Relationship between Physical Activity and Age on Flatfoot in Children

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Abstract

Background: Modern technology has decreased physical activities of most people, especially children. A low physical activity is one of the risk factors of flatfoot. Flatfoot is a flattening of medial longitudinal arch of the foot (MLA) affecting human's body posture and gait. The objective of this study was to analyze the relationship between physical activity and age on flatfoot.
Methods: This study selected 271 children from the elementary school of Cikeruh 1, Jatiroke 1, and Paripurna using cluster random sampling method. Data were collected from August to November 2015. The primary data were collected using questionnaire to determine the physical activity level and footprint method to measure MLA height which was counted using Arch Index (AI). If the AI>0.26, it was considered low arch/flatfoot. Statically, the collected data were analyzed by Fisher's exact test.
Results: From a total of 271, 151 (55.7%) children had a low activity level with 120 of them (44.3%) were flatfoot, whereas in 113 (41.7%) children with an intermediate activity level, 76 children (28.0%) were flatfoot; and from a total of 7 (2.6%) children with a high activity level, 4 children (1.5%) were flatfoot. There was a negative correlation between age and arch index, right foot (r=-1.67;p=0.006), left foot (r=-1.56;p=0.01). This study proved that there was a relationship between the level of physical activity and flatfoot (Fisher=6.125/p=0.040).
Conclusions: The Arch Index of the foot becomes smaller with age with an inverse correlation and low physical activities have been proved to have contibution to flatfoot occurrence. **[AMJ.2016;3(3):396–400]**

Keywords: Arch Index of the foot, children, flatfoot, medial longitudinal arch of the foot, physical activity

Introduction

Modern technologies influence the development of new practical approaches to perform tasks that make many changes in human behaviour and lifestyles. Nowadays, people prefer to use any form of transportation than walking. Moreover, people tend to use entertainment devices such as gadgets in mobile phone, watch television, or play video games to refresh their mind. Such activities are seen in children who prefer playing video games than running, exercising, and other forms of outdoor/physical activities. When playing video games, children often play it for hours. This behavior causes children spend more time sitting and lacking of physical activities.[1,2]

In the United States, a decreased physical activity issue has become a consideration and some studies revealed that schools have the most potential in increasing physical activity in children.[3] Physical activity can reduce the risk of stroke, diabetes mellitus type 2, and severe injuries from falling.[1] Moreover, physical activity is one of the factors relating to flatfoot.[4]

Flatfoot is a condition of a decrease in the medial longitudinal arch of the foot (MLA).[5] Medial longitudinal arch of the foot development begins between ages 2 and 3 when children start walking, and stops 6 years after initial development between ages 12 and 13. Flatfoot is considered normal in children up to the age of 13 because the MLA structure still undergoes development. However, if flatfoot persists after the age of 13, it was feared to be permanent or further complications can possibly arise in adulthood such as fractures, scoliosis, and abnormal body posture.[6,7]

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Physical activity is one of many factors that influences flatfoot. In children having poor physical activities, fat in the soles of the feet break at a slower rate causes the foot to be flat.[4] The aim of this study was to determine the relationship between physical activity and age on flatfoot in elementary school children.

Methods

This study was carried out as a part of a study of teenager health conducted by the Community Health and Wellness (Kesehatan dan Kebugaran Komunitas) research center at Faculty of Medicine Universitas Padjajaran. A cross-sectional study was chosen and sample were collected using the cluster random sampling method. Twenty nine elementary schools in Jatinangor, West Java were compiled into 3 big groups based on location. An elementary school was selected from each location and 3 elementary schools were obtained randomly (1:3). The study population of this sample was students of SD Cikeruh 1, SD Jatiroke 1 and SD Paripurna. The minimum samples of this study were 323 calculated for independent-continuous analytic study. However, this study did not meet the minimum sample size.

The inclusion criteria of this study were students from elementary schools in Jatinangor from class 4 and class 5, who had completed the informed consent form and were presented during data collection. Students who had other anatomical feet abnormalities besides flatfoot were excluded.

The MLA was obtained by measurements based on the footprint method to determine the arch index.[8] Arch Index was measured based on the footprint by locating the axis and drawing a line from the middle of the heel to the end of the index toe. Then, a straight line was constructed from the protruding part of the metatarsal. Lines formed between the medial point of the heel and the point of the protruding part of the metatarsal were obtained and divided into three equal parts. Measurements were made using the following equation.[9,10] The criteria to determine the height of the foot arch were AI ≤0.21 = high arch, 0.21≤AI≤0.26 = normal arch and AI ≥0.26 = flat arch or flatfoot. The criteria of flatfoot stated that if one of both feet was positive for flatfoot, the individual was said to have flatfoot.

Physical activities of the subjects were determined by using the Physical Activity Questionnaire for Older Children (PAQ-C). This questionnaire was used to evaluate daily activities of subjects in the last 7 days and was only reserved for children between the ages of 8 to 12 years old.[11] The questionnaire was validated (Cronbach Alpha's = 0.751) before being used in this study. Physical activities in children were divided into 3 categories. From the questionnaire, a score of 1 and 2 were categorized as low, a score of 3 was categorized as average, and a score of 4 and 5 were categorized as high.

This study involved 271 children as subjects. Seventeen children were not included

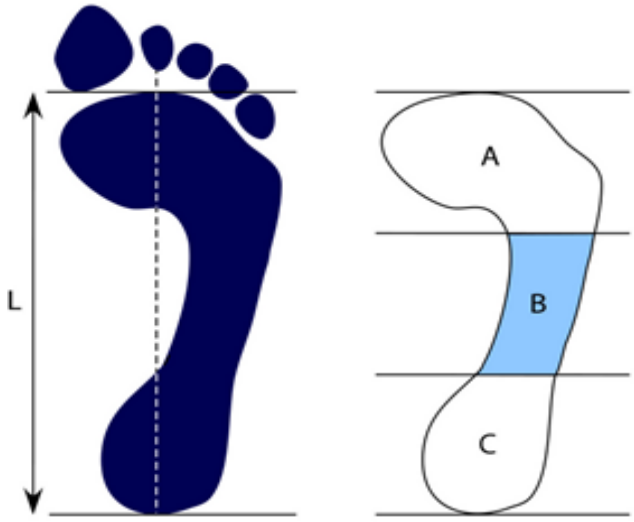

Figure 1 Arch Index Measurements[10]
Note: AI=(B)/(A+B+C)

Table 1 Characteristics of Elementary School Students in Jatinangor

Characteristics	n=271
Age, years, median	10
Sex, male (%)	50.9
School (%)	
SDN Cikeruh 1	25.1
SDN Jatiroke 1	29.5
SDN Paripurna	45.4
Physical Activity (%)	
Low	55.7
Medium	41.7
High	2.6

in the analysis of results because they did not meet the inclusion criteria and data of these subjects were incomplete.

The data were analyzed statistically. The data distribution for numerical variable was already normal. Medial longitudinal arch of the foot and age were analyzed using hypothesis bivariate correlation. Physical activity and flatfoot occurrence were analyzed using Fisher's exact test.

This study was approved by the Health Research Ethical Committee from Faculty of Medicine, Universitas Padjadjaran No. 350/UN6.C2.1.2/KEPK/PN/2013.

Results

This study discovered that more than half of the 271 subjects were boys, between 8 and 13 years old. A majority of students, as much as 135, were from SDN Paripurna and the lowest numbers of student were from SDN Cikeruh 1. Subjects had varying levels of physical activity. One hundred and fifty one subjects were characterized as having the low level of activity, 113 (41.7%) were characterized as having the average level of activity, and 7 (2.6%) subjects were characterized as having the high level of activity.

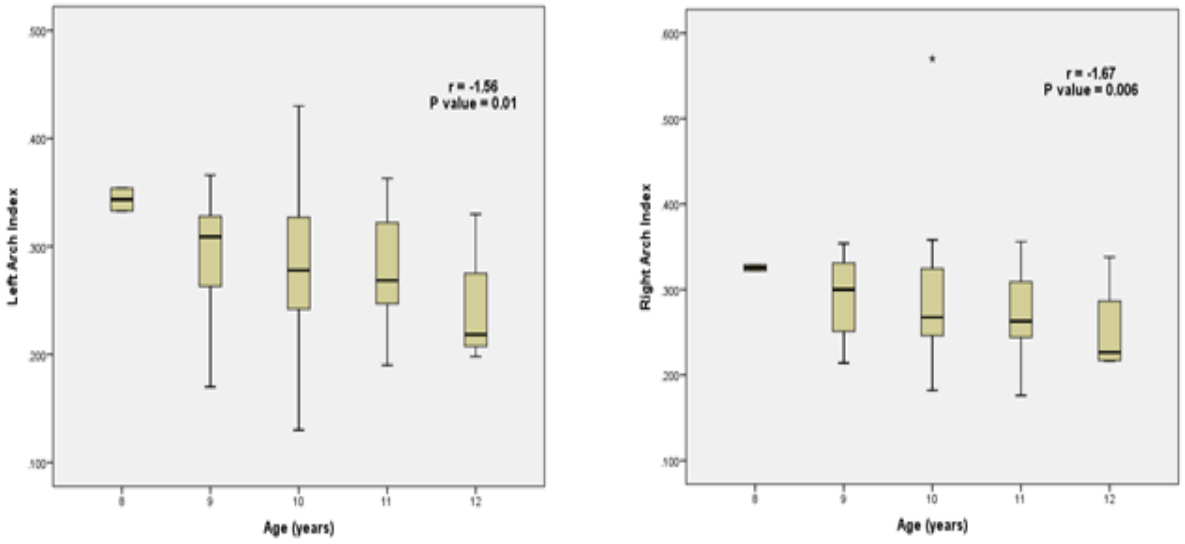

Figure 2 Correlations between Age and Arch Index
Note: (A) Left Foot (B) Right Foot

Table 2 Flatfoot based on Levels of Physical Activity

Physical Activity	Flatfoot (+) (N=200)	Flatfoot (-) (N=71)	Significance
Low	44.30%	11.40%	
Intermediate	28.00%	13.70%	*6.215 (0.040)
High	1.50%	1.10%	

Note: *Fisher Exact

The Arch Index of the left foot in children aged 8 years old had a mean of 0.343, a minimum value of 0.333, and a maximum value of 0.354. Children aged 9 years old had a mean of 0.295, a minimum value of 0.170, and a maximum value of 0.366. Children aged 10 years old had a mean of 0.282, a minimum value of 0.130, and a maximum value of 0.430. Children aged 11 years old had a mean of 0.279, a minimum value of 0.190, and a maximum value of 0.363. Children aged 12 years old had a mean of 0.241, a minimum value of 0.198 and a maximum value of 0.330.

The Arch Index of the right foot in children aged 8 years old had a mean of 0.325, a minimum value of 0.322, and a maximum value of 0.329. Children aged 9 years old had a mean of 0.292, a minimum value of 0.214, and a maximum value of 0.354. Children aged 10 years old had a mean of 0.282, a minimum value of 0.182, and a maximum value of 0.570. Children aged 11 years old had a mean of 0.272, a minimum value of 0.176, and a maximum value of 0.356. Children aged 12 years old had a mean of 0.251, a minimum value of 0.216, and a maximum value of 0.338.

The Arch Index of the foot became smaller with age with an inverse correlation in the right foot (r = -1.67) and in the left foot (r = -1.56). There was a strong relationship between Arch Index and age (p = 0.006) in the right foot and (p = 0.01) in the left foot. Both feet shared the same relationship. (Figure 2)

This study proved that there was a significant relationship between the level of physical activity and the occurrence of flatfoot (p value = 0.040)

Discussions

Subjects from this study were between 8–13 years old with a median age of 10. The age described in this study was the development period of MLA which begins between ages 2–3 years old, when children begin to walk, and stops between ages 12–13 years old.[4] There were more boys (50.9%) than girls (49.1%) in this study. A study in Hong Kong[7] discovered that the occurrence of flatfoot is more common in boys than in girls. The occurrence of flatfoot in boys is higher because of the greater rear foot valgus and late development of the rear foot in boys.[7] Moreover, this study discovered that a majority of students had the low level of activity (55.7%) and a minority of students had the high level of activity (2.6%).

There was a strong correlation between Arch Index with age on the right foot (p value = 0.006) and on the left foot (p value = 0.01). an inverse correlation between age and Arch Index with the right foot and left foot indicated a decrease in Arch Index with an increase in age. A low Arch Index indicated an increased MLA. These results reflected previous studies which reported that MLA increases with an increase in age.[7,12] However, in this study, the twelve year old children were only 4 children and thirteen year old child was only 1 child, thus, this study could not detect if the children aged 12 and 13 had a higher or lower MLA compared to others.

The occurrence of flatfoot was the highest among children with the low level of activity (44.3%). Previous study reported that fat breaks at a slower rate at the soles of the feet in children with a low level of physical activity and ultimately results in a decreased MLA.[3] However, this study was unable to describe whether flatfoot occurrence was high among children with the low level of activity because the numbers of children with the low level of activity were the highest among other activity levels. The low activity level was the highest because there was no routine sport activity and no specific exercise to train foot muscle in school such as football, basketball, running, etc. This study proved that there was a significant relationship between the level of physical activity and the occurrence of flatfoot, and was in accordance with literature reporting that there was a relationship between level of physical activity and the occurrence of flatfoot.[6]

This study had several limitations. The

footprint method had measurement bias, where the thickness of the stamp really determines the result of Arch Index measurement. The questionnaire described children's activities in the last 7 days. However, activities in the last 7 days did not describe the whole activities.

In conclusion, there is an inverse correlation between the Arch Index and age, meaning that MLA decreases with age. Physical activity can be concluded to be a factor influencing the occurrence of flatfoot.

This study suggests that schools have to add routine sport activities which also exercise foot muscle. Schools can record health status of the children and report to the primary health care if there is any abnormality. Therefore, if there is any abnormality, it can be treated immediately. The government also plays a role in this issue, also can promote and have routine exercise programs in schools. Primary health care can have screening programs for flatfoot which provide early detection and management.

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