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Prevalence of Hypertension Among Malay Adolescents in Putrajaya Secondary Schools, Malaysia, 2010

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ABSTRACT

Background: In Malaysia, the prevalence of hypertension amongst adults aged 30 years and above has increased from 32.9% in 1996 to 40.5% in 2004 and to 42.6% in 2006. Information on the prevalence of hypertension among adolescents is lacking. **Objective:** to determine the prevalence of hypertension among Malay secondary school students in Putrajaya. **Methods:** A cross sectional study was carried out in Putrajaya, Malaysia. The sampling frame consisted of a list of all the 12 secondary schools in Putrajaya. Three schools were selected using table of random numbers. All Malay students aged 13 years old to 17 years old from the three selected school students were included in the study. Blood pressure was measured after the respondents had rested for at least 5 minutes using a standard mercury sphygmomanometer. Three blood pressure measurements were taken for each respondent. Systolic blood pressure [SBP] was defined as the average of three SBP readings and diastolic blood pressure [DBP] was defined as the average of three DBP readings. Data was analyzed using SPSS 18. **Results:** The overall mean SBP and DBP were 108.9 mmHg and 63.2 mmHg respectively. The prevalence of pre-hypertension and hypertension among the male was 16.2% and 12.9% respectively as compared to 5.8% and 10.2% respectively in the females. The overall prevalence of prehypertension and hypertension was 11.1% and 11.6% respectively. The prevalence increased with age ($p<0.05$). There was a significant positive correlation between BMI and SBP ($r = 0.52$, $r^2 = 0.27$, $p= 0.001$) and BMI and DBP ($r = 0.38$, $r^2 = 0.15$, $p= 0.001$). The mean SBP was significantly higher in males (111.7 mmHg) as compared to 106 mmHg in females ($p<0.001$). The mean DBP in males (63.5 mmHg) was slightly higher as compared to 62.9 mmHg in females but the difference was not significant. **Conclusions:** Prevalence of hypertension and pre-hypertension is high. There is an urgent need for implementation of a comprehensive CVD prevention program and routine blood pressure measurements should be taken in school children to improve the detection, prevention and treatment of hypertension

Keywords: Prevalence, Hypertension, Adolescents, Putrajaya, Malaysia

INTRODUCTION

Cardiovascular diseases are now responsible for 30% of all deaths worldwide [1-2] . Hypertension is the most frequent treatable risk factor[3]. The prevalence of hypertension has been widely reported in various regions of the world [4-5]. It is ranked third as a cause of disability-adjusted life-years and is a leading risk factor for mortality[6]. By 2025, 1.56 billion people are expected to have hypertension [7]. In Malaysia, the prevalence of hypertension amongst adults aged 30 years and above has increased from 32.9% in 1996[8] to 40.5% in 2004[9] and to 42.6% in 2006 [10]. Elevated blood pressure tracks relatively well from youth to adulthood, making blood pressure in youth a useful predictor of essential hypertension in adulthood [11]. The objective of this study was to determine the prevalence of hypertension and factors associated among Malay secondary school students in Putrajaya.

MATERIALS AND METHODS

A cross sectional study was carried out in Putrajaya, Malaysia. The sampling frame consisted of a list of all the 12 secondary schools in Putrajaya. Three schools were selected using table of random numbers. All Malay students aged 13 years old to 17 years old from the three selected school students were included in the study. Trained interviewers administered a pre-tested validated questionnaire to obtain data on age, gender, family history of hypertension. A standardised format questionnaire was used to collect the data on age, gender family history of hypertension. The interviewer obtained verbal consent from the subjects before administrating the interview.

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Blood pressure measurements

Blood pressure was measured after the respondents had rested for at least 5 minutes using a standard mercury sphygmomanometer. The respondents were examined in a seated position with the arm placed at the heart level. Three blood pressure measurements were taken for each respondent. Systolic blood pressure [SBP] was defined as the average of three SBP readings and diastolic blood pressure [DBP] was defined as the average of three DBP readings. The average of the three values was used in the analysis. The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents was modified and used in this study to classify the respondents [12]. In this study respondents were categorized as normal if the average SBP or DBP levels was less than the 90th percentile and prehypertension if the average SBP or DBP levels was greater than or equal to the 90th percentile, but less than the 95th percentile. The respondents were categorized as hypertension if the average SBP and/ or DBP that was greater than or equal to the 95th percentile for sex, age, and height.

Anthropometric measurements

Weight was recorded using the digital bathroom scale TANITA model HD-312 weighing machine on which the students were made to stand. This digital bathroom scale has scale marked in kilogram and measures weight to the nearest 0.2 kilogram. Two measurements were taken for both weight and height and the average of the two values were used in the analysis. After each respondent, the weighing machine was reset to zero. It was checked frequently by the use of a known weight. The students were requested to stand barefoot on the middle of the weighing machine, with the head looking straight in front, arms by the side and with only basic clothing. When the reading of the weighing machine was stable, the weight was recorded. Height was measured by using SECA Body meter Model 208 (made in Hamburg). The accuracy of this device is up to 0.05 centimeter. Height was measured by suspending the SECA bodymeter, two meters high from the floor against a straight wall, parallel to either doorframe or pillar. The student was then requested to stand barefoot under the center of the measuring tongue of the body meter without cap or songkok and then to lean against the wall with the back and head looking straight ahead so that an imaginary plane that would connect the eyes and ears were parallel to the floor. The student's heels were made to rest together against the wall or pillar, and the hands were loosely by the sides. The measuring tongue was lowered towards the head until it gently touched the head. Height measurement that appeared in the read-off area was then recorded.

Data Analysis

Statistical analysis was carried out using SPSS version 18. Categorical variables were presented as frequencies and percentages. The Pearson's chi-square test (x^2) test was used to determine the associations between categorical variables. Continuous variables were presented as means with their 95% confidence interval (CI) and standard deviation. Pearson correlation coefficient was performed to determine the correlation between two continuous variables. Independent sample t-test was used to compare the means of two independent continuous variables. The one-way Analysis of Variance (ANOVA) was used to test for differences among at least three groups. Post Hoc - Tukey test was used to perform multiple comparisons. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2).

A *p*-value of < 0.05 was considered as statistically significant.

RESULTS

Out of 1900 selected students aged 13-17 years old in the 3 selected schools, 1778 (93.6%) participated in the study. Non-respondents were those who were absent from class or those who did not give the consent to participate in the research. Table 1 shows the socio-demographic characteristics of respondents. Among the 1778 respondents, 899 (50.6%) of them were males. There was no significant difference in the mean age between males 14.7 (95% CI =14.7 - 14.8) years and 14.8 (95% CI =14.7-14.9) years respectively in the females (t= -0.67, df= 1776, p= 0.50). Out of the 1778, 40.4% had a family history of hypertension.

Blood pressure measurements

Table 1 and 2 show the mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) according to age and gender. The overall mean SBP and DBP for 1778 respondents was 108.9 and 63.2 mmHg respectively. Among the males, the mean SBP significantly increased with age except at 17 years, wherein there was a marginal decline in SBP (-0.3). For the females, the SBP also increased with age except at 14 years when there was a fall in SBP (- 1.0) mmHg. The DBP increased with age from 13 to 17 years in both sexes. The increase in the mean systolic

blood pressure with age was significant both in males (One way ANOVA T-test (F= 18.95, df= 4, p<0.001) and females (F= 4.54, df= 4, p= 0.001). Using Post Hoc - Tukey test to perform multiple comparisons between all the age groups for males showed that there was a significant difference in the mean systolic blood pressure levels between age group 13 and 15 (p = 0.001), 13 and 16 (p = 0.001), 13 and 17 (p = 0.001), 14 and 16 (p = 0.001), 14 and 17 (p = 0.001), 15 and 16 (p = 0.003), 15 and 17 (p = 0.005). However, there was no significant difference in the mean systolic blood pressure levels between age group 13 and 14 (p = 0.08), 14 and 15 (p = 0.43), 16 and 17 (p = 0.99). For females, significant difference in the mean systolic blood pressure was only found between age group 14 and 16 (p = 0.01), and between age group 14 and 17 (p = 0.01). The increase in the mean diastolic blood pressure with age was significant in males (One way ANOVA test F= 26.39, df= 4, p <0.001) but not in females (F= 2.11, df= 4, p=0.08). Using Post Hoc - Tukey test to perform multiple comparisons between all the age groups for males showed that there was a significant difference in the mean diastolic blood pressure levels between age group 13 and 14 (p = 0.007), 13 and 15 (p = 0.001), 13 and 16 (p = 0.001), 13 and 17 (p = 0.001), 14 and 15 (p = 0.002), 14 and 16 (p = 0.001), 14 and 17 (p = 0.001), 15 and 17 (p = 0.03). For females, there was no significant difference in the mean diastolic blood pressure between any age group (p > 0.05). The mean SBP was significantly higher in males 111.7 (95% CI = 110.8 – 112.5) mmHg as compared to 106 (95% CI = 105.6 – 112.2) mmHg in females (t= 9.5, df= 1776, p= 0.001). The difference in the mean diastolic blood pressure in males (63.5, 95% CI = 62.8 - 64.2 mmHg) was slightly higher as compared to 62.9, (95% CI = 62.3 – 63.6 mmHg) in females but the difference was not statistically significant (t= 1.2, df=1776, p= 0.23).

Table 1: Mean systolic blood pressure levels according to age and gender

Gender / Age (Years)	Number of respondents	Systolic blood pressure (mmHg)		
		Mean	95% CI	Std. Deviation
Male				
13	180	106.8	104.8-108.7	13.3
14	251	109.9	108.4-111.4	12.0
15	213	111.8	110.3-113.4	11.7
16	120	116.9	114.8-119.0	11.7
17	135	116.5	114.2-118.8	13.5
Total	899	111.7	110.8-112.5	12.9
Female				
13	168	105.1	103.3-107.0	12.1
14	204	104.3	102.7-105.8	11.2
15	251	105.5	104.0-106.9	11.6
16	152	108.4	106.4-110.4	12.6
17	104	108.9	106.5-111.3	12.4
Total	879	106.0	105.2-106.8	12.0
Both Gender				
13	348	106.0	104.6 – 107.3	12.7
14	455	107.4	106.3 – 108.5	12.0
15	464	108.4	107.3 – 109.5	12.1
16	272	112.2	110.6 – 113.7	12.9
17	239	113.2	111.5 – 115.0	13.6
Total	1778	108.9	108.3 – 109.5	12.8

Table 2: Mean diastolic blood pressure levels according to age and gender

Gender / Age (years)	Number of respondents	Diastolic blood pressure (mmHg)		
		Mean	95% CI	Std. Deviation
Male				
13	180	58.2	56.8-59.7	10.1
14	251	61.6	60.3-63.0	10.7
15	213	65.2	63.8-66.6	10.1
16	120	66.8	65.1-68.6	9.7
17	135	68.4	66.7-70.2	10.3
Total	899	63.5	62.8- 64.2	10.8
Female				
13	168	62.0	60.6-63.4	9.1
14	204	62.4	61.2-63.6	9.0
15	251	62.9	61.7-64.0	9.0
16	152	63.2	61.5-65.0	10.8
17	104	65.2	63.4-67.0	9.2
Total	879	62.9	62.3-63.6	9.4
Both Gender				
13	348	60.1	59.0 – 61.1	9.8
14	455	62.0	61.1 – 62.9	10.0
15	464	63.9	63.1 – 64.8	9.6
16	272	64.8	63.6 – 66.1	10.4
17	239	67.0	65.8 – 68.3	9.9
Total	1778	63.2	62.8 – 63.7	10.1

Prevalence of hypertension by age, gender, family history and nutritional status

Table 3 shows that the overall prevalence of pre-hypertension and hypertension was 11.1% and 11.6% respectively. The prevalence increased with age. From age 14 years to 16 years and there was a significant linear increase in trend in the prevalence of hypertension with age ($\chi 2$ for linear trend = 4.1, p =0.04). The data was than reanalysed by combining the pre-hypertension and hypertension group into one and compared to the normal group by age. The results showed that there was a significant association between prevalence of pre-hypertension/ hypertension and age ($\chi 2$=36, df= 4, p =0.001) and there was a linear increase in trend in the prevalence from age 14 to 17 years ($\chi 2$ for linear trend = 13.8, p =0.001). Among the male, the prevalence of pre-hypertension and hypertension was 16.2% and 12.9% respectively. The prevalence of pre-hypertension and hypertension in the female was 5.8% and 10.2% respectively. The results showed that there was a significant association between prevalence of hypertension and gender ($\chi 2$= 56.3, df= 2, p= 0.001).

Family History of Hypertension

Table 3 also shows that out of the 1778 respondents, 719 (40.4%) had family history of hypertension. The prevalence of hypertension was higher among those who had family history (12%) as compared to those who had no family history of hypertension (11.3%). However this difference was not statistically significant (p >0.05). There was no significant difference in the mean systolic blood pressure among respondents with family history and respondents without family history (t= -0.23, df= 1776, p= 0.81). The results also showed that there was no significant difference also in the mean diastolic blood pressure among respondents with family history and respondents without family history (t = -1.85, df= 1776, p= 0.06).

Table 3: Prevalence of hypertension according to age, gender, family history and nutritional status

Characteristic	Prevalence of Hypertension			
Gender /Age (years)	Normal	Pre-hypertension	Hypertension	Total
Male				
13	142(78.9%)	20(11.1%)	18(10.0%)	180
14	198(78.9%)	22(8.8%)	31(12.4%)	251
15	150(70.4%)	33(15.5%)	30(14.1%)	213
16	67(55.8%)	36(30.0%)	17(14.2%)	120
17	80(59.3%)	35(25.9%)	20(14.8%)	135
Total	637(70.9%)	146(16.2%)	116(12.9%)	899
Female				
13	143(85.1%)	7(4.2%)	18(10.7%)	168
14	181(88.7%)	9(4.4%)	14(6.9%)	204
15	211(84.1%)	18(7.2%)	22(8.8%)	251
16	121(79.6%)	8(5.3%)	23(15.1%)	152
17	82(78.8%)	9(8.7%)	13(12.5%)	104
Total	738(84.0%)	51(5.8%)	90(10.2%)	879
Both Gender				
13	285 (81.9%)	27(7.8%)	36(10.3%)	348
14	379(83.3%)	31(6.8%)	45(9.9%)	455
15	361(77.8%)	51(11.0%)	52(11.2%)	464
16	188(69.1%)	44(16.2%)	40(14.7%)	272
17	162(67.8%)	44(18.4%)	33(13.8%)	239
Total	1375(77.3%)	197(11.1%)	206(11.6%)	1778
Family History				
Yes	557 (77.5%)	76 (10.5%)	86(12%)	719
No	818 (77.3%)	121(11.4%)	120 (11.3%)	1059
Nutritional status				
Lean	172 (91.5%)	10 (5.3%)	6 (3.2%)	188
Normal	971 (83.8%)	113(9.7%)	75 (6.5%)	1159
Risk of Overweight	149 (66.8%)	37 (16.6%)	37 (16.6%)	223
Overweight	83 (39.9%)	37 (17.8%)	88 (42.3%)	208

Prevalence of overweight and association between BMI and blood pressure

The prevalence of 'at risk of overweight' and overweight was 12.5% and 11.7% respectively. There was a significant correlation between BMI and SBP ($r = 0.52$, $r^2 = 0.27$, $p= 0.001$) and DBP ($r = 0.38$, $r^2 = 0.15$, $p= 0.001$). The results also showed that the prevalence of hypertension was significantly higher in the children who were overweight and those 'at risk of overweight' as compared to those children who were normal or lean (Table 3).

DISCUSSION

In Malaysia, cardiovascular diseases have been the leading cause of death for the past 40 years [9]. The mortality, morbidity and disability attributable to non-communicable diseases is currently high and continues to grow. The prevalence of hypertension in adults is high; there is low level of awareness, low treatment rates and poor control

of hypertension [10]. Only 35.8% of respondents with hypertension were aware that they had hypertension and only 31.4% were currently being treated, and only 8.2% had their blood pressure under control [10]. The prevalence of risk factors for hypertension continues to show an increasing trend. The prevalence of obesity amongst Malaysians 18 years and above has increased from 4.4% in 1996 [8] to 12.3% in 2004 [13]. and 14.2% in 2006 [10]. In a study carried out by Rampal *et al.* in 2005 among 3,333 school children aged 13-17 years in the Klang district, showed that the prevalence of 'at risk of overweight' and 'overweight' was 11.4% and 8.2% respectively [14]. Hypertension is an established risk factor and contributes substantially to cardiovascular disease incidence and premature mortality [15]. In the next 10 years, China, India, and Britain will lose $558 billion, $237 billion, and $33 billion, respectively as a result of largely preventable heart disease, strokes, and diabetes [16-17]. Increased blood pressure levels during childhood strongly predict hypertension in young adulthood [18-19]. Among adolescents and young adults; elevated blood pressure is also associated with the presence of early atherosclerotic lesions[20]. In our current study, the prevalence of pre-hypertension and hypertension among the male was 16.2% and 12.9% respectively. The prevalence of prehypertension and hypertension in the female was 5.8% and 10.2% respectively. The overall prevalence of pre-hypertension and hypertension was 11.1% and 11.6% respectively, which is high. The prevalence of 'at risk of overweight' and overweight was 12.5% and 11.7% respectively. The prevalence of hypertension was significantly higher in the adolescents who were overweight or at risk of being overweight. The results also showed that there was a significant correlation between BMI and hypertension ($r = 0.52$, $r^2 = 0.27$, df=2, $p= 0.001$). Obesity, glucose intolerance, and hypertension in childhood were strongly associated with increased rates of premature death from endogenous causes in this population [21]. Even in USA blood pressure has increased over the past decade among children and adolescents. This increase is partially attributable to an increased prevalence of overweight [22-23]. In a study carried out among school children aged 8 years to 13 years in Fort Worth, Texas, Urrutia-Rojas *et al.* [24] reported an overall, the prevalence of HBP was 20.6 % and the likelihood of having hypertension was three times higher for overweight children in their study($p < 0.001$). In another study, school-based screening was performed in 5102 students aged 10 to 19 years in 8 Houston public schools from May 2002 to November 2002. The prevalence of elevated blood pressure on first screen was 19.4% [25]. Liang, Ya-Jun *et al.* [26] also reported an upward trend in blood pressure and hypertension in Chinese children and adolescents. The prevalence of pre-hypertension and hypertension increased dramatically from 1991 to 2004, with average relative increases of 6.38% and 8.13% in children and adolescents, respectively. Sharma *et al.* [26] reported that 5.9% schoolchildren aged 11-17 years in Shimla, India had hypertension and 12.3 % had prehypertension. In our study, both systolic and diastolic pressures showed a rising trend with age in both sexes. Similar results have also been reported in many other studies [28-29]. Multiple long-term cohort studies and randomized clinical trials have shown that the risks from raised blood pressure can be partially reversed [30-31]. Implications of this study are that the results show that the risk factors for cardiovascular diseases are already present in school children aged 13 to 17 years in Malaysia. These findings have been highlighted to the members of Ministry of Health staff. There is a need to develop, implement and evaluate effective national policies and sustainable practice for work on healthy eating and physical activity in schools. Second, early adolescents need better education on the need for healthy eating and physical activity in schools in a positive and sustainable way. A comprehensive approach involving behavioral modification intervention both in schools and in the community should be implemented. Involvement of the people at all levels especially those in policy-making and implementation is important. Interventions in schools to increase physical activity should ensure activities are challenging and fun and everyone should be able to participate. Dietary programmes should be integral to both the prevention and management program. There must also be a broader adherence to daily intake of fruit, vegetables, fish and fatty acid composition. School policy should address health-related issues relating to children who are hypertensive's, overweight or physically inactive and not only addressing factors in individual children's lifestyles but also those in the school environment, both physical and social. The Parent Teachers Association could be used as a vehicle for the headmasters, teachers, school health nurses, physicians/dentists and the canteen owners to work cooperatively with parents and the community to achieve the common goal of providing school children with the programs and environment necessary to promote health and improve learning. The parents, teachers and students need to be empowered and we must enable them to have greater control over efforts to improve their health. Third, capacity building and leadership of teachers, health care workers, community leaders and non-government organizations need to be enhanced. The Malaysian Health Promotion Board (MHPB) which is a statutory body established under an Act of Parliament of Malaysia Act 2006 can be approached to assist in capacity building [32]. Lastly, routine blood pressure measurements in school children should be carried out every year. School children with pre-hypertension and hypertension should be referred to the physician for management. This would help to improve the detection, prevention and treatment of hypertension. In conclusion, prevalence of hypertension and pre-hypertension is high among school children aged 13-17 years in Putrajaya. There is an urgent need for implementation of a comprehensive CVD prevention program and routine blood pressure measurements should be taken in school children to improve the detection, prevention and treatment of hypertension.

ETHICAL APPROVAL

Approval from the Faculty of Medicine and Health Science, University Putra Malaysia human research committee was received before commencement of the study. Permission was also obtained from the Ministry of Education, Malaysia. Informed consent was also obtained from the each respondent before data was collected.

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