

ARTIKEL PENELITIAN

**Relationship of Arcus Pedis Shape Based on Foot Print Test
With VO2 Max Score for Students of the Faculty of Medicine
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Abstract: The shape of the pedis arcus affects the way of walking. Abnormal pedis arcus results in an unstable position of the legs as a body support when walking. This can cause several complaints such as imbalance, fatigue during long walks, pain and injury. Walking is one way to measure a person's fitness level. This study analyzes the relationship between the shape of the pedis arcus based on the foot print test and the VO2 Max value of FK UMSU students. This research is observational and analytical with a cross-sectional approach. The footprint test was carried out on 67 respondents followed by Clarke's angle measurement to determine the type of arcus pedis for each respondent. The body weight was then measured, followed by a six-minute walking test (6MWT) to obtain a VO2 Max value. The results obtained were that 36 (53.7%) respondents had a normal pedis arcus shape (normal foot), 13 (19.4%) high pedis arcus shape (cavus foot), and 18 (26.9%) flat foot arcus pedis shape. The results of the Somers'd test were symmetrical ($P = 0.353$), arcus pedis dependent ($P = 0.353$), and VO2 Max dependent ($P = 0.353$). A P -value > 0.05 means that the variable of the shape of the arcus pedis and the fitness level (Vo2max value) is not proven to affect each other, so it can be concluded that the shape of the arcus pedis is not related to a person's fitness level.

Keywords: Arcus pedis, VO2 Max value, Fitness level**INTRODUCTION**

One of the body movements that humans do every day is walking. Walking is a movement that involves two legs to aid propulsion with one foot in contact with the ground. When one foot touches the ground

to support, move, and push, the other leg swings to produce a single step. This causes gait (a way or gait) as a rhythmic movement that alternates between the legs, arms, and body to perform forward movements.^{1,2}

Gait is a characteristic of each individual's way of walking that can be affected by weight, posture, foot length, the shape of the arch of the sole (arcus pedis), the footwear used, and other related things. Therefore, each individual can be different.^{2,3}

The Arcus pedis has function as a weight support and shock absorber when the foot is in contact with the ground. With Arcus pedis, the weight of the body is divided in two, which is balanced to the front and back of the soles of the feet and a person can move quickly from one position to another.^{3,4}

A normal arcus pedis has a curve on the medial side of the foot, thus providing greater force to withstand the weight of the body when performing movements. While the abnormal shape of the pedis arcus is the opposite, the medial side of the sole is flat so that part or all of the surface of the foot is in contact with the floor.^{4,5}

Abnormal arcus pedis (pes cavus and flat foot) results in an unstable position of the foot as a body support when walking. This can cause several complaints such as imbalance, fatigue during long walks, pain and injury. Flat feet are also reported to be associated with foot pain, injuries from overuse, and poor lower limb function, and are assumed to be predisposing factors to disability, according to a study conducted by Abhilash in 2021.^{6,7}

Pes cavus or cavus foot is generally a progressive disease. Flexible cases may only show a change in the shape of the foot after repeated strain. Stiffness, pain, and even dysfunction in the load-bearing area

can occur, which seriously affects the patient's quality of life.⁸⁻¹⁰

Fitness levels are determined by several factors including VO₂ Max, endurance, body composition, balance, and coordination. Balance is the ability to maintain body position and posture on the pedestal when standing or when doing a movement such as walking. Balance requires elements of coordination, agility, and dexterity.^{11,12}

VO₂ Max itself is one of the health parameters as well as a measure of cardiorespiratory fitness and maximum aerobic strength.^{12,13} There are several tests used to get VO₂ Max values, the simplest of which is a 6-minute walking test (6MWT).^{14,15}

This study analyzes the relationship between the shape of the pedis arcus based on the footprint test and the VO₂ Max value of FK UMSU students.

METHOD

This research is observational and analytical with a cross-sectional approach. The population of this study is female students of the Faculty of Medicine, University of Muhammadiyah North Sumatra, Class of 2019. A sample of respondents who met the inclusion criteria was obtained by 67 students.

A footprint test is used to analyze the shape of the pedis arcus. The angle of the tangent formed by the first line connecting the medial edge of the first metatarsal caput and the heel and the second line connecting the first metatarsal caput with the crest of the median longitudinal arcus arch is calculated by Clarke's angle formula.^{16,17}

Respondents were then asked to weigh their weight, and then conduct a six-minute walking test with a line of 30 meters apart. After reaching six minutes, respondents were asked to stop. Measure and record distances, and the number of breaks including stop time and stop duration.¹⁵ The data obtained is included in the formula to calculate the VO₂ Max value = $(0,06 \times 6MWT) - (0,104 \times U) + (0,052 \times BB) + 2,9$.^{12,18}

The final data will be statistically analyzed using the Somers correlation test and is considered significant if a $P <$ value of 0.05 is obtained.

RESULT

This research has been approved by the Health Research Ethics Commission, Faculty of Medicine, University of Muhammadiyah North Sumatra, No: 1009/KEPK/FKUMSU/2023.

The shape of the pedis arcus is determined by measuring Clarke's angle from each of the collected footprint data as seen in Figure 1. A normal foot has an angle range of $31^\circ - < 45^\circ$. The flat foot has an angle range of $< 31^\circ$ whereas the Cavus foot has an angle range of $> 45^\circ$.^{16,17}

Table 1 shows the frequency distribution of the shape of the pedis arcus based on the footprint test of 67 UMSU FK students who were research respondents. The most common form of arcus pedis was the normal shape of the foot in as many as 36 people (53.7%), followed by the flat foot form in as many as 18 people (26.9%) and the least found was the shape of the cavus foot as many as 13 people (19.4%).

Figure 1. Footprint test with Clarke's angle measurement.



Table 1. Frequency distribution of the shape of the Arcus Pedis based on the footprint test.

Arcus Pedis Shape	Frequency	%
Normal Foot	36	53,7
Cavus Foot	13	19,4
Flat Foot	18	26,9
Total	67	100

The fitness level value was obtained by measuring the VO₂ Max of each respondent after conducting a 6-minute walking test. Based on Table 2, information was obtained that of the 67 FK UMSU students who were respondents in this study, 11 people (16.4%) had very poor fitness levels, 21 people (31.3%) had poor fitness levels, 17 people (25.4%) had sufficient fitness levels, 10 people (14.9%) had good fitness levels, 3 people (4.5%) had extraordinary fitness levels, and 5 people (7.5%) had superior fitness levels.

Table 2. Value Frequency Distribution VO2 Max.

Vo2max	Frequency	%
Very Bad	11	16,4
Bad	21	31,3
enough	17	25,4
good	10	14,9
extraordinary	3	4,5
superior	5	7,5
Total	67	100

The fitness level value was obtained by measuring the VO2 Max of each respondent after conducting a 6-minute *walking test*. Based on Table 2, information was obtained that of the 67 respondents in this study, 11 people (16.4%) had a very poor fitness level, 21 people (31.3%) had a poor fitness level, 17 people (25.4%) had a sufficient fitness level, 10 people (14.9%) had a good fitness level, 3 people (4.5%) had an extraordinary fitness level, and 5 people (7.5%) had a superior fitness level.

Table 3. Results of the Somers Correlation Test.

			Approx. Sig.
Ordinal	Somer's d	Symmetric ^a	0,353
by		Bentuk Arcus	0,353
Ordinal		Pedis Dependent ^b	0,353
		Vo2max Dependent ^c	0,353

Based on table 3, information was obtained that the results of the Somers'd test symmetrically showed a $p >$ value of 0.05 which means that the variables of the shape of the pedus arcus and the fitness level (Vo2max value) were not proven to affect each other. The shape of the arcus pedis dependent^b has a value of $p >$ 0.05 which

also explains that the value of Vo2max is not proven to affect the shape of the pedis arcus, as well as the Vo2max dependent^c also has a value of $p >$ 0.05 which explains that the shape of the pedis arcus is not proven to affect the fitness level.

DISCUSSION

The results of the study using *Somer's test* obtained a significance number (*P-value*) greater than 0.05. This shows that there is no relationship between the shape of *the pedis arcus* based on the *footprint test* and the Vo2max value. This indicates that the shape of the foot arch does not directly affect the fitness level or endurance ability of FK UMSU students.

The results of this study show varying data regarding the relationship between *the shape of the pedis arcus* and fitness levels. It is proven by the existence of sample data that shows the normal shape of the arcus pedis which totals 36 people have different fitness levels, some are included in the very poor, bad, adequate, good, extraordinary, or superior levels. Arcus pedis with the shape of *a cavus foot* and with a *flat foot* shape which totals 13 people and 18 people respectively have different fitness levels. In addition, students who have *normal pedis arcus*, *cavus foot*, and *flat foot* are all dominated by students who have poor fitness levels. Thus the shape of *the pedis arcus* cannot determine a person's fitness level.

One of the factors that causes fitness levels is gender.¹⁹ Biological differences between men and women can have an impact on fitness levels. In this study, it was found that the majority of respondents as

many as 77.26% were women. In general, men tend to have a higher proportion of muscle than women and tend to have a higher cardiorespiratory capacity (cardiorespiratory endurance). This means that men tend to have an advantage in physical abilities that require strength and endurance, such as weightlifting or long-distance running.^{6,20}

There is a difference in the results with a study conducted by Sahri et al. (2017) on elementary school students in grades 1-3 which stated that the more normal the shape of the respondent's foot, the better the respondent's level of agility, and vice versa.⁵ Meanwhile, in this study, the respondents used were students. Age can affect fitness levels. The child's agility and speed increase until the age of 12 (entering rapid growth). After that period agility and speed do not increase, even decreased. So that after the growth period has passed, the decrease in agility and speed will decrease, and the fitness level will of course weaken.^{4,21}

The implication of these findings is that it is important to consider other factors such as exercise habits, genetics, diet, and physical exercise adaptations that may have a greater role in determining a person's fitness level. This can guide the approach to building balanced fitness by taking these variables into account. In the context of physical exercise adaptation, these results suggest that individuals can overcome some of the negative impacts of the arcus pedis form on their fitness through proper exercise. The implication is the importance of planned and directed exercise in forming

positive physical adaptations and optimizing fitness.

The main advantage of this study is the use of statistical testing that allows for the drawing of strong conclusions. Using the Somers'd statistical test, the study provided a higher level of confidence in the results. In addition, this study also includes a variety of pedicel arcus shapes, namely normal, cavus foot, and flat foot, and involves a fairly representative sample of FK UMSU students. This provides a more comprehensive picture of the observed relationships.

In addition, several limitations need to be considered in this study. One of the limitations that needs to be considered is the limited research context of the UMSU FK student population. This will affect the generalization of the findings in this study to other populations. Furthermore, the study may not consider other variables that can affect fitness levels such as more specific physical exercise patterns, psychological factors, or certain medical conditions. The use of *the Foot Print Test* as a measurement method also has certain limitations that can affect the accuracy of the results.

CONCLUSION

A person's fitness level can be measured by a VO2 Max value which is influenced by many factors, ranging from age, gender, physical exercise, body composition, balance, and coordination. The shape of the pedis arcus in this case is only one of the many factors that affect balance so it does not have much effect on fitness levels. Therefore, it can be

concluded that the shape of the pedis arcus is not related to fitness level.

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