SHORT COMMUNICATION

Blood Pressure Values in Healthy Malaysian Children Aged 6 - 12 Years

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Summary

Blood pressure examination was done manually in 1756 healthy school children aged 6 - 12 years. Korotkoff 1 represented the systolic blood pressure (SBP) and Korotkoff 5 was taken as the diastolic blood pressure (DBP). Blood pressure percentile charts were then drawn up based on age group and sex regardless of ethnicity. There was a significant correlation between both SBP and DBP to increasing height, weight and body mass index.

Key Words: Blood pressure, Percentile, Correlation

Introduction

Routine blood pressure (BP) measurement of normal healthy children is not carried out in Malaysia although child health clinics and school health services that screen for common childhood disorders are a standard health provision. Standard reference values for BP in children from developed nations are readily available but its use in our population may not be appropriate due to differences in genetic, environment and socio-demographic parameters. We therefore set out to determine the BP values of healthy school going children aged 6 - 12 years who reside in the Klang Valley.

The study design was a cross sectional survey of healthy school children aged 6 - 12 years attending a national type school. Children with previous renal, cardiac or endocrine problems and those who had physical education lessons on the day of sampling were excluded. The body mass index (BMI) was calculated for each subject with the formula weight/height^2. The right arm was used for the manual measurement of BP with a standard clinical sphygmomanometer (mercury column). The size of the sphygmomanometer should cover at least 80% of the upper arm i.e. lower acromian to olecranon process and the length of the inflatable bladder should encircle the limb completely. BP measurement was taken with the subject sitting with the right arm supported, horizontal and at the heart level. Every effort was made to reduce the influence of fear, crying, laughing and recent activity on the BP. The systolic blood pressure (SBP) was initially estimated by palpation. The cuff was inflated until the right radial pulse was no longer palpable. The cuff was then inflated to a further 30 mmHg and then slowly deflated until the pulse was again palpable indicating the estimated SBP. The cuff was then re-inflated to 30 mmHg above the estimated SBP and the stethoscope was placed over the brachial artery pulse, proximal and medial to the cubital fossa and below the bottom edge of the cuff (i.e. about 2cm above the cubital fossa). The bladder was then deflated at a rate of 2 - 3mmHg per pulse beat. Auscultatory sounds of Korotkoff 1 phase (pressure at which the pulse beat first appears) was taken as the SBP

Table I
Systolic and diastolic blood pressure values for boys aged 6 - 12 years (n=895)

Age group (years)	N	Systolic blood pressure Percentile							Diastolic blood pressure Percentile						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
6 - 7	130	80	82	88	95	101	108	110	40	45	50	58	64	70	72
7 - 8	136	88	90	96	104	110	118	120	43	48	55	60	66	70	76
8 - 9	140	90	92	98	105	113	120	123	44	49	55	61	69	75	80
9 - 10	130	90	94	100	106	114	120	124	46	50	55	62	70	75	81
10 - 11	175	91	94	101	110	118	125	130	48	51	59	67	71	80	84
11 - 12	184	96	99	106	110	120	126	130	51	57	61	68	75	80	84

Table II
Systolic and diastolic blood pressure values for girls aged 6 - 12 years (n=861)

Age group (years)	N	Systolic blood pressure Percentile							Diastolic blood pressure Percentile						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
6 - 7	140	78	80	83	93	103	108	110	39	42	50	59	65	71	75
7 - 8	116	80	85	94	100	106	113	118	45	49	54	60	67	71	76
8 - 9	164	83	90	96	104	111	119	123	46	50	55	61	70	75	79
9 - 10	141	89	91	97	105	114	123	126	47	50	56	62	70	76	80
10 - 11	147	89	93	101	110	116	124	127	49	52	57	65	75	80	84
11 - 12	153	94	99	105	111	120	124	129	50	54	62	70	79	82	85

and Korotkoff 5 phase (pressure at which the pulse beat disappears) was taken to represent the diastolic blood pressure (DBP). When the mercury level was between 2 markings, the lower value was taken. A second measurement was taken after at least 30 seconds from the first with the cuff totally deflated. The average of the 2 readings was calculated and used for analysis. The subjects were then divided into age groups of 6-7 years, 7-8 years, 9-10 years, 10-11 years and 11-12 years for analysis. Data collected was analyzed using a statistical programme SPSS version 7.5 on Windows 98 operating system. The BP distribution was determined empirically on the percentile distribution at the 5th, 10th, 25th, 50th, 75th, 90th and 95th for each age group and sex regardless of ethnicity. Correlation with height, weight and BMI was studied using the Spearman correlation test on ranks of data for two random variables and expressed as the correlation coefficient r with its 95% confidence interval (CI). A p-value of less than 0.05 was considered significant.

BP values were obtained for 1756 children of whom 895 were boys and 861 were girls. Table I and II show the percentile values for SBP and DBP of the study population with regards to age group and sex regardless of ethnicity. There was significant correlation of the height, weight and BMI to both SBP and DBP (Table III).

BP measurement is an essential part of the physical examination but is not usually done in children unless a renal, cardiovascular or endocrine disorder is suspected. Although clinical hypertension occurs less frequently in children than adults, the need to routinely measure BP

in childhood is gaining importance, as essential hypertension in adults appears to be established in childhood[1,2]. Intervention programmes in children found to have an elevated BP offer a promising avenue of prevention against the development of adult essential hypertension and its complications like ischaemic heart disease and cerebro-vascular accident. Nonetheless, BP measurement in Malaysian children is compounded by the lack of standard normal reference values that are important for its subsequent interpretation. To our knowledge this cross sectional survey is the first to measure and chart BP percentile values in healthy Malaysian children.

There are various methods of determining BP in children, with the use of automated devices more popular in recent years. As the standard clinical sphygmomanometer is more readily available in Malaysian health facilities than automated devices, we chose the manual auscultatory BP measurement method for the study population. The sphygmomanometer is also a cheaper, mobile and durable device. In addition, the reliability of automated devices is less clear because of the need for standardized calibration and the current lack of established reference standards.

SBP is determined by the onset of Korotkoff phase I but the phase of Korotkoff sounds that defines DBP is rather controversial[3]. We chose Korotkoff phase 5 as the determinant for DBP in accordance with the American Heart Association definition. With the body of data available, it is now established that the definition of the DBP should be based on the Korotkoff 5 phase, that more importantly enables a uniform designation of diastolic BO for all age groups[4].

Hypertension is defined as an average SBP or DBP greater than or equal to the 95th percentile for age and sex. However, the BP can vary widely throughout the day in children due to normal physical and emotional fluctuations. An elevated BP found therefore warrants further follow-up and repeated BP measurements before a diagnosis of hypertension can be made[5]. The availability of BP percentile values for normal healthy Malaysian children provide the necessary information to enable identification of these children who are presumably at risk of hypertension and require further assessment.

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Table III
Correlation between systolic and diastolic blood pressure with height, weight and body mass index [BMI] (N=1756)

	Systolic blood pressure		Diastolic blood pressure		p value
	r	95% CI	r	95% CI	
Height	0.53	0.49 - 0.56	0.43	0.39 - 0.47	<0.001
Weight	0.61	0.58 - 0.63	0.49	0.45 - 0.52	<0.001
BMI	0.52	0.49 - 0.55	0.42	0.38 - 0.46	<0.001

References

1. Lauer RM, Clarke WR. Childhood risk factors for high adult blood pressure: the Muscatine study. Pediatrics 1984; 633-41.
2. Voors AW, Webber LS, Berenson GS. Time course studies of blood pressure in children - the Bogalusa Heart study. Am J Epidemiol 1979; 109: 320-34.
3. Biro FM, Daniels SR, Similo SL, Barton BA, Payne GH, Morrison JA. Differential classification of blood pressure by fourth and fifth Korotkoff phases in school-aged girls - the National Heart, Lung and Blood Institute Growth Health Study. Am J Hypertens 1996; 9: 242-7.
4. National Heart, Lung and Blood Institute. Update on the 1987 Task Force Report on High Blood Pressure in Children and Adolescents: a working group report from the national high blood pressure education program. Pediatrics 1996; 98: 649-58.
5. Sinaiko AR, Gomez-Marin O, Prineas RJ. Prevalence of significant hypertension in junior high school-aged children: The Children and Adolescent Blood Pressure Program. J Pediatr 1989; 114: 664 - 9