

## Blood Pressure Values in School Age Children in Medan

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**ABSTRACT** A cross sectional study on blood pressure in school children aged 6 to 16 years was carried out in the city of Medan from November 1 through January 31, 1993. By using stratified random sampling, 660 school children (336 boys and 324 girls) were enrolled. Blood pressure was measured using standard sphygmomanometer as recommended by The Second International Symposium on Hypertension in Children (1985). Relationships between the mean values of systolic and diastolic pressures with age and sex were sought for. There was a tendency that both systolic and diastolic blood pressures increased with increasing age. Based on percentile's graphic for age and sex, blood pressure higher than 95th percentile was found in 15 boys (4.5%) and 15 girls (4.6%) and 70% of them were in 11-16 years age group. Statistically significant correlations were found ( $p < 0.001$ ) between blood pressures and height as well as weight; however the correlation coefficients were only weak to moderate. [*Paediatr Indones* 34:154-163]

### Introduction

Hypertension is considered to be a major public health problem, because of its high prevalence (5-15%) that may result in premature death, high morbidity, and complications leading to frequent precursor of very serious disorders of brain,

heart, and eyes. Early identification of young hypertensives must be the first step in early management and control of this disorder, which otherwise may proceed to stages of symptomatic complication.<sup>1,2</sup> In order to increase early detection of hypertension, blood pressure measurement should be a part of routine physical examination in children besides body weight and length.

Childhood hypertension is commonly defined as the values of blood pressure

which higher than the 95th centile of the population that are confirmed by two further examinations.<sup>3</sup>

Within the last years, awareness of and interest in diagnosis, treatment and surveys of childhood hypertension have been increasing in Indonesia<sup>4,8</sup> Unlike in adults, systemic blood pressure in children gradually increase with age and correlated both with height and weight.<sup>8</sup>

The difficulty in diagnosing childhood hypertension is due to several different standards of normal values of childhood blood pressure in Indonesia. Generally, we use mean plus and minus 2 SD, which is similar to 95th percentile as the normal limit values for both systolic and diastolic blood pressures.<sup>5,7,8</sup> This study was carried out to obtain blood pressure values in school age group of children in 144 subdistricts in the city of Medan.

### Methods

The study was carried out prospectively from November 1, 1992 through January 31, 1993 in the city of Medan. This city has a total area of 265 km<sup>2</sup> or 26510 hectares, which was divided into 7 urban areas (village); 11 districts, and 144 sub districts. Its total population was approximately 1 730 735.

The sampling method used was stratified cluster random sampling, involving all subdistricts of the city of Medan. This survey collected 30 clusters from these 144 subdistricts; every cluster consisted of 22 school-age children. At the end of the survey, the total subjects studied were 660 children, comprising 324 boys and 336 girls.

The questionnaire used in this study covered child's identity (characteristics; age and sex) obtained a couple of days before study. Written informed consent was obtained from all parents.

Measurements of body height (cm) and weight (kg) were performed by using pair of scales of Detecto Medic. Blood pressure was measured at the left and right arms by a doctor using Nova presameter with an appropriate cuff after the child in sitting position at least 5-10 minutes. Korotkoff sounds were auscultated by Littman's Pediatric stethoscope. The procedures of the investigation was explained to every subject to avoid or minimize anxiety states.

Blood pressure was measured in accordance with the Recommendation of International Committee on The Second International Symposium on Hypertension in children (1985),<sup>3</sup> by indirect auscultatory method, as follows:

The subject was in sitting position and the forearm was at the level of the heart. The cuff was wide enough to cover at least two-third of the upper arm length. The membrane side of the Littman's Pediatric stethoscope was then applied over the fossa cubiti. The cuff was then inflated 20-30 mmHg above the point which radial arterial pulses were not palpable. The investigator's eye should be at the level of meniscus. Thereafter, the cuff was deflated gradually at the rate of 2-3 mmHg/second until the first sound heard. This sound was considered as the first Korotkoff sound which was identical with systolic blood pressure, while diastolic blood pressure was identical with the 4th Korotkoff sound, i.e., when the sound was abruptly soften.

The survey was done at 10-12 AM. Body weight, height, and blood pressure were recorded in a specially designed form. Both systolic and diastolic blood pressures were grouped according to age, sex, to be analyzed for determining 5th, 10th, 50th, 90th, and 95th centiles.

The criterion of childhood systemic hypertension in this investigation was the values of systolic and / or diastolic pressures which were higher than 95th percentile. This was then confirmed by two further examinations. Linear correlations of blood pressures and height and weight were calculated, and regression analysis was applied by using Microstat statistical program.

## Results

The results of the measurement of blood pressure in 660 children are shown in Table 1. It was clear that both systolic and diastolic blood pressures in both sexes were almost similar, and increased with age. The mean systolic pressure in boys rose from 96.7 mmHg at age of 6 to 117.5 mmHg at age 15; while in girls it rose from 100.7 mmHg at age of 6 to 116.2 mmHg at age 16. The mean diastolic blood pressure in boys rose from 61.5 mmHg at age of 6 to 74.2 mmHg at age 15, while in girls, it from 65.8 mmHg at 6 to 76.5 mmHg at age 16 (Figure 1).

The age-specific percentiles of blood pressure measurements in both sexes could be seen in Figures 2, 3, 4, and 5. In the present series, the criteria of childhood hypertension was the values of both systolic and diastolic blood pressures higher than 95th percentile for

Table 1. Age distribution of mean systolic and diastolic blood pressures among school age children

Age	Sex	N	Systolic		Diastolic	
			Mean	Mean	Mean	Mean
6	B	14	96.7	61.5		
	G	12	100.7	65.8		
7	B	22	99.3	64.6		
	G	25	103.2	68.2		
8	B	35	100.8	66.2		
	G	23	103.2	66.9		
9	B	24	103.0	68.4		
	G	23	105.1	68.8		
10	B	27	102.0	65.7		
	G	33	106.2	69.2		
11	B	40	105.7	70.4		
	G	33	110.0	73.2		
12	B	41	109.0	69.7		
	G	52	111.7	73.7		
13	B	38	111.7	70.4		
	G	36	112.9	74.2		
14	B	27	110.4	68.9		
	G	27	114.7	73.8		
15	B	34	117.5	74.2		
	G	24	113.0	72.3		
16	B	34	116.3	73.3		
	G	31	116.2	76.5		

B = Boy G = Girl

Table 2. Prevalence of hypertension in children

	Boys	Girls
Total number studied	336	324
No of hypertension	15 (4.5%)	15 (4.6%)
Type hypertension		
systolic	7 (46.7%)	6 (40.0%)
diastolic	5 (33.3%)	5 (33.3%)
systolic & diastolic	3 (20.0%)	4 (26.7%)

each age studied, and the results were shown in Tables 2 and 3. Of 336 boys and 224 girls, there were 15 boys (4.5%) and 15 girls (4.6%) suffering from hypertension and 70% of them belonged to

11-16 year-old group. Based on the type of hypertension, in the boys they were 46.7% of systolic type; 33.3% of diastolic type, and 20% were of both systolic and diastolic types. In girls, the percentages were 40%, 33.3%, and 26.6%, respectively (Tables 2 and 3). The correlation of blood pressures with body weight and height are shown in Tables 4 and 5.

Table 3. Prevalence of hypertension by age and sex

Age (yrs)	No of subjects			Hypertension			
	B	G	Total	B	G	Total	%
6	14	12	26	-	-	-	
7	22	25	47	2	2	4	8.5
8	35	23	58	2	1	3	5.2
9	24	23	47	-	1	1	2.1
10	27	33	60	-	1	1	1.7
11	40	38	78	3	2	5	6.4
12	41	52	93	3	3	6	2.7
13	38	36	74	1	1	2	2.7
14	27	27	54	2	1	3	5.6
15	34	24	58	1	2	3	5.2
16	34	31	65	1	1	2	1.5

Table 4. Correlation between blood pressure and body weight

	Regression equation	r	p-value
A. SYSTOLIC			
1. Boy: S = 90.58 + 0.52 BW (Kg)		0.52	< 0.001
2. Girl: S = 94.66 + 0.43 BW (Kg)		0.45	< 0.001
B. DIASTOLIC			
1. Boy: D = 61.40 + 0.23 BW (Kg)		0.32	< 0.001
2. Girl: D = 62.90 + 0.25 BW (Kg)		0.37	< 0.001

r = Pearson's coefficients; BW = Body weight; S=systolic; D=diastolic.

Table 5. Correlation between blood pressure and body height

	Regression equation	r	p-value
A. SYSTOLIC			
1. Boy: S = 57.56 + 0.32 BW (Kg)		0.52	< 0.001
2. Girl: S = 66.88 + 0.31 BW (Kg)		0.43	< 0.001
B. DIASTOLIC			
1. Boy: D = 44.79 + 0.18 BW (Kg)		0.38	< 0.001
2. Girl: D = 41.04 + 0.22 BW (Kg)		0.43	< 0.001

r = Pearson's coefficients; BW = Body height

## Discussion

In our observation, the rise of both systolic and diastolic blood pressures in school age children were in accordance with the increasing of age. This findings were similar to that described by Pruitt.<sup>9</sup>

Table 2 represented that 15 (4.5%) out of 336 boys and 15 (4.6%) out of 224 girls suffered from hypertension. This present series indicated that systolic hypertension was predominant, i.e., 13 of 30 subjects (43.3%); this was similar to the report Wahab and Kristanti which showed that 5 of 10 children (50%) and 15 of 39 children (38.4%), respectively, suffered from systolic hypertension.<sup>5,8</sup>

IGN Wila Wirya who used the criterion of blood pressure higher than 95th percentile as hypertension reported that among 4983 school-age children aged 6-18 years old in 5 areas in Jakarta, there were 67 out of 2524 boys (2.65%) and 88 out of 2459 girls (3.57%) suffered from hypertension, and 72.9% of them were in 13-16 years age group.<sup>5</sup> Wahab<sup>8</sup> studied 159 boys and 155 girls in 6-14

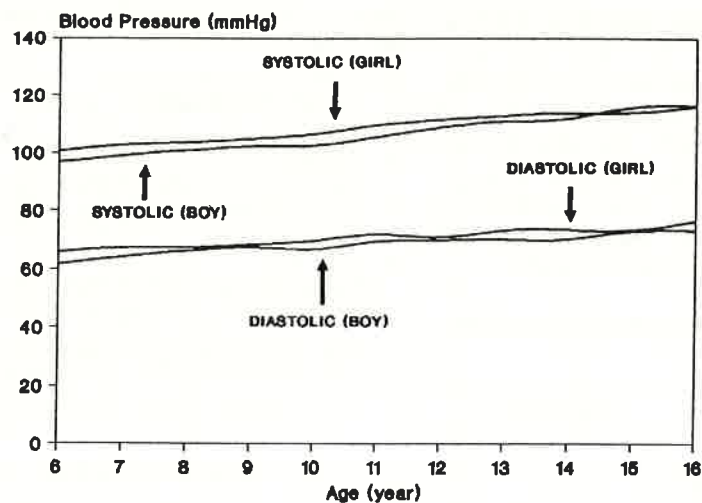


Figure 1. Blood pressure among children of school age group in Medan

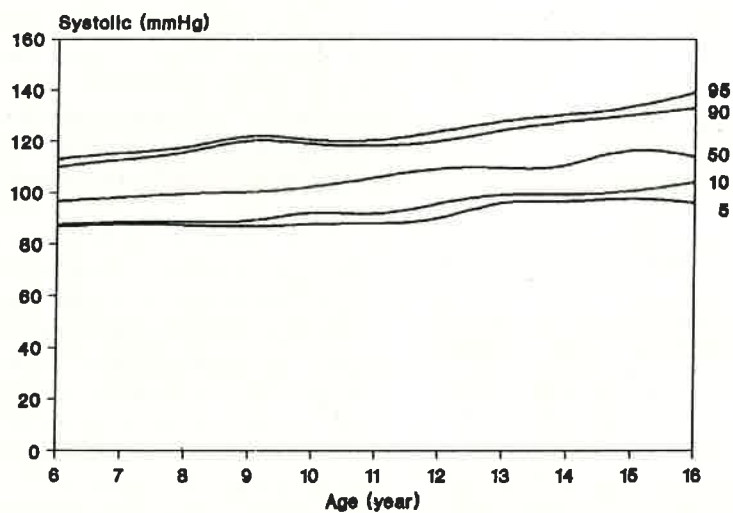


Figure 2. Age-specific percentiles of systolic blood pressure measurements of boys

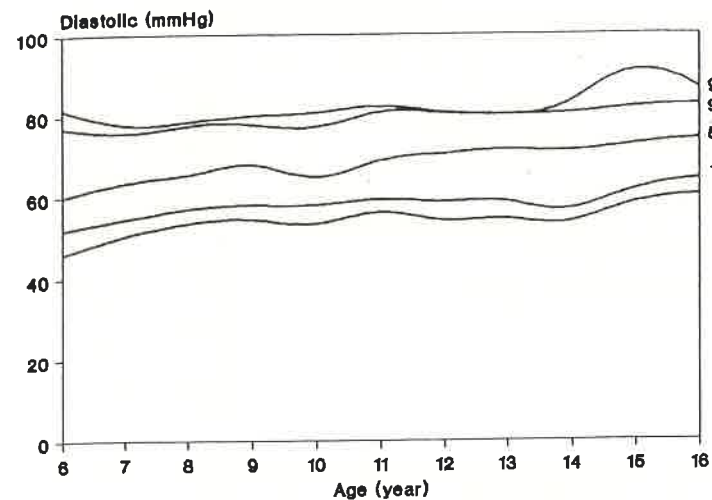


Figure 3. Age-specific percentiles of diastolic blood pressure measurements of boys

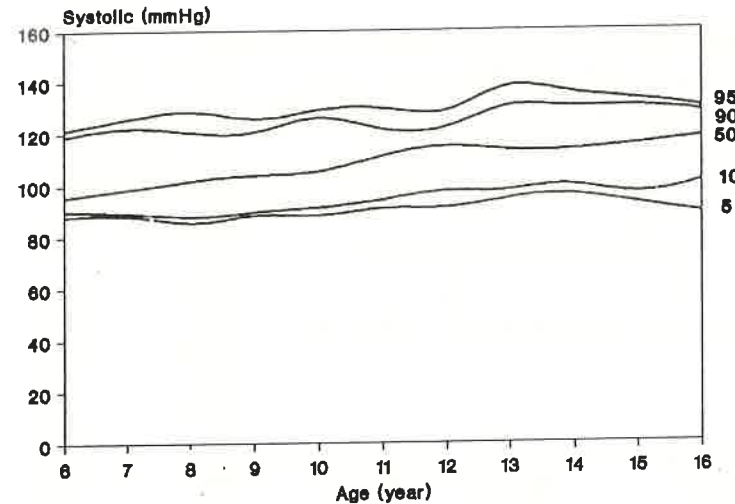


Figure 4. Age-specific percentiles of systolic blood pressure measurements of girls

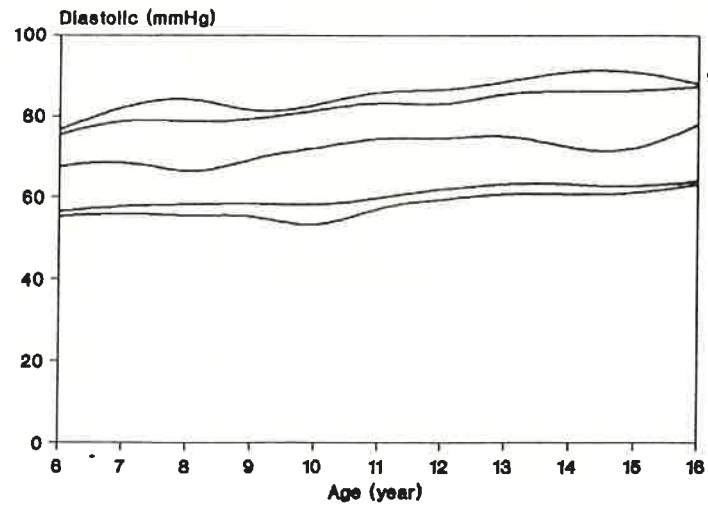


Figure 5. Age-specific percentiles of diastolic blood pressure measurements of girls

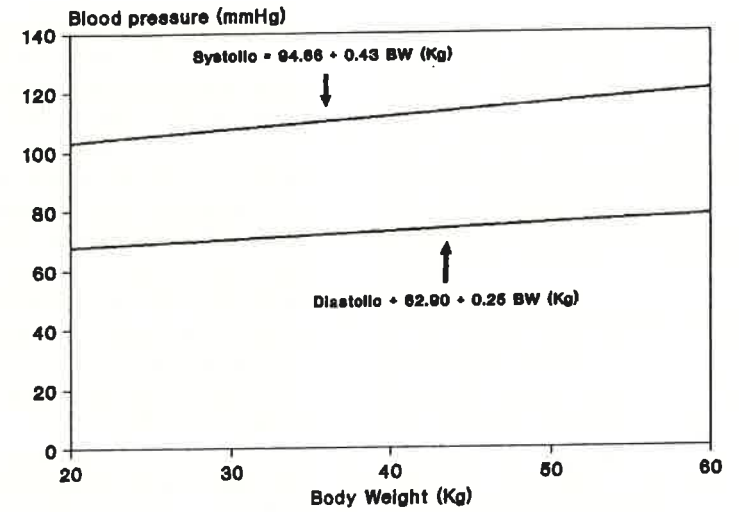


Figure 7. Correlation between blood pressure and weight in girl

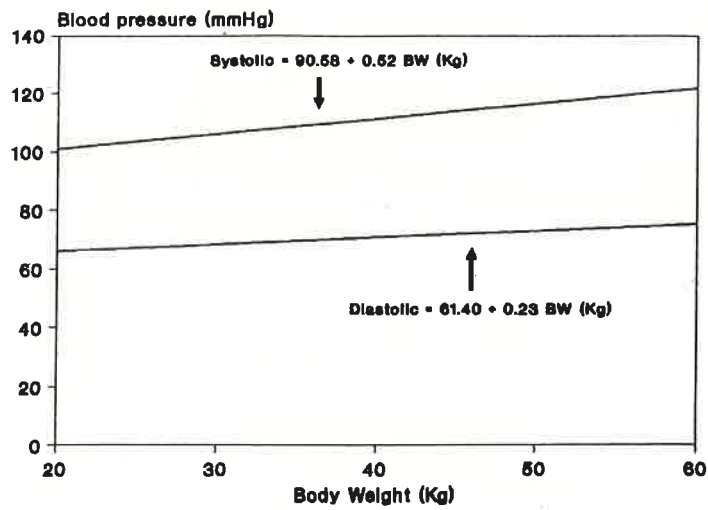


Figure 6. Correlation between blood pressure and weight in boy

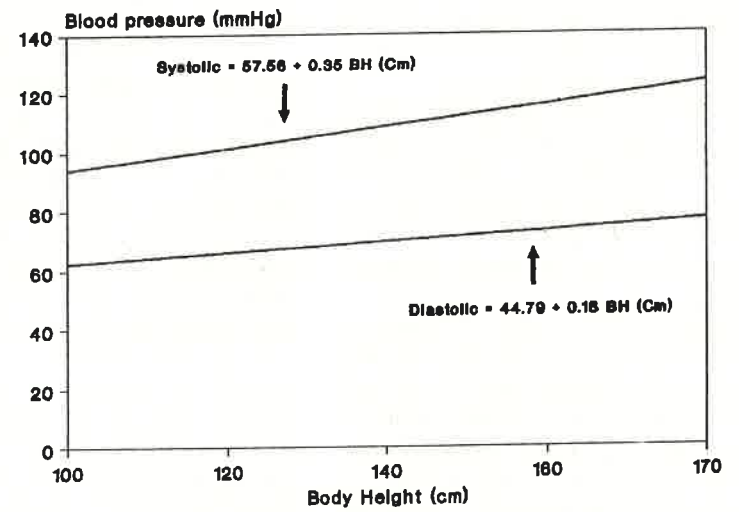


Figure 8. Correlation between blood pressure and height in boy

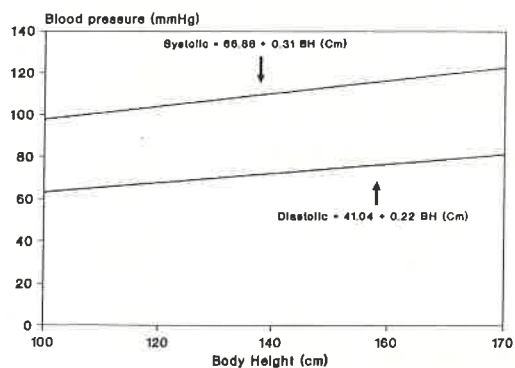


Fig 9. Correlation of blood pressure and height in girl

years age group; he found that 3.14% of boys and 3.22% of girls suffered from hypertension. While Sinuhaji et al, found 2.5% boys and 2.2% girls in 3-7 years age group suffered hypertension.<sup>7</sup>

Pelupessy *et al* in his study in Makassar reported a figure of 4% of children in 7-13 years age group suffered from hypertension, but when he repeated the study during the next 12 months, he found that all of the subjects were normotensive.<sup>6</sup>

The diagnosis of childhood hypertension should be regarded with caution, because there are many factors that may influence the readings in blood pressure measurement, including environment, physiologic factors, and body position. In this study, we found that of the variables measured, weight and height were shown to have a poor to moderate linear

correlation with blood pressure. In 321 normotensive boys, there were positive correlations of both systolic and diastolic blood pressures and body weight (systolic  $r=0.52$ , and diastolic  $r=0.32$ ,  $p<0.001$ ). It is possible to construct linear regression equations as shown in Table 4 and Figure 6. Similarly, in 309 normotensive girls, there were positive correlation of both systolic and diastolic blood pressures and body weight (systolic  $r=0.45$ , and diastolic  $r=0.37$ ,  $p<0.001$ ). The equations of linear regression were shown in Table 4 and Figure 7.

Weak to moderate positive correlations were also noted between height and both systolic and diastolic blood pressures in boys (systolic  $r=0.56$ , diastolic  $r=0.38$ ). The linear regression equations of height and blood pressures were shown in Table 5 and Figure 8. In girls similar correlations (systolic  $r=0.43$ , diastolic  $r=0.43$ ) and regressions appear in Table 5 and Figure 9.

These correlation between blood pressure and weight and height were in accordance with the report of Berenson<sup>10</sup> who found that blood pressure among children was significantly related with body weight and height. Nevertheless, during childhood there are many temporary variables influencing blood pressure measurement, such as exercise, coughing, or excitement.<sup>11</sup>

It is still difficult to determine for certain the etiology of childhood hypertension, but the presence of coarctation of the aorta and renal diseases are considered as the associated conditions. Londe studied 74 children with systemic hypertension and documented that in 64 of them, no clear causes were detected.

However, the prevalence of obesity and hypertension of the parents of these 64 children were significantly higher than those children who had normal blood pressure.<sup>12</sup>

In summary, we have measured blood pressures in school-age children in Medan. Using the convention that values beyond mean plus and minus SD, we noted children in whom by definition had hypertension, although it may not be associated with high blood pressure in this survey were not examined. However, literature indicates that in many cases the etiology of childhood hypertension is not known, but the presence of some diseases as coarctation of the aorta and renal diseases, as well as other factors such as obesity and genetic may play an important role.

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