

Flat Feet TriSuciati

by Indri Septadina

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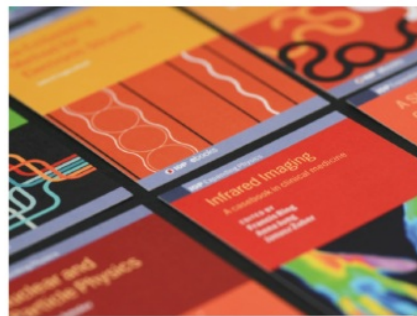
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Correlation between flat feet and body mass index in primary school students

Tri Suciati, Msy Rulan Adnindya*, Indri Seta Septadina, Poppy Putri Pratiwi

* Department Anatomy, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

† Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

Abstract. Body mass index is one of the indicators used to detect body weight and nutritional status. Excessive weight in children can affect the occurrence of flat feet compared with children who have normal weight. Flat feet is a foot structure disorder that does not form the medial arch. The aim of this research is to know the relationship between body mass index and flat feet in elementary school children at Xaverius 1 Palembang. This is an analytical-observational research with a cross-sectional design. The subjects of this research are 70 students of elementary school at Xaverius 1 Palembang and collected by using stratified random sampling proportionally. The research was conducted in October 2017. Data analysis was performed by Chi-Square test on SPSS application. The category of body mass index was classified into overweight/obese and not-overweight. In the category of overweight/obese, there are 24 (80%) people were positive flat feet and 6 (20%) normal people. In the category of not-overweight, there are 7 (17.5%) people were positive flat feet and 33 (82.5%) normal people. The result of the bivariate analysis showed that there was a significant relationship between body mass index and flat feet ($p = 0,000$) with PR value of 4.571, that is overweight/obese people risk 4.5 times for flat feet compared to people who were not-overweight.

1. Introduction

Flat feet, also known as pes planus, is a leg structure deformity characterized by the absence of the medial arch of the foot which is usually covered by excessive fat tissue [1]. This condition occurs mainly in children, which in principle can be physiological. Therefore, it can be disappear on their own without treatment [2,3].

Foot arch formation begins in the first 5 years of life with a range of 2-5 years. Normally, flat feet will disappear with age. Any abnormalities which appear during this period will be overcome more easily than if the onset is older [4]. Flat feet are most common in children and rarely found in adults. Flat feet are reported to occur in young children as a consequence of the process of developing the medial arch [5].

Pathological flat feet can cause changes in muscle balance, gait, and alignment of joint motion [3]. The most disturbing complaint for the patient is the increasing pain. Early prevention is necessary for everyone who has risk factors in terms of heredity or disproportionate body shape [6].

There are 20-30% children in the world who experience flat feet. In Surakarta Indonesia, a study of 1089 elementary school students found that 299 students experiencing flat feet [7]. Research conducted in primary schools in Enugu, Nigeria with 474 children aged 6-10 years old found that 106 (22.4%) students experienced flat feet with 93 (87.7%) students experiencing flat foot on one foot and 97 (91, 5%) students experience flat foot on both legs [8]. Another study that conducted at a school in India with a total sample of 297 students found that flat feet are found more often in children younger than 5 years old (40.32%) than in children between 5 to 10 years old (22.15%) and in children older than 10 years (15, 48%) [9].



Some of the factors that can cause this disorder are age, sex, foot anatomy, and obesity. Obesity is one of the parameters obtained from measurements of the Body Mass Index (BMI) [4]. Body Mass Index (BMI) is one of the indicators used to measure a person's weight level by calculating body weight (kg) divided by height (m²) [10]. BMI can be an indicator of obesity and can be used to screen weight categories. BMI can be applied to children using CDC charts based on the child's age and can determine which children are underweight, normal or overweight [11].

A study was conducted with 822 preschool children with different BMI categories found that children who experienced flat foot were underweight children (52.6%), normal weight children (42%), overweight children (50.9%) and obese children (61.7%) [12].

The prevalence of child obesity in Indonesia is still high (18.8%). The highest prevalence are in DKI Jakarta (30.1%) and the lowest was in East Nusa Tenggara (8.7%) [13]. In South Sumatra, the prevalence of overweight in 6-14 years children are 16.0% for boys and 11% for girls. The lowest prevalence of obesity for boys are in Prabumulih (7.4 %) and for girls are in Ogan Ilir (4.5%) [14].

Obesity is affected by diet, exercise, and healthy lifestyle. These require parental attention and the school environment for children to get the ideal weight and height. Excessive BMI is a risk factor for flat feet.

2. Methods

This study was an observational analytic study with a cross-sectional design. The population were students in one of the elementary schools in Palembang from 2nd grade to 5th grade. The inclusion criteria were 7-10 years old elementary students. The exclusion criteria were elementary students who were sick at the time of measurement, who were not present at the time of measurement, who experienced flat feet due to genetic abnormalities and who experienced abnormalities due to surgery or trauma. 140 sample was taken proportionally by stratified random sampling technique. The dependent variable is flat feet and the independent variable is body mass index. Data analysis was performed using SPSS version 24 software.

3. Results

Measurements of body weight and height were taken to obtain a body mass index. Flat feet measurement were obtained by rubbing the soles of the feet on the container containing the dye and then placing the soles on the paper.

Table 1 shows the characteristics of research subjects based on age. The age group is divided into 4 groups. Table 2 shows data about sex distribution. The result of the wet footprint test can show the form of a normal foot or flat feet by measuring based on the foot axis. Table 3 shows the distribution of research subjects based on foot shape. Table 4 shows the data on the distribution of research subjects based on the BMI category.

Table 1. Characteristics of research subjects.

| Age Group (years) | n | % |
|----------------------|-----|-------|
| 7 | 33 | 23,6% |
| 8 | 32 | 22,9% |
| 9 | 30 | 21,4% |
| 10 | 45 | 32,1% |
| Total | 140 | 100% |

Table 2. Distribution of research subjects by gender.

| Gender | n | % |
|--------|-----|---------|
| Man | 70 | 50,00% |
| Woman | 70 | 50,00% |
| Total | 140 | 100,00% |
| Total | 140 | 100% |

Table 3. Distribution of research subjects based on foot shape.

| Foot Shape | n | % |
|------------|-----|---------|
| Flat Feet | 72 | 51,40% |
| Normal | 68 | 48,60% |
| Total | 140 | 100,00% |

Table 4. Distribution of research subjects by BMI categories.

| BMI classification | n | % |
|--------------------|-----|--------|
| Underweight | 12 | 8,57% |
| Normal | 70 | 50,00% |
| Overweight | 21 | 15,00% |
| Obesity | 37 | 26,40% |
| Total | 140 | 100% |

Table 5 shows the cross-tabulation between age and flat feet. There were 18 (12.9%) people with flat feet and 15 (10.7%) people with normal feet that found in the age group 7 years. In the 8-year age group, there were 18 (12.9%) people with flat feet and 14 (10%) people with normal feet. In the 9-year age group, there were 18 (12.9%) people with flat feet and 12 (17.6%) people with normal feet. In the 10 years age group, there were 18 (12.9%) people with flat feet and 27 (19.3%) people with normal feet. The p-value obtained using Chi-Square test are 0.383 ($p > \alpha$). This means that there is no relationship between age and flat feet.

In table 6, data on the relationship between body mass index (BMI) and gender are presented. There were 31 (44.28%) males who experienced flatfeet and 41 (58.57%) females who experienced flatfeet. Based on the Chi-Square test results, the p-value is 0.091 ($p > \alpha$). This means that there is no relationship between sex and flat feet.

Table 5. The relationship between age and flat feet.

| Age | Foot Shape | | | | Total | p-value | |
|----------|------------|--------|--------|--------|-------|---------|------|
| | Flat Feet | | Normal | | | | |
| | n | % | n | % | | | |
| 7 years | 18 | 12,90% | 15 | 10,70% | 33 | 100% | 0,38 |
| 8 years | 18 | 12,90% | 14 | 10,00% | 32 | 100% | |
| 9 years | 18 | 12,90% | 12 | 17,60% | 30 | 100% | |
| 10 years | 18 | 12,90% | 27 | 19,30% | 45 | 100% | |
| Total | 72 | 51,40% | 68 | 48,60% | 140 | 100% | |

Table 6. The relationship between gender and flat feet.

| Gender | Foot Shape | | | | Total | p-value | |
|--------|------------|--------|--------|--------|-------|---------|------|
| | Flat Feet | | Normal | | | | |
| | n | % | n | % | | | |
| Man | 31 | 44,28% | 39 | 55,72% | 70 | 100% | 0,09 |
| Woman | 41 | 58,57% | 29 | 41,43% | 70 | 100% | |
| Total | | | | | 140 | | |

Table 7 shows the relationship between body mass index (BMI) and flat feet. The BMI category is divided into 2, overweight/obese and not overweight. The overweight/obese category is a combination of overweight and obese categories, while the non-overweight category includes underweight and normal weight categories.

This grouping is made to get the prevalence ratio (PR) which is the estimated risk of flat feet occurring in people who are overweighted/obese. In the category of overweight/obese, there were 45 (32.1%) people with flat feet and 13 (9.3%) people with normal feet. In the non-overweight category, there were 27 (19.3%) people with flat feet and 55 (39.30%) people with normal feet.

The p-value is 0,000 ($p < \alpha$) which means that there is a statistically significant relationship between body mass index and flat feet with a PR value of 2.356, meaning that people who are overweight/obese have a 2.4 times risk for flat feet compared to people who are not overweight.

Table 7. The relationship between BMI and flat feet.

| BMI | Foot Shape | | | | Total | | p-value | |
|------------------|------------|--------|--------|--------|-------|------|---------|------|
| | Flat Feet | | Normal | | n | % | | |
| | n | % | N | % | | | | |
| Overweight/Obese | 45 | 32,10% | 13 | 9,30% | 58 | 100% | 0,000 | 2,36 |
| Not overweight | 27 | 19,35% | 55 | 39,30% | 82 | 100% | | |
| Total | 72 | 44,3% | 68 | 55,7% | 140 | 100% | | |

4. Discussions

4.1. The relationship between age and flat feet

The results showed that there is no significant relationship between age and flat feet. The risk of flat feet will decrease with age. Flat feet or leg structure deformities are characterized by no longitudinal medial arch formation. Medial arch is an important part of the leg structure, as an adaptation to hold the body weight. The absence of medial arch or low arch can cause changes in balance, gait, and alignment of joint motion [2]. Flat feet are normally present in babies and it is a physiological phenomenon that will change with age as the musculoskeletal system matures.

The results of this study are consistent with the research of Ezema, Abaraogu and Okafor (2013) which showed that there were no significant differences in the incidence of flat feet between the ages of 7 years and 8 years ($p=0.181$) and between the ages of 9 years and 10 years [9]. This research is also in accordance with the research of Hazza et al. (2015) which states that there is an insignificant correlation between age and incidence of flat feet ($p>0.05$) [15]. This is due to resolution and improvement of the medial arch when the child gets older. In babies, flat feet are present because there are fats that cover the developing arches and partly because it has not been fully developed. The longitudinal arc will form naturally starting from when the child begins to stand [10].

The degree of valgus on the heel for weight-bearing is usually used to evaluate the shape of flat feet in children. The degree of valgus is the angle formed between the diameter of the heel and the position of eversion. This angle will decrease with age. Children aged 6-16 years have 4° valgus. This means that there is no significant difference in the rate of valgus in children of different ages [16].

4.2. The relationship between gender and flat feet

The results showed no relationship between gender and flat feet. Some parameters are thought to affect flat feet; one of the parameters is gender. This can be explained by considering the variation in structure and foot size in certain genders. Some literature states sexual dimorphism based on osteological differences between men and women [17]. But in this study, there was no significant relationship between the sexes.

However, this study found that female students tended to experience flat feet compared to male students. The percentage of female students who experienced flat feet was 58.57% while for male students it was 44.28%. This study is in accordance with Reihanah, et al 2013, who stated that the prevalence of flat feet in girls was 75.6%, while in boys 72.4%, although overall sex did not have a significant effect for flat feet. The degree of weight of flat feet is also greater in girls. It can be explained because the leg joints of girls are weaker and unstable than men [18].

4.3. The relationship between body mass index (BMI) and flat feet

The results showed that there was a significant relationship between body mass index and flat feet ($p=0,000$). Obesity is a risk factor for flat feet. The results of this study are in accordance with Mickle, et al. (2006) which showed a significant relationship between BMI and flat feet ($p=0.03$) [4]. In addition, this study is also in accordance with the research of Pfeiffer, et al. (2006) which stated that there were significant differences in flat feet prevalence among children who were overweight (51%),

obese (62%), and normal weight (42%) with observations ($p < 0.05$) [12]. Base on the foot biomechanics, obesity in childhood showed an association with dimorphism in the legs, especially flat feet [8]. Child weight is significantly associated with flat feet. The high prevalence of flat feet in obese and overweight children shows a relationship between the pressures applied to the longitudinal arc during walking. In overweight/obese children, the midfoot area (the middle area of the soles of the feet) are most affected by contact of the sole and the soil, and receive more pressure during weight-bearing [2]. The height of longitudinal arc is lower in children with obesity, these shows that their flat feet are caused by a decrease in the longitudinal arc and are caused by feet which always carry excessive mass (weight-bearing). Structural changes can affect the functional capacity of the medial longitudinal arch. This situation is made worse if overweight or obesity from childhood continues into adulthood [4].

5. Conclusions

There is a significant relationship between body mass index and flat feet ($p = 0,000$) with a PR value of 2.36, which means that people who are overweight/obese have a 2.36 times risk for flat feet compared to people who are not overweight.

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