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Original Article

Comparison of blood pressure of senior high school students in the inner and outer city of Medan

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Abstract

Background Blood pressure (BP) in children and adolescents depends on multiple factors, both genetic and environmental such as gender, age, body weight and height, obesity, life style, socioeconomic status, etc. Surveillance of families in Medan (2000) reported that the socioeconomic status in the outer city was lower than in the inner city; other factors that influence BP of adolescents may also be different.

Objective To compare the prevalence of hypertension between senior high school students in the inner and outer city of Medan.

Methods A cross sectional study was conducted on 250 students selected randomly from four senior high schools in Medan, each 2 schools from inner and outer city. This study was done between June and August 2003. BP measurement was done in the morning at 08.00 – 12.00 o'clock before the subjects got exercises. BP measurements were done three times according to Task Force on Blood Pressure 1996 recommendation. The average of systolic and diastolic was considered as BP of the subjects.

Results Systolic and diastolic BPs of the female students in the outer city (115.3/80.0 mmHg) were higher than those of the female students in the inner city (111.2/71.8 mmHg) and the difference was statistically significant (P=0.008 and P=0.014), but not for the male students. The prevalence of hypertension in the inner and outer city of Medan was 6.0% and 8.4%, respectively.

Conclusions The prevalence of hypertension in the outer city was abit higher than that in the inner city. The averages of systolic and diastolic BPs of female students in the outer city were higher than those of the female students in the inner city of Medan. **[Paediatr Indones 2007;47:247-251]**.

Keywords: *blood pressure, senior high schools, inner city, outer city*

Blood pressure (BP) is important in physical examination in children and adolescents as are body weight and height measurements, but almost never been done. BP measurement should be included in the physical examination as a part of the continuing care of the child, not as an isolated procedure. All physicians who care for children of 3 years of age through adolescence should be encouraged to measure BP at least once a year, when the child is well. The incorporation of BP measurement into the routine pediatric examination not only enable to detect significant asymptomatic hypertension secondary to a previously undetected disorder, but also confirm that mild elevations in BP during childhood are more common than previously recognized, particularly in adolescents.[1,2]

BP in children and adolescents depends on multiple factors, both genetic and environmental such as gender, age, body weight and height, obesity, life style, socioeconomic status, etc.[1,3,4] Some studies about BP in infants, play group children, elementary and junior high schools in Medan have been done,

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but never in senior high schools. From the surveillance of families in Medan in 2000 by *Badan Koordinasi Keluarga Berencana Nasional* (BKKBN), the socioeconomic status in the outer city was lower than that in the inner city.[5] Besides socioeconomic status, other factors that influence BP in adolescents may be different, so that the average of BP in those areas could also be different. There is no study about BP comparison between two populations in Medan. This study aimed to know the prevalence of hypertension in those areas, and to know whether there is a difference between BP of senior high schools students in the inner and outer city of Medan.

Methods

This cross sectional study was conducted in four senior high schools in Medan between June and August 2003. We studied senior high school students in the inner and outer city of Medan and the eligible subjects were students aged 15-18 years old from two schools in each area.

Selection of area and schools

The selection of inner and outer city of Medan was done by cluster random sampling. Sub-districts of Medan were divided into inner and outer city areas. There were 10 and 11 sub-districts inner and outer city, respectively. From each area, two sub-districts were taken randomly through computerized programs of simple random numbers. Medan Maimun and Medan Polonia subdistricts represented the inner city area while outer city area was represented by Medan Marelan and Medan Belawan subdistricts. There were six senior high schools in Medan Maimun and five in Medan Polonia, while in Medan Marelan and Medan Belawan there were 11 and 5 senior high schools, respectively. From each subdistricts, one senior high school were taken randomly, so that each inner and outer city of Medan was represented by 2 schools.

Sample size calculation

Sample size was calculated for 90% power and 5% level of significance. From the previous community-based study conducted by our department, we found the standard deviation of 13.41. With an assumption of 5 mmHg to be a clinically important difference, a total of 250 students were required from each area. One hundred and twenty five students were taken randomly from each school by computer program.

Definitions

Systolic BP was determined by the onset of the "tapping" Korotkoff sounds. Diastolic BP was determined by the disappearance of Korotkoff sounds or the fifth Korotkoff sound (K5). Normal BP was defined as systolic and diastolic BP less than 90th percentile for age, sex, and height. (Task Force on Blood Pressure Control in Children and Adolescents 1996). Hypertension was defined as systolic and/or diastolic BP greater than or equal to the 95th percentile for age, sex, and height on at least three separate occasions. Family history of hypertension was defined if a student has one or both of his parents, brother, sister, grandmother or grandfather suffered from hypertension or stroke. Obesity was defined as body mass index greater than 95th percentile. Low socioeconomic status was defined if the student's family were in preprosperous and prosperous I family stages according to BKKBN 2001 criteria. Middle socioeconomic status was defined if the student's family were in prosperous II family stage according to BKKBN 2001 criteria. High socioeconomic status was defined if the student's family were in prosperous III and III plus family stages according to BKKBN 2001 criteria.

BP measurement was done in the morning at 08.00 – 12.00 o'clock before the subjects got exercises. First we gave information about things that will be done in this study and then we asked the willingness of the subjects. If they agree we asked them to fill in the informed consent and then the questionnaire about identity, family history of hypertension, and the socioeconomic status. After the questionnaire was filled, we made physical examinations that include body weight and height, body mass index, and BP. BP measurement were done three times according to Task Force on Blood Pressure 1996 recommendation by Nova sphygmomanometer, and the average of systolic and diastolic BP was considered as the BP of the subjects.

Data management

Before entering data into the computer, individual forms were scrutinized thoroughly for accuracy and consistency. Data were subsequently fed into a personal computer using SPSS version 11.5 for windows. The x^2 and independent t-test were applied for comparisons of differences in proportions and means, respectively.

Results

Table 1 summarizes the profile of 250 subjects in each area. The average age of female subjects in the outer city (16.9 years) was older than in the inner city (15.6 years). There were about 5.6% subjects in the inner city suffered from obesity and 3.2% subjects in the outer city. Most subjects in the inner city (70.4%) belonged to high socioeconomic status while in the outer city was only 37.6%.

Systolic and diastolic BPs of the female students in the outer city (115.3/80.0 mmHg) were higher than those in the inner city (111.2/71.8 mmHg) and the difference was statistically significant (P=0.008 and P=0.014), but not for the male. BP of the obese students was higher than that of non-obese ones in both areas. Also BP of the students with family history of hypertension is slightly higher than that of students without family history of hypertension. BP of students from the middle socioeconomic status in the inner city (113.4/72.8 mmHg) and outer city (115.2/78.2 mmHg) were higher compared to that of high socioeconomic status (112.5/71.1 mmHg and 113.5/71.9 mmHg) (**Table 2**).

The prevalence of hypertension in the inner and outer city of Medan was 6.0% and 8.4%, respectively. (**Table 3**). Twelve of twenty-four obese subjects (50%) suffered from hypertension, while in non obese subjects it was only 5.1% (**Table 4**).

Discussion

The average systolic and diastolic BPs of female students in the outer city were higher compared to

Table 1. Characteristics of students in both of areas

	Inner city				Outer city			
	N	%	Mean	SD	N	%	Mean	SD
Males	126	50.4			146	58.4		
Age (yrs)			16.0	1.02			16.9	0.81
Weight (kg)			58.7	17.76			53.4	9.77
Height (cm)			165.9	8.51			165.7	6.57
Females	124	49.6			104	41.6		
Age (yrs)			15.6	0.78			16.9	0.83
Weight (kg)			51.9	11.13			49.6	9.78
Height (cm)			157.4	5.59			154.2	4.45
Obesity								
Yes	14		5.6		8	3.2		
No	236		9.4		242	96.8		
Family history of hypertension								
Yes	105		42.0		100	40.0		
No	145		58.0		150	60.0		
Socioeconomic status								
Low	-				-			
Middle	74	29.6			156	62.4		
High	176	70.4			94	37.6		

Table 2. BP according to the influencing factors

	Systolic BP (mmHg)					Diastolic BP (mmHg)				
	Inner city		Outer city		P	Inner city		Outer city		P
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Males	114.4	12.87	114.1	9.91	0.798	72.8	9.85	72.9	9.08	0.870
Females	111.2	10.43	115.3	12.55	0.008	71.8	11.50	80.0	65.28	0.014
Obesity										
Yes	125.4	14.06	141.3	12.61	0.028	81.4	15.79	92.6	5.75	0.110
No	112.1	11.26	113.9	10.22	0.063	71.4	7.80	75.5	43.12	0.147
Family history of hypertension										
Yes	114.3	12.51	115.1	12.15	0.691	72.4	9.40	76.7	54.60	0.095
No	111.7	11.18	114.2	10.34	0.054	72.2	11.56	74.7	9.78	0.333
Socioeconomic										
Middle	113.4	11.82	115.2	11.03	0.269	72.8	11.42	78.2	53.58	0.257
High	112.5	11.82	113.5	11.15	0.518	71.1	8.67	71.9	8.38	0.530

Table 3. Comparison of the prevalence of hypertension in inner and outer city

Area	Hypertension n (%)	Non hypertension n (%)	Total
Inner city	15 (6.0%)	235 (94.0%)	250
Outer city	21 (8.4%)	229 (91.6%)	250
	36	464	500

$x^2 = 1.078$, df = 1 ; P = 0.299

Table 4. Comparison of the prevalence of hypertension in obese and non-obese children

Obesity	Hypertension n (%)	Non-hypertension n (%)	Total
Yes	12 (50%)	12 (50%)	24
No	24 (5.1%)	452 (94.9%)	476
	36	464	500

$x^2 = 68.949$, df = 1 ; P < 0.0001

those in the inner city, this maybe caused by the average age of those female students was older than that in the inner city. BP increases gradually with age in all population, although the level and model vary from one population to another.[6-8] The prevalence of hypertension also increases with age.[6]

BP was influenced by body weight and height;[1,3,4] height is independently related to BP at all ages.[4] Larger children (heavier and/or taller) have higher BP than that of smaller children of the same age.[1] In this study although the average of body weight and height were higher in the female students in the inner city but the BP was lower compared to that in outer city of Medan. However, previous study on BP in adolescents' population found that the difference of BP between female adolescents from two different races was not influenced by body weight and height.[9]

There were more obese students in the inner than in the outer city of Medan, it could be due to higher level of socioeconomic status, less activity, and food consumption pattern that contains more calorie, salt, or fat. Obese students had higher BP than non obese ones. Obesity can cause hypertension through a complex interaction among sodium retention, sympathetic nervous system activation, and selective insulin resistance.[10] Selective insulin resistance is a condition caused by inability of insulin in glucose metabolism, but other physiological effects of insulin like sodium retention, change of vascular function and structure, ion transport, and sympathetic nervous system activation are still present. Selective insulin resistance will cause hyperinsulinemia so that the physiological effects of insulin especially sodium retention and sympathetic nervous system activation will raise the BP.[10,11] In this study 50% of obese students from those two areas got hypertension.

Students with family history of hypertension had higher BP than those without. Adolescents with family history of hypertension have a larger risk for hypertension.[4,11-13] If both parents are hypertensive, the incidence of hypertension in the offspring rose 4 to 15 fold.[7] It has been demonstrated that not only BP but also its regulatory mechanisms, such as the renin-angiotensine-aldosterone system, the sympathetic nervous system and renal electrolyte system, are all genetically influenced. Modern molecular techniques have raised the possibility of investigating individual genes that may be responsible for hypertension.[13]

In this study, the students from middle socioeconomic status had higher BP compared to that from high socioeconomic status in both of areas. Socioeconomic status have inversed relation with prevalence of hypertension.[14] Adolescents who come from lower socioeconomic status have higher BP than those from the higher socioeconomic status.[14-16] They experience more difficult situation because of lack of funds, or less communication with their parents, so that they tend to have unfavorable behaviors like smoking and drinking alcohol, things that can increase the BP.[15,16]

Our data indicate that the prevalence of hypertension in students from the outer city (8.4%) was higher than those from the inner city. The reason is unclear since many factors may influence BP such as age, gender, body weight and height, race, family history of hypertension, socioeconomic status, salt consumption, smoking, alcohol, etc.[7,9,17,18] This study tried to find the influence of gender, obesity, family history of hypertension, and socioeconomic status on BP. This is one of the limitations of our study. It is also because this study was cross sectional so it couldn't determine the effect and causes. Further study with different design, like cohort study, is needed to be able to determine or explain the relationship among factors that influence hypertension.

In conclusion, the averages of systolic and diastolic BPs of female students in the outer city were higher than those in the inner city of Medan, but not for the male ones. The prevalence of hypertension in

the outer city of Medan was higher than that in the inner city, but statistically not significant.

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