ORIGINAL ARTICLE

Correlation Between the Knee Height and Pulse Pressure in the Young Adults

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ABSTRACT

Introduction: Wider pulse pressure (PP) can be an indicator of cardiovascular diseases (CVDs), and affected among others by lower bone marrow density (BMD) of the long bones and the circulating insulin-like growth factor 1 (IGF-1) level. We aim to determine the correlation between the knee height (KH) and the PP in the seemingly healthy young adults in Indonesia. **Methods:** The PP and KH of 32 seemingly healthy males and females aged 20-26 years were examined using standardised anthropometry for the KH and digital sphygmomanometer to get the systolic and diastolic pressures, respectively. Data were analysed using Pearson correlation test with level of significance of $p<0.05$. **Results:** We found strong positive correlation between the KH and the PP ($r= 0.621$, $p<0.001$). **Conclusion:** In this study, greater pulse pressure correlates significantly to the higher KH, and vice versa; arguably could modulate the risk for having CVDs in the later life.

Keywords: Knee, Arterial pressure, Young adult

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INTRODUCTION

One indicator of growth and development in humans can be measured from the length of the long bones including the tibia and the foot. The height of these bones is measured in the anthropometry known as the knee height (KH) (1). Various factors might modulate the growth of the long bones including the level of the IGF-1 which may affect the calcium metabolism hence determine the bone mineral density (BMD) (2).

Impairment of growth and development can be found in the form of e.g. stunting, dwarfism, and gigantism (3). In Indonesia, stunting is approximately occurred in 9.2 million out of 24.5 million children under 5 years old (4). In these cases, the patients are reported to suffer from various CVDs including impaired blood pressure and abnormality of the function of the heart. The underlying mechanism reported includes modulation in the atherosclerosis formation of the big vessels due to altered mineral and lipid metabolisms (5).

Cardiovascular diseases are still the leading cause of high mortality in the world. In 2012, deaths due to CVDs are 17.5 million, more than a half of these cases occurred in the developing countries including Indonesia (6).

Several studies showed that there was a correlation between the risk of CVDs and the body height. In the age of 50, negative association was shown between leg length and blood pressure in males and females (7, 8). It was shown in the elderly women, hypertension was correlated to the lower femoral neck density, although there was no evidence that osteopenia and osteoporosis associated to the hypertension (5). On the other hand, in adolescent, when the puberty process occurs, IGF-1 levels are at their peak, these have an effect on high bone marrow density with the balance between bone resorption and bone formation (2, 9).

In this study, we aim to determine correlation between the knee height and the pulse pressure in the seemingly healthy young adults in Indonesia, to

understand the prevalence of the risk of the CVDs in the early period of life.

MATERIALS AND METHODS

This study was approved by the Health Research Ethical Clearance Commission of the Universitas Airlangga, Surabaya, Indonesia (No.173/HRECC. FODM/III/2020). This is a cross-sectional study that was conducted on 32 healthy subjects (16 males and 16 females) in Surabaya, Indonesia aged 20-26 years. All participants are the university students with no history of metabolic syndrome and other major illnesses e.g. thyrotoxicosis, ischemic heart diseases, hypertension and major trauma. They are all originated from East Indonesian region; they come from middle-upper class. They have been living sedentary lifestyle whilst mostly spending their daily activities by studying and using gadgets. Their routine diets include rice as the primary carbohydrate source, vegetables, and side dishes, also snacks including several types of fast food and other kind of traditional foods. Participants with amputated limb(s) and/ or abnormality of the hard and soft tissue of the lower leg, taking medication i.e. antihypertension drugs, thyroid disease drugs were excluded. All participants have agreed to the research nature of this study and signed the informed consent and concern of information prior to this study.

All measurements were done by two trained medical doctors. The knee height was measured using the protocol of the Third National Health and Examination Survey (NHANES III) (10). Further details are explained somewhere else (11). Data of sex and age were collected.

The blood pressure was measured by validated Omron HEM 7130 digital automatic sphygmomanometer (Omron, Kyoto, Japan), using American Heart Association guidelines (12). The blood pressure was measured 3 times (in 5 minutes interval). The systolic and diastolic blood pressure was defined as the average of second and third measurement values, the pulse pressure was then defined as the difference between these two values (mmHg) (13, 14).

All analysis was done using SPSS 25.0. Data were tested with Shapiro-Wilk normality test and Levene homogeneity test, all data were parametric. Differences in KH and PP between males and females were then tested using Independent t-test. Pearson correlation test was used to identify the relationship between the knee height and the pulse pressure. The significant level is $p<0.05$.

RESULTS

The mean pulse pressure and the KH between male and female was significantly different ($p<0.001$). Further information of these will be explained in Table I.

The knee height (KH) of males is significantly longer than female, 52.9 + 2.8 cm for men, while for women 48.1 + 1.9 cm ($p<0.001$). On the other side, the pulse pressure of females is significantly lower than men ($p<0.001$).

The knee height (KH) of all participants are strongly correlated to the pulse pressure ($r = 0.621$, $p <0.001$) as explained in Table II.

Table I : The pulse pressure and knee height between males and females

Variables	μ ± SD	p	Mean Difference (95%CI)
Pulse pressure (mmHg)			
Male (n= 16)	49.00 ±12.16	<0.001[a]	15.5 (8.01-22.99)
Female (n= 16)	33.50 ± 8.21		
Knee Height (cm)			
Male (n= 16)	52.9 ± 2.8	<0.001[a]	4.9 (3.2-6.6)
Female (n= 16)	48.1 ± 1.9		

[a]Significant (Independent t-test)

Table II : Correlation analysis between pulse pressure and knee height in all participant

Pearson correlation	Pulse pressure (n=32)	
	r	p
Knee height	0.621	< 0.001[a]

[a]Significant.

DISCUSSION

In the current study we found significantly higher knee height in males than females with significant wider pulse pressure in males than females. Wider pulse pressure indicates target organ damage and/ or atherosclerosis which result in stiffer and damage blood vessel wall. Several CVDs with widened pulse pressure include aortic regurgitation, aortic sclerosis, severe iron deficiency anemia, atherosclerosis, and hyperthyroidism. Pulse pressure tends to increase after the age of 50 years from the normal range of approximately 40-60 mmHg. This might be due to the stiffening of arteries of blood pressure as someone ages (15).

We also found that there was a strong positive correlation between the knee height and the pulse pressure. Previous study reported that shorter height and leg length were closely correlated with high blood pressure in males and females. This means the increase in systolic blood pressure of someone whose legs where shorter would be higher compare with someone with greater body height (7, 8).

Furthermore, another study showed that wide PP is associated with bone marrow density (BMD) and the level of LDL plasma. The adipose tissue is secreting the apelin, which is a kind of adipokine ligand, modulated by the level of insulin. It was reported that this is correlated to the CVDs in the obese people (1, 5, 16). There was a negative relationship between hypertension and vitamin D level (17). Moreover, several antihypertension drugs i.e. nifedipine may affect the calcium metabolism due to the same type of calcium channel (L-type) (18).

Sexual dimorphism of the long bones was highly dependent on estradiol, the naturally occurring estrogens. Estrogen was produced in both the ovaries and testes, where androgens were converted to estrogen by enzyme aromatase. Low estrogen levels enhanced growth hormone (GH) and insulin-like growth factor 1 (IGF-1), but the high level of estrogen inhibited IGF-1 (9). Estrogen is known as a vasodilator which may decrease the blood pressure due to the activation of endothelial nitric oxide (NO) and inhibiting angiotensin II and endothelin 1 (ET-1). It was reported that the angiotensin II type 2 (AT2) receptors which is served as a protective factor against the CVDs, were higher in females than males. Together with angiotensin converting enzyme 2 (ACE 2), the AT2 were located on the sex chromosomes (X-linked) in humans; they might help to stabilize the blood pressure (19).

The limitation of this study includes a relatively small number of participants due to the physical distancing situation during the Covid-19 pandemi in 2020. Thus, the interpretation of the current result must be taken wisely.

CONCLUSION

Here we observed significant greater knee height and wider pulse pressure was observed in males than females; there was a positive strong correlation between the knee height and the pulse pressure in all participants.

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