood pressure values in the study population are of considerable public health significance.

Key words: *Adolescents, Blood pressure, India, Obesity, Overweight.*

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Hypertension in children is an emerging public health issue attracting the attention of medical professionals worldwide. Hypertension in children exhibits strong correlations with various factors, among which bodyweight assumes considerable significance(1-4). Excess weight resulting in hypertension in children deserves immediate attention even in large developing economies like India, China and Brazil(2,5,6). Data from diverse populations shows that the tracking of blood pressure from childhood into adulthood is very strong(7). In addition to aggravating cardiovascular morbidity and mortality burden, hypertension contributes significantly to other chronic diseases such as stroke and end-stage organ damage(8,9). Throughout adulthood, blood pressure is strongly and directly related to vascular as well as overall mortality(10).

The existing reference values for blood pressure in children were derived from a multiethnic pediatric population from USA(11). The application of this international reference to other populations that differ in various demographic factors, may not be valid. The aim of this study was to plot blood pressure distribution in schoolchildren and to derive population specific reference values appropriate for age, gender and height status.

Accompanying Editorial: Pages 473-474

METHODS

A contiguous area with a population of approximately 1.37 million was selected from Ernakulam district, in central Kerala, India. Sampling was done by stratified random cluster sampling method. Schools in the area were stratified

into 5 groups according to the strength of children and a representative sample of 46 schools with a cumulative population of 25,228 children was randomly chosen. Blood pressure (BP) and anthropometric data (height and weight) were collected from 20,263 students of 5-16 years age during the period 2005-06. Children with body mass index (BMI) more than or equal to 85th percentile of reference data were considered overweight(12). The reference data used to identify the cut offs were taken from CDC 2000 data set for BMI(13). A total of 18,931 non-overweight children were selected from the total sample and used for deriving blood pressure nomograms. Blood pressure was measured using mercury sphygmomanometer. Standard methodology, as recommended by the Fourth Report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents, was used to measure blood pressure(11). Three readings of blood pressures of each child were taken maintaining an interval of 2 minutes between the readings. Mean of the three readings was reported. Weight and height of each child were recorded using standard methods. The detailed design and methodology is available in our previous publication(2).

Statistical analysis

Polynomial regression models were considered to estimate blood pressure percentiles in relation to sex, age and height. The same model was adopted previously in computing blood pressure percentiles(11). The model used was a fourth degree polynomial model to predict adjusted blood pressure as a function of age and height Z score for both genders separately. The formulae used for expected BP is given in ***Annexure* I**. This expected BP corresponds to mean BP of that particular age and height *Z* score (Zht) of the specified gender. Using this mean BP and the standard deviation derived from our sample, we derived appropriate values for other BP percentiles. The advantage of using polynomial regression model is that although the distribution of height varies greatly with age, the distribution of Zht does not, thus allowing one to estimate blood pressure percentiles as a function of age and height with a relatively simple polynomial model across a wide age range(14).

RESULTS

The descriptive data of the school survey is presented in ***Table* I**. The mean systolic blood pressure was similar in boys and girls up to the age of 8 years after which girls demonstrated higher values compared to boys till the age of 15 years. At the age of 16 years, boys demonstrated slightly higher values than girls. The mean diastolic blood pressure demonstrated a relative increase in girls by 9 years of age, which stayed till the age of 16 years. The relative increase in systolic blood pressure in girls compared to boys peaked during 11 to 13 years of age. In case of diastolic blood pressure, the relative increase peaked during 12 to 15 years of age.

The regression coefficients from polynomial regression model were derived for both genders separately. The intercept (α) for systolic BP was 100.63 in boys and 102.87 in girls. The corresponding values for diastolic BP was 66.25 and 67.35 respectively. The regression, co-efficients for various powers of age (β_1, β_2, β_3 and β_4) in case of systolic blood pressure for boys were 1.36, 0.17, 0.02 and –0.0036, respectively. The corresponding figures for girls were 2.66, 0.07, -0.03 and -0.0009. The values (β_1, β_2, β_3 and β_4) of diastolic blood pressure for boys were 1.21, –0.08, –0.00013 and 0.0019, respectively. The corresponding values for girls were 1.89, –0.06, –0.02 and 0.001, respectively. The regression co-efficients for various powers of height z score (γ_1, γ_2, γ_3 and γ_4) in case of systolic blood pressure for boys were 2.30, 0.02, –0.028 and –0.0098, respectively. The corresponding figures for girls were 1.36, -0.16, 0.015 and 0.016, respectively. The values (γ_1, γ_2, γ_3 and γ_4) of diastolic blood pressure for boys were 1.18, –0.13, 0.017 and 0.012, respectively. The corresponding values for girls were 0.89, –0.11, 0.007 and 0.012, respectively. The standard deviation (σ) for systolic BP was 11.08 in boys and 11.6 in girls, and for diastolic BP was 9.07 in boys and 9.0 in girls.

The height percentiles for both genders from the study population were tabulated separately (***Table* II**). Blood pressure percentile tables were constructed for total sample population after excluding the overweight children (***Tables* III** and

TABLE I CHARACTERISTICS OF THE STUDY SAMPLE

Age (yr)	No.	Height (cm) Mean	Weight (kg) Mean	BMI (kg/m^2) Mean	SBP (mm Hg) Mean	DBP (mm Hg) Mean
Boys						
5	198	111.6 (5.63)	17.8 (3.19)	14.2 (1.53)	95.2 (8.15)	61.0 (8.41)
6	689	116.1 (5.61)	19.5 (3.77)	14.4 (1.85)	96.5 (8.68)	60.9 (8.93)
7	729	122.0 (5.61)	21.9 (4.71)	14.6 (2.20)	97.7 (8.22)	62.9 (8.75)
8	788	127.4 (6.26)	24.5 (5.32)	15.0 (2.26)	99.5 (9.09)	64.3 (8.68)
9	912	132.1 (6.32)	26.8 (5.76)	15.2 (2.32)	100.5 (8.56)	66.0 (8.31)
10	1109	137.1 (6.48)	29.3 (6.50)	15.4 (2.48)	102.1 (8.67)	67.3 (8.08)
11	1126	141.9 (7.24)	32.6 (7.94)	16.1 (2.83)	103.5 (9.60)	68.3 (8.24)
12	1125	146.7 (7.87)	35.9 (9.13)	16.5 (2.96)	105.3 (10.0)	68.6 (8.08)
13	1024	153.7 (8.83)	40.9 (9.71)	17.2 (2.99)	108.0 (11.20)	69.1 (8.67)
14	1088	159.8 (8.36)	45.1 (9.60)	17.5 (2.79)	111.0 (11.29)	71.2 (8.25)
15	687	164.2 (7.71)	49.3 (10.51)	18.2 (3.05)	113.8 (10.92)	72.8 (8.46)
16	279	165.9 (7.5)	52.4 (11.42)	18.9 (3.28)	115.1 (11.44)	73.2 (8.20)
Girls						
5	222	110.0 (5.52)	17.2 (2.89)	14.2 (1.57)	94.1 (9.25)	59.2 (9.20)
6	563	114.8 (5.55)	18.9 (3.36)	14.2 (1.66)	95.9 (8.44)	61.7 (7.97)
7	594	121.6 (5.73)	21.8 (4.61)	14.6 (2.20)	97.9 (8.35)	63.3 (8.32)
8	667	126.2 (6.33)	23.8 (4.99)	14.8 (2.16)	98.8 (9.36)	63.7 (8.51)
9	855	132.3 (6.58)	26.7 (5.69)	15.1 (2.32)	101.5 (9.36)	66.5 (8.38)
10	1178	137.6 (7.08)	29.9 (7.10)	15.7 (2.62)	104.4 (9.87)	68.5 (8.17)
11	1301	142.8 (7.33)	33.7 (8.01)	16.3 (2.77)	107.3 (10.01)	70.0 (7.85)
12	1269	148.6 (6.68)	38.2 (8.07)	17.2 (2.83)	109.8 (10.35)	71.7 (7.62)
13	1388	152.1 (6.24)	41.5 (7.82)	17.9 (2.84)	112.3 (10.57)	72.6 (7.80)
14	1481	154.2 (5.99)	44.0 (8.53)	18.5 (3.08)	113.2 (10.42)	73.3 (7.85)
15	813	155.3 (6.28)	45.8 (8.39)	19.0 (2.88)	114.4 (10.47)	74.2 (7.94)
16	178	155.2 (6.58)	46.6 (8.92)	19.3 3.28	114.7 (10.87)	74.5 (7.10)

Figures in parentheses are standard deviations. BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure.

IV). This was done with the idea that a non-overweight population should be used to construct a reference nomogram for blood pressure because it avoids the influence of excess weight on blood pressure distribution. Application of this data for clinical and epidemiological purposes is explained in ***Appendix* A**. Comparison of blood pressure distribution pattern of both genders show significant differences which persist in both systolic and diastolic blood pressures.

DISCUSSION

Studies in the past have demonstrated that age appropriate blood pressure values tend to be more among boys than girls through out childhood and adolescence(11,15). The results of our study appear to be at variance to this finding. In our study, there is a relative increase in mean systolic and diastolic blood pressures in girls by the age of 9 years (***Table* I**). By the age of 16 years, both genders have similar

TABLE II HEIGHT PERCENTILE VALUES IN CENTIMETERS FOR BOYS AND GIRLS

	Boys							Girls						
Age (yr)	5	10	25	50	75	90	95	5	10	25	50	75	90	95
5	103	105	107	112	116	119	121	101	103	107	110	113	117	120
6	108	109	112	116	120	123	126	106	108	111	115	118	122	124
7	113	115	118	122	126	129	131	112	115	118	121	125	129	131
8	117	120	123	127	132	135	138	115	118	122	126	130	134	137
9	122	124	128	132	136	140	143	122	124	128	132	136	141	144
10	127	129	133	137	141	145	148	122	124	128	132	136	141	144
11	131	133	137	142	147	152	154	131	133	138	143	148	152	155
12	135	137	141	146	152	157	161	137	140	144	149	153	157	159
13	140	142	148	153	160	165	168	142	144	148	152	156	160	163
14	145	149	154	161	166	170	173	144	147	150	154	158	162	164
15	151	155	160	164	169	173	176	145	147	151	156	159	163	165
16	152	157	161	166	171	174	177	143	146	151	155	160	163	166

systolic blood pressure values. By the age of 16 years there appears to be minimal differences in diastolic blood pressure between both genders. Similar data was reported in a study from Jordan(16).

Early signs of a change in gender based blood pressure distribution among adolescents are emerging. Comparison of data sets from US adolescents demonstrated an increasing trend for high blood pressure among adolescent girls in contrast to a decreasing trend for the same in adolescent boys(17). The onset of sexual maturation is associated with increases in systolic and diastolic blood pressures(18,19). The timing of sexual maturity is different for boys and girls with the latter attaining it relatively earlier. This difference could contribute to differences in blood pressure progression during adolescence. The same reason could explain the lack of difference in systolic blood pressure and the comparable values in diastolic blood pressure between the genders by age 16, a time at which majority of the boys too have attained significant sexual maturity.

The blood pressure distribution pattern constructed using data from the present study was compared with an existing international reference(14). There appears to be minimal difference in systolic blood pressure among boys from the two populations. There exists difference among girls in terms of systolic blood pressure with girls from the present study showing higher values consistently for all age groups (***Fig.*1**). The difference in diastolic blood pressure appears to be more than the difference in systolic blood pressure. The same is consistently demonstrated in a higher magnitude in both gender and in all age groups, with children from the present study exhibiting higher values. In addition, the difference in diastolic blood pressure between the populations appears to be more in girls than boys. Higher values for mean systolic as well as diastolic blood pressures in comparison to US data were demonstrated previously for children from Indian, Jordan and Pakistan(16,20-22). All these studies have shown consistently higher diastolic blood pressures in comparison to US children. The differences in systolic blood pressures were less in magnitude compared to that of diastolic pressures. There appears to be a consistent difference in diastolic blood pressures between the present study and the US data(14), pointing towards a population-based difference. This difference appears to start even before the age of 5 years and persists into late adolescence. Similar trends in Pakistani and Jordanian children support this observation(16,22).

The validity of the results of this study can be ascertained by the relatively significant correlation for both systolic and diastolic pressures with height

TABLE III BLOOD PRESSURE (BP) PERCENTILE VALUES FOR NON-OVERWEIGHT BOYS IN RELATION TO AGE AND HEIGHT PERCENTILES

Age (yr)	BP Percentile	Systolic blood pressure (mm Hg) Height percentiles							Diastolic blood pressure (mm Hg) Height percentiles						
		5	10	25	50	75	90	95	5	10	25	50	75	90	95
5	50	90	91	92	93	95	96	97	57	58	58	59	60	61	61
	90	104	105	106	108	109	110	111	69	69	70	71	72	72	73
	95	108	109	110	112	113	115	115	72	73	73	74	75	76	76
	99	116	116	118	119	121	122	123	78	79	80	80	81	82	82
6	50	92	93	94	96	97	99	99	58	59	60	61	61	62	62
	90	106	107	108	110	111	113	114	70	70	71	72	73	74	74
	95	110	111	112	114	116	117	118	73	74	75	75	76	77	77
	99	118	119	120	122	123	124	125	79	80	81	82	82	83	83
7	50	94	94	96	97	99	100	101	60	60	61	62	63	63	64
	90	108	109	110	111	113	114	115	71	72	73	74	74	75	75
	95	112	113	114	116	117	118	119	75	75	76	77	78	78	79
	99	119	120	122	123	125	126	127	81	81	82	83	84	84	85
8	50	95	95	97	98	100	101	102	61	62	63	64	64	65	65
	90	109	110	111	113	114	115	116	73	73	74	75	76	76	77
	95	113	114	115	117	118	120	120	76	77	78	78	79	80	80
	99	121	121	123	124	126	127	128	82	83	84	85	85	86	86
9	50	96	97	98	99	101	102	103	63	63	64	65	66	66	67
	90	110	111	112	114	115	116	117	74	75	76	77	77	78	78
	95	114	115	116	118	119	121	121	78	78	79	80	81	81	82
	99	122	122	124	125	127	128	129	84	84	85	86	87	87	88
10	50	97	98	99	101	102	104	104	64	65	65	66	67	68	68
	90	111	112	113	115	116	118	118	76	76	77	78	79	79	80
	95	115	116	117	119	120	122	123	79	79	80	81	82	83	83
	99	123	124	125	126	128	129	130	85	86	87	87	88	89	89
11	50	98	99	101	102	104	105	106	65	66	67	67	68	69	69
	90	113	113	115	116	118	119	120	77	77	78	79	80	80	81
	95	117	118	119	120	122	123	124	80	81	81	82	83	84	84
	99	124	125	126	128	130	131	132	86	87	88	89	89	90	90
12	50	100	101	103	104	106	107	108	66	67	68	68	69	70	70
	90	115	115	117	118	120	121	122	78	78	79	80	81	81	82
	95	119	120	121	122	124	125	126	81	82	82	83	84	85	85
	99	126	127	128	130	131	133	134	87	88	89	89	90	91	91
13	50	103	104	105	106	108	109	110	67	68	68	69	70	71	71
	90	117	118	119	121	122	124	124	79	79	80	81	82	82	83
	95	121	122	123	125	126	128	128	82	83	83	84	85	86	86
	99	129	129	131	132	134	135	136	88	89	90	90	91	92	92
14	50	105	106	108	109	111	112	113	68	69	69	70	71	72	72
	90	120	120	122	123	125	126	127	80	80	81	82	83	83	84
	95	124	124	126	127	129	130	131	83	83	84	85	86	87	87
	99	131	132	133	135	136	138	139	89	90	91	91	92	93	93
15	50	108	109	110	112	113	115	115	69	70	71	71	72	73	73
	90	122	123	124	126	127	129	130	81	81	82	83	84	84	85
	95	126	127	129	130	132	133	134	84	85	86	86	87	88	88
	99	134	135	136	138	139	140	141	90	91	92	93	93	94	94
16	50	111	111	113	114	116	117	118	71	71	72	73	74	74	75
	90	125	126	127	128	130	131	132	82	83	84	85	85	86	86
	95	129	130	131	133	134	135	136	86	86	87	88	89	89	90
	99	136	137	139	140	142	143	144	92	92	93	94	95	96	96

Data constructed from the sample of non-overweight boys (N=9039).

TABLE IV BLOOD PRESSURE (BP) PERCENTILE VALUES FOR NON-OVERWEIGHT GIRLS IN RELATION TO AGE AND HEIGHT PERCENTILES

Age (yr)	BP Percentile	Systolic blood pressure (mm Hg) Height percentiles							Diastolic blood pressure (mm Hg) Height percentiles						
		5	10	25	50	75	90	95	5	10	25	50	75	90	95
5	50	92	92	93	94	95	96	96	58	58	59	60	60	61	61
	90	107	107	108	109	110	111	111	69	70	70	71	72	72	72
	95	111	111	112	113	114	115	115	73	73	74	74	75	75	76
	99	119	119	120	121	122	123	123	79	79	80	81	81	82	82
6	50	92	93	94	95	96	97	97	59	59	60	60	61	61	62
	90	107	108	109	110	111	111	112	70	71	71	72	72	73	73
	95	111	112	113	114	115	116	116	73	74	75	75	76	76	76
	99	119	120	121	122	123	124	124	80	80	81	81	82	82	83
7	50	94	94	95	96	97	98	98	60	60	61	62	62	63	63
	90	108	109	110	111	112	113	113	72	72	73	73	74	74	75
	95	113	113	114	115	116	117	117	75	75	76	77	77	78	78
	99	121	121	122	123	124	125	125	81	81	82	83	83	84	84
8	50	95	96	97	98	99	100	100	62	62	63	63	64	64	65
	90	110	111	112	113	114	114	115	73	74	74	75	76	76	76
	95	115	115	116	117	118	119	119	77	77	78	78	79	79	80
	99	122	123	124	125	126	127	127	83	83	84	84	85	85	86
9	50	98	98	99	100	101	102	102	64	64	65	65	66	66	67
	90	113	113	114	115	116	117	117	75	76	76	77	77	78	78
	95	117	117	118	119	120	121	121	79	79	80	80	81	81	82
	99	125	125	126	127	128	129	129	85	85	86	86	87	87	88
10	50	100	101	102	103	104	104	105	66	66	67	67	68	68	69
	90	115	116	117	118	119	119	120	77	78	78	79	79	80	80
	95	119	120	121	122	123	124	124	80	81	82	82	83	83	83
	99	127	128	129	130	131	131	132	87	87	88	88	89	89	90
11	50	103	104	105	106	106	107	108	67	68	69	69	70	70	70
	90	118	118	119	120	121	122	122	79	79	80	81	81	82	82
	95	122	123	124	125	126	126	127	82	83	83	84	85	85	85
	99	130	131	132	133	133	134	135	88	89	89	90	91	91	91
12	50	106	106	107	108	109	110	110	69	69	70	71	71	72	72
	90	120	121	122	123	124	125	125	81	81	82	82	83	83	84
	95	125	125	126	127	128	129	129	84	84	85	86	86	87	87
	99	133	133	134	135	136	137	137	90	90	91	92	92	93	93
13	50	108	109	110	111	112	112	113	70	71	71	72	73	73	73
	90	123	124	125	126	126	127	128	82	82	83	84	84	85	85
	95	127	128	129	130	131	131	132	85	86	86	87	87	88	88
	99	135	136	137	138	139	139	140	91	92	92	93	94	94	94
14	50	110	111	112	113	114	114	115	71	72	72	73	74	74	74
	90	125	126	127	128	128	129	130	83	83	84	85	85	86	86
	95	129	130	131	132	133	133	134	86	87	87	88	88	89	89
	99	137	138	139	140	141	141	142	92	93	93	94	95	95	95
15	50	111	112	113	114	115	115	116	72	72	73	74	74	75	75
	90	126	127	128	129	130	130	131	84	84	85	85	86	86	87
	95	130	131	132	133	134	135	135	87	87	88	89	89	90	90
	99	138	139	140	141	142	143	143	93	93	94	95	95	96	96
16	50	112	112	113	114	115	116	116	72	73	74	74	75	75	75
	90	126	127	128	129	130	131	131	84	84	85	86	86	87	87
	95	131	131	132	133	134	135	135	87	88	88	89	90	90	90
	99	139	139	140	141	142	143	143	93	94	95	95	96	96	96

Data constructed from the sample of non-overweight girls (N=9892).

WHAT IS ALREADY KNOWN?

- Blood pressure in children shows positive associations with age and height.

WHAT THIS STUDY ADDS?

- Blood pressure distribution in Indian children exhibits significant differences in comparison to existing US reference values.

and weight as demonstrated by our previous publication from the same database(2). Anxiety among children subjected to blood pressure measurements in a field setting might have influenced the recordings to certain extent. This limitation was unavoidable considering the design of the study. The study results deserve attention due to the anticipated public health implications they predict. Any demonstrable increase in a known cardiovascular risk factor like blood pressure in large populations could seriously result in amplification of morbidity burden resulting from cardiovascular diseases. The morbidity and mortality pattern from cardiovascular diseases in the coming decades when the current pediatric population reaches adulthood appears to be one of grave concern.

Blood pressure distribution in children from this study exhibits a different pattern in comparison to existing international reference. Higher blood pressure values for our population in comparison to international reference values could contribute to heightened disease burden resulting from hypertension in future. This study underscores the need for a population specific reference for pediatric blood pressure. The public health implications of higher blood pressure values in Indian children starting from a relatively young age could be potentially serious. Further studies from other parts of India are needed to determine the influence of diverse socioeconomic, cultural and nutritional factors on blood pressure in children.

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Contributors: MR conceived, designed and drafted the study. RKK supervised and revised the manuscript for important intellectual content. MP managed the data and

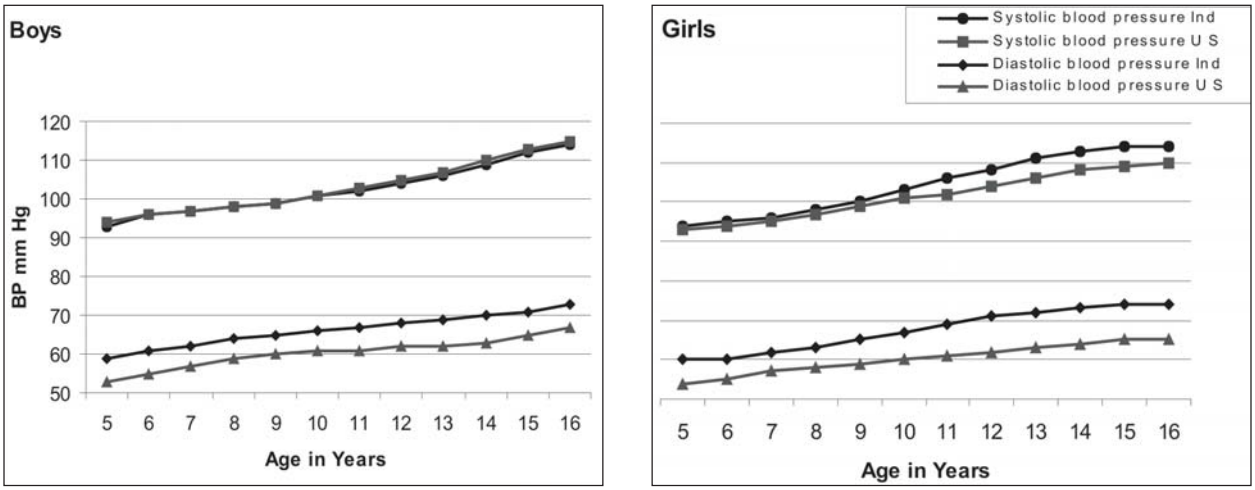

FIG. 1 *Comparison of blood pressure between the present sample and US children. Comparison made for 50th percentile of blood pressure of non-overweight children at 50th percentile of height. Values derived from polynomial regression model. *Data with permission from ref 14.*

assisted in drafting of the manuscript and in statistical analysis. KRS did the statistical analysis and assisted in drafting the manuscript. MR will act as guarantor of the study.

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APPENDIX A

Identifying BP percentiles for clinical use

For example, a 14-year old boy with height 166 cms has SBP of 126 mm Hg.

First step is to refer to the height percentile table (***Table* II**) and see which percentile of height the boy has. In this case, the boy has 75th percentile of height.

Then, refer the values in BP percentile table corresponding to the case's sex, age and height percentile. In this case, the 50th, 90th, 95th and 99th percentiles of SBP for this 14-year-old boy whose height is in the 75th percentile are 111, 125, 129 and 136 respectively. The observed SBP value of 126 mm Hg lies above 90th percentile, but below 95th percentile. Hence this child will be classified as having systolic pre-hypertension.

Actual BP percentiles assume clinical significance in diagnosis, classification and treatment targets of hypertension in children. Systolic or diastolic BP ≥95th percentile for gender, age and height for 3 or more occasions is defined as hypertension in children. Pre-hypertension is defined as systolic BP or diastolic BP that are ≥90th percentile but <95th percentile. Stage 1 hypertension refers to BP from 95th percentile to the 99th percentile plus 5 mm Hg. Stage 2 hypertension refers to values above stage 1 hypertension. The 50th percentile of BP is the target attempted when hypertensive children are subjected to anti hypertensive drug therapy.

Calculating exact BP percentiles using polynomial regression equation

$$\text{Expected BP } \mu=\alpha+\sum_{j=1}^{4}\beta_j\,(y\text{-}10)^j+\sum_{k=1}^{4}\gamma_k\,(Zht)^k$$

where *y*- age in years, ht- height in cms, α, $\beta_1 \ldots \beta_4$ and $\gamma_1 \ldots \gamma_4$ are regression co-efficients.

For example, a 14-year old boy with height 166 cms has a height equivalent to 75th percentile. The Z score for 75th percentile = 0.6745. The parameter Age-10 = 4 in this case.

His expected SBP (μ) is,

$\mu = 100.63 + 1.36(4) + 0.17(4^2) + 0.02(4^3) - 0.0036(4^4) + 2.30(0.6745) + 0.024(0.6745^2) - 0.028(0.6745^3) - 0.0098(0.6745^4) = 110.70$ mmHg.

Suppose his actual SBP is 126 mmHg (x); his SBP Z score then equals

$(x- \mu)/\sigma = (126\text{-}110.70)/11.08 = 1.3809$.

The corresponding SBP percentile = φ (1.3809) × 100% = 91.6 percentile.