

Prevalence of Hypertension in School and College Students

Prevalensi Hipertensi pada Pelajar dan Mahasiswa

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Abstract

In Indonesia, the onset of hypertension has been observed in younger populations. Previous studies showed that hypertension occurred in adolescence, even in childhood. This cross sectional study aimed to provide a population-based estimation of hypertension prevalence and risk factors among school and college students in Surabaya, Indonesia. Using mercury sphygmomanometer blood pressure was measured in 335 participants grouped into 5 – 9, 10 – 14, 15 – 19, and 20 – 26 years of age. The prevalence data was linked to sex, age, body mass index (BMI), and a family history of diabetes and/ or cardiovascular disease. Hypertension in children was determined according to the Update on the Task Force Report (2004) and to the JNC-7 for other participants. Thirty one (9.3%) participants had developed hypertension. Hypertension prevalence tended to increase with age from 0% at 5 – 9 years and 8.1% at 10 – 14 years to 15.2% at 20 – 26 years. Hypertension developed in 18 males and 13 females. Aged more than 20 years and family history of heart disease were significant risk factors for hypertension. Other factors, such as BMI and a family history of diabetes, were not significant. Malnutrition among children in golden age (0 – 5 years) plays major role in increasing future risk of hypertension. Routine hypertension screening should be done in young adults aged 20 years in this country.

Keywords: College students, hypertension, students

Abstrak

Di Indonesia, timbulnya hipertensi telah diamati pada populasi lebih muda. Studi sebelumnya menemukan bahwa hipertensi dapat terjadi pada masa remaja, bahkan masa kecil. Tujuan penelitian potong lintang ini adalah memberikan estimasi berbasis populasi prevalensi dan faktor risiko hipertensi pada pelajar dan mahasiswa di Surabaya, Indonesia. Dengan sfignomanometer merkuri diukur tekanan darah pada 335 partisipan yang dikelompokkan ke dalam kelompok usia 5 – 9, 10 – 14, 15 – 19, dan 20 – 26 tahun. Data prevalensi dikaitkan dengan jenis kelamin, usia, indeks

massa tubuh (IMT), dan riwayat diabetes dan/atau penyakit kardiovaskular pada keluarga. Hipertensi pada anak ditentukan sesuai dengan *the Update on the Task Force Report* (2004). Partisipan lain dikelompokkan menurut JNC-7 untuk diagnosis hipertensi. Peserta sebanyak 31 (9,3%) didapatkan telah mengalami hipertensi. Prevalensi hipertensi cenderung meningkat sejalan usia dari 0% pada 5 – 9 tahun dan 8,1% pada 10 – 14 tahun menjadi 15,2% pada 20 – 26 tahun. Hipertensi terjadi pada 18 laki-laki dan 13 perempuan. Usia lebih 20 tahun dan riwayat penyakit jantung pada keluarga merupakan faktor risiko signifikan untuk hipertensi. Faktor-faktor lain, seperti IMT dan riwayat keluarga diabetes, tidak signifikan. Gizi buruk pada anak di usia emas (0 – 5 tahun) berperan utama meningkatkan risiko hipertensi di masa depan. Di Indonesia, skrining hipertensi rutin harus dilakukan pada dewasa muda usia 20 tahun.

Kata kunci: Mahasiswa, hipertensi, pelajar

Introduction

Hypertension, which highly contributes to cardiovascular diseases and renal failure, is related to various risk factors, such as environment, race, diet, age, sex, nutritional status, and family history. The role of environmental factors can be observed in the finding that shows that the highest prevalence is observed in Nordic countries, which are close to the North Pole, and the lowest is observed in Mediterranean countries, which are warmer in comparison. Environmental factors, such as low temperature, are suggested explanations. A similar pattern is observed in Britain, where the prevalence of hypertension is the highest in cooler Scotland and the lowest in

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Wales and southeast England. In the US, a high prevalence of hypertension in the southeastern states is attributed to a greater number of African – Americans settled there. A recent study has reported a higher prevalence of hypertension in Europe as compared with the USA. Mean blood pressure was 136/85 mmHg in European countries and 127/77 mmHg in Canada and USA, and there was a 60% higher prevalence of hypertension. The cause of this difference is still unknown. Other risks factors for hypertension include a high salt intake, obesity and excess alcohol intake, and other important risks factors are likely to exist.¹ Sodium content within a diet is an important predictor of hypertension. Populations with a negligible sodium intake have very low blood pressure.

Surveys have shown a high salt intake in the Indian state of Rajasthan. In contrast, the urinary sodium content, as an indicator of its intake, was studied in a tribal population of 4,523 subjects in the Indian state of Orissa, which reported hypertension of 0.44%. In a random population sample, daily urinary sodium excretion levels were 35 – 75 mEq in 86.3% of people, 76 – 100 mEq in 7.2%, and 100+ mEq in 6.3%, while the hypertensive person had a mean sodium excretion of 120.7 mEq. The sodium content of the diets in the populations of the other states is not known and further studies are needed to explain regional differences in hypertension prevalence.

However, from all of the factors mentioned above, this study underlines the role of age and family history. An earlier onset of hypertension has tended to be progressive, with medical literature documenting that today hypertension is a common disease worldwide.^{2,3} In Indonesia, the onset of hypertension may be found in younger populations. Current studies have noted that hypertension may commence in young adulthood, or even in children.

The objective of this cross-sectional study is to provide population-based estimates of the prevalence and risk factors of hypertension among school and college students in Surabaya, Indonesia.

Methods

A cross sectional study was performed on participants who underwent a blood pressure screening in order to calculate the prevalence of hypertension in school and college students aged 5 – 9, 10 – 14, 15 – 19, and 20 – 26 years old. Participants for each survey site were randomly selected. The only exclusion criteria for physical measurements were participants with any gross physical abnormality. Data was collected using questionnaires and through the physical measurement of body weight, height, and blood pressure. Body weight and height were measured with participants standing wearing light clothing and without shoes. Sample size was calculated using

the formula for single population proportion. This prevalence data was then linked to age, body mass index (BMI), and a family history of diabetes and/or cardiovascular disease. For child participants, hypertension is considered when blood pressure is more than the 95th percentile according to the Update on the Task Force Report (2004). Other participants were grouped according to the Joint National Committee (JNC-7) for diagnosis of hypertension (systolic blood pressure > 140 and or diastolic blood pressure > 90 mmHg or known hypertension). A total of 335 participants had blood pressure measurement by mercury sphygmomanometer.

Each participant answered a questionnaire on socioeconomic elements, family history of cardiovascular disease or risk, and was then given a physical examination. Sitting blood pressure was measured using a mercury manometer, with at least two readings in a 5 m interval. If a high blood pressure (140/90 mmHg) was noted, the examination was repeated 30 minutes later. Phase V of Kortakoff's sounds was taken as a determination of diastolic blood pressure. Normal blood pressure was defined as systolic blood pressure < 140 mmHg and a diastolic blood pressure < 90 mmHg. Participants undergoing anti-hypertensive treatment were considered to have hypertension regardless of the measured blood pressure.

Mean, standard deviation, median and percentile distribution of systolic and diastolic blood pressure in males and females at different age-deciles were calculated. Intergroup differences were evaluated by analysis of variance (ANOVA). Correlation coefficients (r) were determined for age with blood pressure levels. Regression coefficients (b) were calculated for blood pressure with age-deciles to determine change in blood pressure with increasing age. The prevalence rates were given by percentage. To determine significant associations of hypertension risk factors with its prevalence, a logistic regression analysis was performed. Odds ratios and 95% confidence intervals were determined. Two-tailed $p < 0.05$ were considered significant.

Results

Sex and age-specific distribution respondents with hypertension is shown in Table 1. Excluding in females aged 15 – 19 years, there was an age dependent increase in the prevalence of hypertension in both males and females with a low prevalence of hypertension in younger age groups and a high prevalence in older persons (Table 1).

Age-group specific systolic and diastolic blood pressure values are also shown in Table 2 and 3. The median values for systolic and diastolic blood pressure are lower than the mean values, suggesting a positive distribution skew, except in those of more than 20 years. There is a significant increase in mean systolic and diastolic blood

Table 1. Sex and Age-Specific Distribution of Persons with Hypertension

Age-group Years	Males		Females		Total	
	Total	Patients	Total	Patients	Total	Patients
5 – 9	8	0 (0.0%)	4	0 (0.0%)	12	0 (0.0%)
10 – 14	29	1 (3.4 %)	33	4(12.1%)	62	5 (8.1%)
15 – 19	69	6 (8.7%)	87	4 (4.6%)	156	10 (6.4%)
≥ 20	63	11 (17.5%)	42	5 (11.9%)	105	16 (15.2%)

Table 2. Systolic Blood Pressure

Age-group Years	Number	Mean mmHg	Median mmHg	Skew	P value
5 – 9	12	103.3 ± 4.9	100	0.81 ± 0.64	< 0.0001
10 – 14	62	111.1 ± 9.3	110	0.67 ± 0.30	
15 – 19	156	114.1 ± 10.1	110	2.08 ± 0.19	
≥ 20	105	115.81 ± 9.8	120	4.07 ± 0.24	

Notes: ANOVA $F = 7.717$; $r = 0.234$, $r^2 = 0.055$; $b = 0.64 \pm 0.15$

pressure with age (ANOVA, $F > 20.00$, p value < 0.0001), except in diastolic blood pressure of those aged 15 – 19 years. Univalent analysis showed that age and a family history of cardiovascular disease was significantly associated with hypertension. No significant relationship between higher BMI and gender were risk factors for hypertension prevalence. The overall prevalence of hypertension using the criteria of either systolic blood pressure 140 and/or diastolic blood pressure > 90 mmHg or hypertension on treatment was 10.7% in males and 7.8% in females (Table 4).

Discussion

Cardiovascular disease (CVD) has been the main cause of death on the world. The relationship between the level of blood pressure and the risk of CVD events is independent of other risk factor. The higher the blood pressure the greater the risk of heart attack, heart failure, stroke and kidney disease. The presence of additional risk factors such as smoking, diabetes and high cholesterol levels increases the CVD risk from hypertension.^{4,5} Blood pressure in children tends to track from childhood into adulthood, and prevention and control of increased blood pressure in children might be an important strategy to limit the global disease burden due to hypertension.^{6,7}

In this study, we investigated hypertension in school and college students. Interestingly, we were not only able to demonstrate that hypertension begins in an adolescence population, but even in younger populations. In our investigation, school students aged 10 – 14, 15 – 19, or 20 – 26 years were examined. They demonstrated an increase in hypertensive prevalence with each age group (8.1, 6.4, and 15.2% respectively). The hypertension percentage of 8.1% in the group of 10 – 14 years of age was

Table 3. Diastolic Blood Pressure

Age-group Years	Number	Mean mmHg	Median mmHg	Skew	P value
5 – 9	12	70.8 ± 2.9	70	3.46 ± 0.64	< 0.0001
10 – 14	62	75.2 ± 6.7	70	0.61 ± 0.30	
15 – 19	156	74.2 ± 7.0	70	-0.12 ± 0.19	
≥ 20	105	78.3 ± 6.7	80	0.02 ± 0.24	

Notes: ANOVA $F = 9.773$; $r = 0.238$, $r^2 = 0.057$; $b = 0.408 \pm 0.102$

observed unexpectedly. However, previous studies generally reported that the prevalence was found in the adults of more than 20 years old.⁵ The International Clinical Epidemiology Network (INCLIN) data,⁸ using an older WHO criteria, reported that the prevalence of hypertension in developing countries were varied, from a low of 3% in rural Thailand and 5% in rural China to a high of 22% in the Philippines and 23% in Indonesia. Our overall prevalence of hypertension among participants aged 5 – 26 years was 9.3%, which confirmed this statement. However, this rate was much lower than the percentage (23%) that was reported by INCLIN in Indonesia. This discrepancy may be due to the different age of onset during the study. Meanwhile, a study conducted among people aged 20 years and older in Guatemala reported that the overall prevalence of hypertension there was 12.9%.

Another interesting finding in this study was that the prevalence of hypertension was shown to increase with advancing age. This finding was similar to the results from the southwestern region in China and Canada. In our statistical analysis, it was observed that age was significantly correlated with a high prevalence of hypertension. This finding confirmed the results of studies from the Philippines and India. When the samples were grouped into those of more than 20 years old and less than 20 years old, the results were statistically significant, where the percentages of the hypertension were 15.2% and 6.5%, respectively. The results of this study confirmed one of the findings in Falkner's and Flynn's study, which observed that there were several outcomes of pediatric hypertension that have been studied, including the tracking of blood pressure from childhood into adulthood and the presence of a multitude of surrogate markers of cardiovascular injury associated with hypertension.^{9,10} A study by Chen et al,¹¹ concluded that the

Table 4. Various Risk Factors and the Prevalence of Hypertension

Variables	Categories	Hypertension		Non Hypertension		P value	OR	95% CI
		n	%	n	%			
Age (years)	< 20	15	6.5	215	93.5	0.019	2.58	1.22 – 5.44
	≥ 20	16	15.2	89	84.8			
Sex	Male	18	10.7	151	89.3	0.485	1.40	0.66 – 2.96
	Female	13	7.8	153	92.2			
Nutritional status	Normal	20	8.3	220	91.7	0.604	1.29	0.50 – 5.59
	Underweight	6	10.5	51	89.5			
	Overweight	5	13.2	33	86.8			
Family history hypertension	Yes	9	8.0	103	92.0	0.730	0.80	0.36 – 1.80
	No	22	9.9	201	90.1			
Diabetes Mellitus	Yes	5	9.4	48	90.6	1.000	1.03	0.38 – 2.80
	No	26	9.2	256	90.8			
Kidney	Yes	1	6.7	14	93.3	1.000	0.69	0.09 – 5.44
	No	30	9.4	290	90.6			
Heart	Yes	5	26.3	14	73.7	0.022	3.98	1.33 – 11.93
	No	26	8.2	290	91.8			
Cardiovascular	Yes	11	8.5	118	91.5	0.865	0.87	0.40 – 1.87
	No	20	9.7	186	90.3			
Urine	Abnormal	7	7.1	92	92.9	0.492	0.67	0.28 – 1.62
	Normal	24	10.2	212	89.8			
Proteinuria	Positive	2	8.3	22	91.7	1.000	0.88	0.20 – 3.95
	Negative	29	9.3	282	90.7			

evidence for blood pressure tracking into adulthood was strong, and that the strength of the correlation increased with baseline age.

The results showed that hypertension in adulthood can be predicted in children. Specifically, the odds ratios of hypertension occurring in a 30 years old was found to be 3.8 and 4.5 in 5 – 7 year-old boys and girls who had elevated blood pressure during a single evaluation in childhood.¹¹ When assuming the results of Chen’s study, the prevalence of hypertension in those of 20 – 26 years old was 15.2%, a multiplication of about 2.3 from the prevalence of hypertension among those of less than 20 years old. The implication of this finding for health policy makers in Indonesia is that in order to reduce hypertensive complication in the community, a screening program should be initiated for the age group of 20 years. However, we cannot exclude the possibility that those of less than 20 years of age with risk factors should also be subjected to the screening.

Medical literature mentions that genetic factors contribute to racial differences in hypertension prevalence. Various genes (involving hormones in the renin angiotensin aldosterone system) have been studied and one of the results shows that they are involved in the epithelial sodium channel in the collecting duct of the kidney.¹² Polymorphisms of this channel have been found to be present in African Americans, who are known to have a high risk of hypertension.¹³ In this study, we found a significant correlation between a high prevalence of hypertension and a family history of cardiovascular disease. This underlines the role of genetic factors in high

prevalence hypertension. In developed countries, hypertension is frequently related to obesity in all ages, including in young adults and children. For example, studies in the United States have demonstrated that the increase of mean blood pressure and the prevalence of hypertension, trends that are in part attributable to the increased prevalence of obesity, which is now referred to as pandemic obesity, in a percentage of 31%.¹⁴ In addition, several studies have strongly supported the concept that the incidence of hypertension might be related to the increase of BMI in the results of the current study. Another study conducted among elementary school teachers from USA found that elevated blood pressure found that 38 from 355 school children and college students had obesity. From these 38 overweight students, 5 (13%) students had hypertension. In short, these figures are not statistically significant when compared with the rates of hypertension in the individuals with normal or under body weight, indicating that underweight individuals have the same opportunity to have increasing hypertension prevalence. This is also confirmed by the studies of Jafar et al,¹⁵ and Folsom et al,¹⁶ who suggested that such an increase is not only related to being overweight, but also to other factors. For example, it is speculated that malnutrition is an important factor, as observed in the finding that the prevalence of hypertension in children from Pakistan, who have a lower BMI, is higher than that in children from the United States, who are predominantly overweight.¹⁷ This is also supported by Mzayek et al,¹⁸ who found an inverse association between birth weight and later blood pressure.

In our study, the prevalence of hypertension was 10.5% in the underweight group. We conducted our study in people who live below the poverty level, which has been associated with poor health due to inadequate nutrition and substandard lifestyles. We speculate that this group, predominated by the age group 10 – 14 years old, had a life history of being exposed to the effects of the monetary crisis in Indonesia, which occurred between 1997 – 2003. In those years this age group was in its golden age (from fetal to the first five years of life) and were particularly vulnerable to organ maturity disorder, including their vascular organs.

Those findings confirm studies on the changing pattern of diseases, which suggest the extent of socio-economic factors on the prevalence of disease. It concluded that health policy should have been emphasized, with the mortality rate as the main objective. Hypertension is not excluded in this case. The combination of medical and social approaches will reduce the risk factors of hypertension, which will have impact on human life through the delay in disease severity and reduced physiological conditions in more advanced ages, so that the time spent leading a healthy life can be prolonged considerably. In view of this study, the group of 10 – 14 year olds with hypertension and exposure to malnutrition during their golden age should be studied in greater detail. In this regard, Thompson,¹⁹ reported that the additional studies are needed to improve the diagnosis and risk stratification of children with elevated blood pressure and to quantify risks, and benefits of interventions. The limitation of this study was that the participants were exclusively school and college students aged 5 to 26 years. This study was also purely observational, yielding only prevalence data.

Conclusion

The prevalence of hypertension in the Indonesian people was 9.3 %. Age and family history of heart disease are the significant risk factors of hypertension. Malnutrition among children in their golden age has been considered as a major role in increasing the risk of blood pressure increases in the future. Routine hypertension screening should be carried out in young adults 20 years of age.

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