



Original Article

The Association Of Obesity With The Incident Of Flat Foot In Adults: A Cross-Sectional Study Of Academic Community In Jambi City

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ABSTRACT

Background: Flat feet is a foot deformity that refers to the loss of the mid-length of the foot. This can cause pain, stiffness, discomfort, and irritation in the ankles and feet. This study attempts to determine the relationship between obesity and the issue of flat feet in the academic community of the Faculty of Medicine and Health Sciences (FKIK) Universitas Jambi (UNJA) Medical Study Program.

Method: This observational analytic research used a cross-sectional design with samples of 102 academics from the FKIK UNJA Medical Study Program. The primary data consisted of body weight, height, BMI, and soles of the feet. Bivariate analysis using the Chi-square test.

Result: The incidence of flat feet is 20.6%, and 45,7% of flat feet are obese. There is an association between obesity and the incidence of flat foot in the academic community of the FKIK UNJA Medical Study Program.

Conclusion: There is a significant relationship between body mass index and the incidence of flat feet in the academic community of the FKIK Jambi University Medical Study Program.

INTRODUCTION

Pes planus, also known as flat foot, is a relatively common pedis deformity that refers to the loss of the medial longitudinal arch of the pedis, resulting in the pedis area being closer to the ground or in contact with the environment. Archus complex

dysfunction is usually asymptomatic but can alter the biomechanics of the lower limbs and lumbar spine, causing an increased risk of pain and injury.^{1,2} Flat feet can cause a variety of problems. This reduced arch height can cause pain, irritation, and discomfort in the pedis and lower leg joints.

This continuous process can biomechanically affect the joints and bones in the proximal part, which can also cause pain in the knees and lower back.³

Flat feet are divided into two types, namely rigid flat feet and flexible flat feet. A rigid flat foot is rare. It usually develops during childhood but can also occur in other age groups, and several things can cause it.⁴ Flat foot, including Congenital, has a rupture in the tendon m. tibialis posterior, History of malunion in ankle fracture, Excessive pedis muscle activity, Neuromuscular disease, Neuropathic disease, inflammation, such as arthritis, Obesity, and Pregnancy.^{4,5}

Many factors can cause flat feet, including the effect of excess BMI. Being overweight and obese causes an imbalance between energy intake and expenditure. It can also cause excess adipose tissue, promoting pathological fat storage. The onset of obesity in adulthood occurs due to poor diet, sedentary lifestyle, and other external factors. Being overweight and obese during the developmental years is associated with some foot dimorphisms, especially flat feet.^{6,7}

Obese individuals will have higher pressure levels on the plantar pedis than normal-weight individuals. Increasing the pressure in the plantar pedis occurs on metatarsals 1 and 2, as well as on the calcaneus. This causes strain on the plantar fascia because it has its origin and insertion on metatarsal 1, metatarsal 2, and calcaneus. Plantar fascia is a tissue that maintains the shape of the medial longitudinal arch and supports the operation of the pedis.^{8,9}

Obesity will affect a person's gait, and the pedis will receive a load from body weight when walking. The load on the pedis increases 1.2 times when walking and 2-3 times when running. Obese people will increase their weight in pedis three times compared to normal-weight individuals, and

this can cause negative changes in biodynamic growth and potentially reduce quality of life and limit physical activity. This can result in weak muscle strength and will limit movement, resulting in changes in abnormal structure and function in the pedis, namely flat feet.^{2,10}

Body mass index (BMI) is an indicator used to measure a person's weight level by calculating body weight (kg) divided by height (m²). BMI can be an indicator of obesity and can be used to screen weight categories. BMI classification is divided into underweight, normal weight, overweight, obesity I, and obesity II.¹¹ It is estimated that around 20% to 37% of the human population has some degree of flat feet. Most of these cases are flexible flat feet.¹² A 2003 study by Dunn et al. found that the prevalence among non-Hispanic whites was 17%, and the prevalence was greater among African Americans, namely 34%.¹ In a study conducted in Surakarta by Seteriyo Wardanie, it was found that out of a total sample of 1089 students, 299 students had a flat foot, and 790 students had pedis with normal arch.¹³

In research conducted by Shyamala Shree et al. regarding the relationship between BMI and flat feet of a medical student in India, it was concluded that there was a strong correlation between BMI, especially overweight and obese with flat feet.¹⁴ Different results were obtained. In research conducted by Purwo Sri Rejeki et al., the results showed that there was no difference in BMI between participants with flat pedis and those with normal pedis, and there was no relationship between BMI and the medial longitudinal curve in Khairunas Nurul Hayat Kindergarten students in Surabaya.¹⁵

Only now, information regarding the incidence and prevalence of flat feet and their correlation to BMI still needs to be more extensive from the results of existing research. There are differences in results

mentioned previously, and the population used in research that has been carried out is mostly children.¹⁵⁻¹⁷ Meanwhile, populations other than children are still limited. Therefore, researchers are interested in researching the association between obesity and flat feet in the adult population, namely the academic community of the Medical Study Program, Faculty of Medicine and Health Sciences (FKIK) Universitas Jambi (UNJA).

METHOD

This research uses an observational analytical method with a cross-sectional research design to determine the relationship between BMI and the incidence of flat foot in the academic community of the Medical Study Program FKIK UNJA. The research was conducted at the FKIK UNJA from June to October. The population of this study was the academic community of the Medical Study Program, including employees, academic staff, and medical students from the 2019 class, numbering 200 people. The sample for this research was taken using a total sampling technique from a total population of 200. Exclusion criteria include experiencing

musculoskeletal trauma, having impaired body mobility, having congenital abnormalities, pregnant women, thyroid gland disorders, anasarca, and edema.

The data collected in this research are primary data obtained from measuring the height, weight, and footprint of the subjects. Data collection by measuring body height and weight was then used to assess the BMI category of the sample. Then, the presence or absence of flat feet was done using a wet footprint test, the results of which were based on Clarke's angle criteria. Flat foot was assessed using the Clark's angle pedograph. In making a pedograph, the subject's right and left plantar pedis are wetted with stamping ink or paint. The plantar pedis is then placed on paper with a flat surface and cannot be moved so there are no artifacts. The following is an example of a pedograph image (picture 1). The plantar pedis angle is then measured using the technique in the image above. The measurement results are divided into three categories (picture 2):

- a. Clarke angle $<31^\circ$: Flat foot
- b. Clarke angle $31^\circ - 45^\circ$: Normal
- c. Clarke angle $> 45^\circ$: Pes cavus.

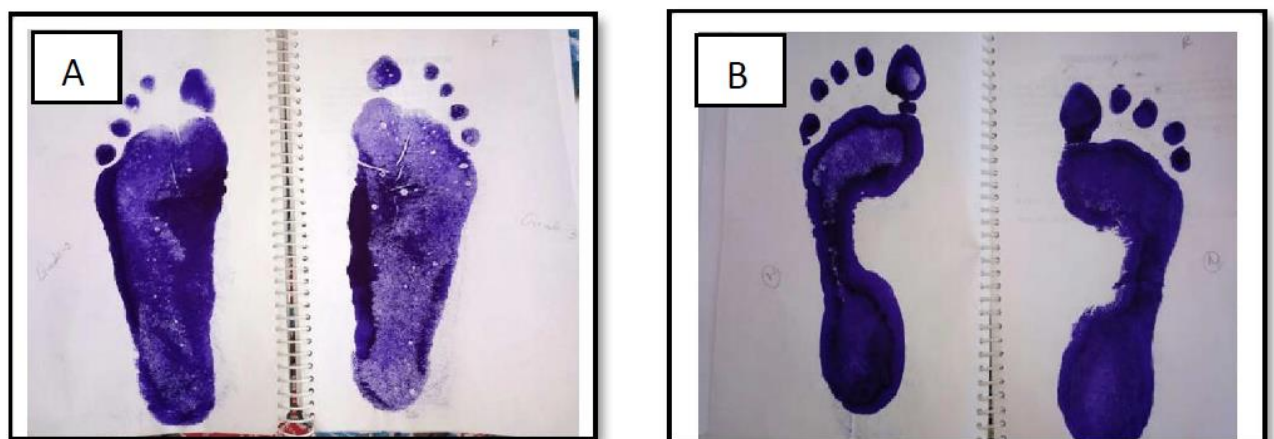


Figure 1. Pedograph, A. flat foot, B. Not flat foot¹⁴

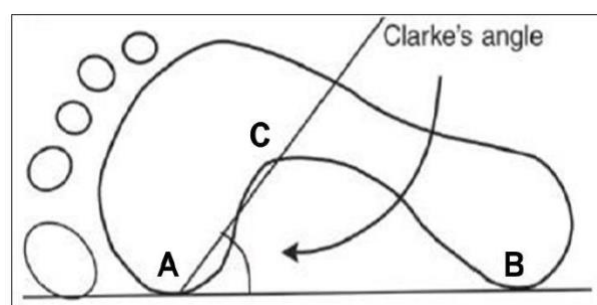


Figure 2. Clarke's angle¹⁸

Data is processed and analyzed with a computer program. Research data will be presented in table form. Univariate analysis was carried out to provide an overview of sample characteristics, BMI, obesity, and the incidence of flat foot. The hypothesis test that will be carried out in bivariate analysis is the Chi-square test.

RESULTS

In this analysis, the characteristics of the research sample will be described, as

well as the frequency distribution of the independent variables and dependent variables of the study. Based on Table 1, most of the research samples are female, 59 samples (57.8%). The majority of the samples are 19-28 years old, with as many as 86 samples (84.3%). Normal body mass index has the highest frequency of all research samples, namely 42 (41.2%). Based on Table 2, of the 35 samples with obese BMI, 25 (71.4%) are obese 1, and 10 (28.6%) others are obese 2.

Table 1. Sample Characteristic

Characteristic Subject	Frequency (n)	Persentase (%)
Gender		
Male	43	42.2
Female	59	57.8
Age		
19-28	86	84.3
29-38	12	11.8
39-48	4	3.9
BMI		
Underweight	10	9.8
Normal weight	42	41.2
Overweight	15	14.7
Obese	35	34.3
Total	102	100

Based on Table 3, it is known that the frequency of flat foot incidents is 21 incidents (20.6%), and the frequency of non-flat foot incidents is 81 incidents (79.4%). Based on the table above, from 21

incidents of flat feet, 11 (52.4%) of which were bilateral flat feet, and the other 10 (47.6%) were unilateral flat feet consisting of 3 (14.3%) right unilateral flat feet and 7 (33.3%) left unilateral flat foot.

Table 2. Category of Obesity

Obesity	Frequency (n)	Persentase (%)
Obese 1	25	71.4
Obese 2	10	28.6
Total	35	100

From the results of the Chi-Square statistical test, it was found that the value of $p=0.001$ means that there is a relationship between obesity and the incidence of flat feet in the academic community of the Medical Study Program

FKIK UNJA. The academic community of the FKIK Jambi University Medical Study Program with an obese BMI is ten times more likely to experience flat feet compared to those with a BMI other than obese.

Table 3. The incidence of flat foot

Variable	Frequency (n)	Persentase (%)
Arcus Pedis		
Flat foot	21	20,6
Not flat foot	81	79,4
Location Flat foot		
Unilateral		
Right	3	14.3
Left	7	33.3
Bilateral	11	52.4
Total	21	100.00

Table 4. Association obesity and flat foot

IMT	Flat foot		Not Flat foot		P value	Odds Ratio
	(n)	(%)	(n)	(%)		
Obese	16	45.7	19	54.3	0.001	10.442
Not Obese	5	7.5	62	92.5		(3.380-32.263)
Total	21	20.6	81	79.4		

DISCUSSION

The description of body mass index in the academic community of the medical study program, Faculty of Medicine and Health Sciences, Jambi University, showed that the majority had a normal body mass index, namely 42 people, with a percentage of 41.2% of all samples. In line with research conducted by Okezue et al. on 103 adults, the results showed that

samples with a normal and overweight BMI were more numerous (98.1%) than samples with an obese BMI (1.9%).¹⁹ In contrast to research conducted by Azzahra et al. on students at the Faculty of Medicine, UPN Veteran Jakarta, research conducted on 99 samples found that 58.6% of the samples were obese and 41.4% of the samples were not obese.²⁰ Many factors can influence body mass index.

Factors, including genetics, age, gender, diet, and physical activity. A previous study said that the lack of physical activity in Medical Faculty students causes the risk of obesity to increase.^{7,21} However, with a high normal BMI, this research can show the factors that influence BMI in the academic community of the FKIK Jambi University Medical Study Program in good condition so that obesity does not occur.

In the assessment of the archus pedis, it is grouped into flat foot and non-flat foot. The number of flat foot incidents was 21 (21.6%). This follows the epidemiology of flat foot, which is only around 20% of the population. This can be why, in this study, more samples had normal BMI, so fewer samples experienced flat feet. Lowth believes that musculoskeletal disorders, trauma, and obesity mostly cause flat feet.⁸ Based on the results of the bivariate analysis, it can be concluded that the incidence of flat feet occurs more frequently in research samples that are obese compared to samples that are not obese. This is because obesity can make the pressure on the arch of the foot very high, causing the arch of the foot to become flat.^{12,22}

Flat feet can also be found in individuals with BMI other than obese, but with less frequency, as in this study, it was only found that around 7,5% of the total sample with non-obese BMI experienced flat feet. Based on the analysis using the chi-square test, the value of $p = 0.001$ was obtained, which shows the relationship between obesity and the incidence of flat foot in the academic community of the Medical Study Program FKIK UNJA are ten times more likely to experience flat feet than those with a BMI other than obese. This can be caused by genetic factors or trauma that results in changes in the position of the connective tissue or bones that make up the medial longitudinal arch.^{13,23} The results of this research

following research conducted by Azzahra et al. show a significant relationship between high BMI (obesity) and the incidence of flat feet in students at the Faculty of Medicine, UPN Veteran Jakarta.²⁰ The results of this research are also in accordance with the study conducted by Shree et al. in India, which concluded that there was a significant relationship between obesity and the incidence of the flat foot with a value of $p = 0.0265$.¹⁴ Research conducted by Suciati et al. on students at SD Xaverius 1 Palembang aged 7-10 years totaling 140 samples showed that There is a relationship between BMI and flat feet, also found that students were obese or overweight 2.4 times more risk of experiencing flat feet compared to other BMIs.¹⁶

However, this research differs from that of Hajirezaei et al. in Iran. Research was conducted on 260 samples who were students at Mazandaran University. The research aimed to determine the relationship between flat foot and pes cavus and BMI in female students, and the results showed that there was no relationship between flat foot and pes cavus and BMI in female students at Mazandaran University.²⁴ In the two studies above, The frequency of samples with an obese BMI and experience flat feet is only small. This may be due to the low frequency of obesity variables and the incidence of flat feet in the research target population; the low frequency of the research variables is strong for describing the relationship between the variables studied.

CONCLUSION

Normal body mass index is the BMI with the highest frequency in the academic community of the Medical Study Program, Faculty of Medicine and Health Sciences Universitas Jambi.

Obesity in the academic community of the FKIK Jambi University Medical Study Program is 34.3%.

The incidence of flat feet in the academic community of the FKIK Jambi University Medical Study Program is 20.6%, and from the sample who were

obese, 45.7% had flat feet.

There is a significant relationship between body mass index and the incidence of flat feet in the academic community of the FKIK Jambi University Medical Study Program.

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