ORIGINAL ARTICLE

A Study on Relationship between Sitting Height and Blood Pressure among Malaysian Adolescent Population

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ABSTRACT

Background: High blood pressure is a major predisposing factor contributing to morbidity and mortality, both in developed and developing nations. Literature stipulated a significant association of sitting height with blood pressure in adolescents. However, such studies were not conducted in Malaysia.
Aim: To assess the correlation between sitting height and blood pressure in Malaysian adolescents, which enables in prediction and early diagnosis of hypertension and other associated risk factors.
Methods: For this study, a total of 375 children aged between 13 to 17 years old attending two public secondary schools in Malaysia were recruited. The anthropometric and blood pressure measurements were obtained via standard procedures. The obtained data is then analysed through Excel spreadsheets and SPSS version 2015.
Results: The results evinced a significant correlation between sitting height and systolic blood pressure and diastolic blood pressure in the unadjusted analysis. **Conclusion:** The positive correlation between body measurements with blood pressure enables early detection of high blood pressure from sitting height during adolescence, in turn preventing many chronic disorders later in life.
Keywords: Sitting height, blood pressure, adolescents.

INTRODUCTION

As hypertension is the leading global risk factor for several chronic disorders, even resulting in mortality, there is an indispensable need of action to address the problem[1]. However, due to little awareness, lack of treatment and control of hypertension, most of the cases were never diagnosed[2]. Therefore, it is advisable to identify the susceptibility to the disease and embrace preventive measures at an earlier age. Adolescence is the considerate phase of life of an individual, during which, the physical growth ascertains their health during later life[3].

An increase in blood pressure at young age helps in predicting the likelihood of developing the hypertension in adulthood[4,5]. Existing literature determined that, sustained high blood pressure in children is associated with the risk factors of cardiovascular diseases and chronic kidney diseases[6,7,8].

Previous studies have manifested a substantial association of body mass index with high blood pressure in children and adolescents[9].

Measurement of blood pressure may not show accurate values in a clinical setup due to various factors, such as, blood pressure variability, white coat hypertension, and un-cooperative children[10]. Hence, several studies in the past have demonstrated a positive significance of body mass index and standing height with blood pressure, wherein, these anthropometric variables predicts blood pressure[11,12,13,14,15].

Furthermore, researchers reported that sitting height and sitting height total height ratio are better parameters to predict the blood pressure in this age group. A study performed by Marcato, D. G et al on Brazilian children showed an association of only sitting height with blood pressure[16]. Dong et al. study in Chinese children and adolescents substantiated the previous studies[17].

In another study, a significant relationship has been established between sitting height with both systolic blood pressure and diastolic blood pressure in rural South African children[18]. A longitudinal study done by Regnault et al on American children also exhibited a positive correlation between trunk length and blood pressure levels, justifying that, the higher blood pressure in children with greater trunk lengths is because of the additional pressure needed to overcome the gravity to perfuse the brain.

However, in Malaysia, few studies have been conducted related to establish this correlation. One among them demonstrated the significance between waist measurements and blood pressure in adolescents[19]. Hence, the aim of this study was to evaluate the correlation between these anthropometric components and blood pressure among Malaysian school children, aged 13-17 years.

MATERIALS AND METHODS

Study population and ethical approval: A total of 375 adolescents (171 males and 204 females), aged 13 to 17 years old, attending 2 public secondary school in Malaysia participated in the study in December 2019. The majority of the participants were Chinese (61.87%), followed by Malay (33.07%), Indian (3.47%) and other racial groups (1.6%). Prior to the study, ethical approval had been obtained from the Ethics Committee of the University of Perdana (PU IRBHR0216), Ministry of Education Malaysia - Educational Policy Planning and Research Division (Reference number: KPM.600-3 / 2/3-eras (4955)), Selangor State Department of Education (Reference number: JPNS.PPN.600-1/1/2 JLD.11(36)), as well as by principals of the targeted schools.

Data collection: All the participants who were available during the days of the survey participated in the study. However, subjects with significant vertebral deformities and those who did not consent for participation were excluded from this study. Before obtaining the data, the procedures and the importance of this study were clearly explained to the participants. Moreover, the written signed consent from the parent or legal guardian was collected.

Anthropometric measurements:

The height of the participant was measured by bringing the horizontal bar of the anthropometer to the most superior midline of the head, while the subject was standing erect.

The sitting height of the subject was measured by bringing the horizontal bar of the anthropometer to the most superior midline of the head, while the subject sitting erect on a flat surface.

Blood pressure:

The blood pressure was measured with a sphygmomanometer. The systolic blood pressure and diastolic blood pressure were measured after the child had been seated for 5 minutes.

Data analysis:

The data obtained was analysed using Excel spreadsheets and IBM Statistical Package for Social Sciences (SPSS) version 2015.

Detailed statistics were performed for standing height, sitting height, sitting height/standing height, and blood pressure of the adolescents aged 13-17 years.

Means and standard deviations were obtained for standing height, sitting height, and sitting height/standing height. Moreover, the means of both systolic and diastolic blood pressure were compared against all age groups.

The linear regression models were used to analyse the relationship between blood pressure (SBP: Systolic Blood Pressure and DBP: Diastolic Blood Pressure) and components of height (standing height, sitting height, and sitting height/standing height) and were unadjusted and adjusted to age, gender, and race.

RESULTS

The statistical analysis evinced a proportionate increase of systolic blood pressure, diastolic blood pressure and pulse pressure with age for both genders.

In unadjusted analysis and after adjustment with race and male gender, the standing height, sitting height, and sitting height/standing height were significantly associated with systolic blood pressure and diastolic blood pressure.

In adjusted female gender, while all the three anthropometric variables showed correlation with systolic blood pressure, only sitting height remained associated with diastolic blood pressure.

DISCUSSION

The trends in the mean systolic blood pressure, diastolic blood pressure, and pulse pressure are illustrated by age for males and females (Figure. 1, 2, and 3). In general, there was a moderate rise in blood pressure with age for all gender groups.

The increase in blood pressure with age was described as cardiovascular adaptation to growth, which reflects physiological maturation[20].

Table 1 displays the unadjusted Pearson correlation coefficient and p-value between standing height, sitting height, and sitting height/height with blood pressure in these subjects. There was a significant relationship between these anthropometric parameters with both systolic and diastolic blood pressure with p-value <0.001.

After adjustment against race, the Pearson correlation coefficient was slightly lowered in the data adjusted with race in comparison to the unadjusted analysis with no change in p-value (Table 2).

Table 3 explains the adjustment against age, which resulted in an unchanged p-value with systolic blood pressure. However, the p-value changed with diastolic blood pressure, especially for sitting height (p-value 0.012) and sitting height/height (p-value 0.003). For Pearson correlation coefficient, all the variables of anthropometry were weakly correlated with systolic blood pressure. Whereas, only sitting height exhibited correlation with diastolic blood pressure which is weak (Pearson Correlation Coefficient = 0.229).

The p-value remained significant for all the morphometric parameters with both systolic and diastolic blood pressures, after adjustment against male and female genders.

For Pearson correlation coefficient in adjustment against males, the measurements were moderately correlated with systolic blood pressure and weakly correlated with diastolic blood pressure, which is shown in table 4.

Table 5 illustrates the Pearson correlation coefficient, a weak correlation of all the three variables of body measurements with systolic blood pressure, in adjustment against females. However, only sitting height showed a weak association with the diastolic blood pressure.

The results of present study are coinciding with the results of other studies, where sitting height is positively related to the blood pressure[7,13]. The possible explanation for such finding is, for an adequate blood perfusion to the brain, the blood pressure at the heart level need to surpass the hydrostatic pressure which is induced by the vertical distance between the heart and the head[7,11].

The positive association of body measurements with blood pressure in this study indicates that, early monitoring of childhood's vulnerability towards high blood pressure can be achieved through measurements of sitting height. Considering the substantial risk of cardiovascular and other disorders in children with high blood pressure, it is crucial to identify and screen the susceptible individuals by monitoring the blood pressure from early ages. Hence, early detection of high blood pressure from sitting height during adolescence facilitates in preventing many chronic disorders later in life and increase the longevity of individuals. The present study has not included the information such as socio-economic and nutritional status of the subject families and family history of hypertension. As the blood pressure and morphometric measurements were taken directly, estimation bias will not reign in our study.

Figure 1 illustrating the mean blood pressure across genders

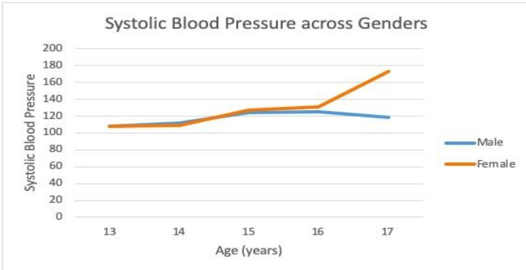

Figure 1. Mean systolic blood pressures for males and females.

Figure 2 illustrating the diastolic blood pressure across genders

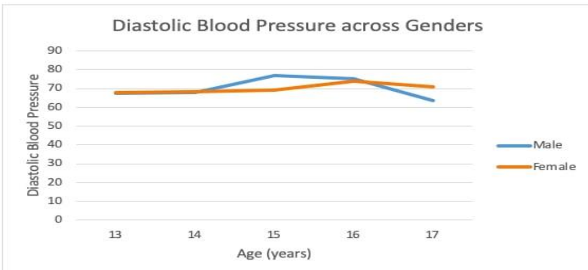

Figure 2. Mean diastolic blood pressures for males and females.

Figure 3 illustrating the mean pulse pressure across genders

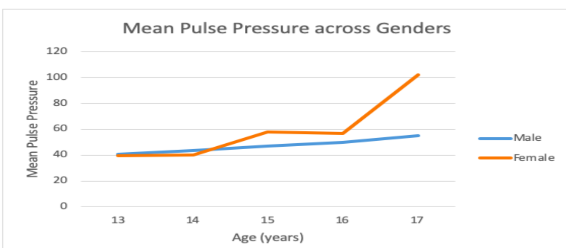

Figure 3. Mean pulse pressures for males and females.

Table 1 displaying the unadjusted Pearson correlation coefficient and p-value between standing height, sitting height, and sitting height/height with blood pressure.

Unadjusted		
	Pearson Correlation Coefficient	p-value
Systolic Blood Pressure (mmHg)		
Standing height (cm)	0.364	<0.001
Sitting height (cm)	0.487	<0.001
Sitting height/Standing height (%)	0.293	<0.001
Diastolic Blood Pressure (mmHg)		
Standing height (cm)	0.226	<0.001
Sitting height (cm)	0.321	<0.001
Sitting height/Standing height (%)	0.218	<0.001

Table 1: Unadjusted Pearson Correlation Coefficient and *P*-value for the association between standing height, sitting height (SH), SH to height ratio (SH/H) and blood pressure among Malaysian adolescents.

Table 2 illustrating the adjusted Pearson correlation coefficient and p-value between standing height, sitting height, and sitting height/height with blood pressure.

Adjusted against Race		
	Pearson Correlation Coefficient	p-value
Systolic Blood Pressure (mmHg)		
Standing height (cm)	0.337	<0.001
Sitting height (cm)	0.454	<0.001
Sitting height/Standing height (%)	0.258	<0.001
Diastolic Blood Pressure (mmHg)		
Standing height (cm)	0.211	<0.001
Sitting height (cm)	0.305	<0.001
Sitting height/Standing height (%)	0.200	<0.001

Table 2: Pearson Correlation Coefficient and *P*-value adjusted with race for the association between standing height, sitting height (SH), SH to height ratio (SH/H) and blood pressure among Malaysian adolescent.

Table 3 illustrating the adjusted Pearson correlation coefficient and p-value with age for correlation between standing height, sitting height, and sitting height/height with blood pressure.

Adjusted against Age		
	Pearson Correlation Coefficient	p-value
Systolic Blood Pressure (mmHg)		
Standing height (cm)	0.233	<0.001
Sitting height (cm)	0.365	<0.001
Sitting height/Standing height (%)	0.204	<0.001
Diastolic Blood Pressure (mmHg)		
Standing height (cm)	0.130	0.012
Sitting height (cm)	0.229	<0.001
Sitting height/Standing height (%)	0.155	0.003

Table 3: Pearson correlation coefficient and *P*-value adjusted with age for the association between standing height, sitting height (SH), SH to height ratio (SH/H) and blood pressure among Malaysian adolescent.

Table 4 illustrating the adjusted Pearson correlation coefficient and p-value with male for correlation between standing height, sitting height, and sitting height/height with blood pressure.

Adjusted against Male Gender		
	Pearson Correlation Coefficient	p-value
Systolic Blood Pressure (mmHg)		
Standing height (cm)	0.432	<0.001
Sitting height (cm)	0.559	<0.001
Sitting height/Standing height (%)	0.396	<0.001
Diastolic Blood Pressure (mmHg)		
Standing height (cm)	0.320	<0.001
Sitting height (cm)	0.374	<0.001
Sitting height/Standing height (%)	0.228	0.003

Table 4: Pearson Correlation Coefficient and *P*-value adjusted with male gender for the association between standing height, sitting height (SH), SH to height ratio (SH/H) and blood pressure among Malaysian adolescent.

Table 5 illustrating the adjusted Pearson correlation coefficient and p-value with female for correlation between standing height, sitting height, and sitting height/height with blood pressure.

Adjusted against Female Gender		
	Pearson Correlation Coefficient	p-value
Systolic Blood Pressure (mmHg)		
Standing height (cm)	0.216	0.002
Sitting height (cm)	0.351	<0.001
Sitting height/Standing height (%)	0.257	<0.001
Diastolic Blood Pressure (mmHg)		
Standing height (cm)	0.170	0.015
Sitting height (cm)	0.286	<0.001
Sitting height/Standing height (%)	0.218	0.002

Table 5: Pearson coefficient correlation and *P*-value adjusted with female gender for the association between standing height, sitting height (SH), SH to height ratio (SH/H) and blood pressure among Malaysian adolescent.

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