FISIO MU

Novianti, I.G.A.S.W & Jaya, I.P.P
*Fisiomu. 2026, Vol 7(2):89-94*
DOI : 10.23917/fisiomu.v7i2.17655

# Correlation of Flat Foot to Static Balance in Children Aged 10-12 Years

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Submitted : 2026-05-20; Accepted : 2026-05-31; Published : 2026-06-01

**ABSTRACT**

**Introduction:** Flat foot is a condition in which the medial longitudinal arch of the foot descends so that most of the soles of the feet touch the surface while standing. This condition can cause biomechanical changes in the lower extremities, such as excessive pronation and changes in body load distribution. These changes affect postural stability and the body's ability to maintain static balance. **Methods:** This study is an analytical observational study using a *cross sectional study* design. The sampling technique used in this study is *non-probability sampling* with *purposive sampling* with a total sample of 48 students who meet the inclusion criteria. Foot arch measurement using *wet foot print test* with *clarke's angle* and static balance measurement using *standing stork test*. Data analysis used *sommer'd test* with SPSS version 25. **Results:** The results of the study using the somers'd test showed that from 48 samples, the results of the analysis of the relationship between flat feet and static balance were obtained, namely $p<0.05$ which showed that there was a significant relationship with the strength of the weak relationship and the direction of the positive relationship. **Conclusion:** Therefore, it can be concluded that there is a meaningful relationship between flat foot and static balance in children aged 10-12 years.

***Keywords***: *balance, clarke's angle, flat foot.*

ISSN 2722 – 9610
E –ISSN 2722 - 9629

## INTRODUCTION

Childhood is a time when children experience a rapid growth and development process in various aspects for later life. Children's growth and development occur from physical, intellectual, and emotional. Growth refers to certain physical changes and an increase in the size of a child's body, all forms of child growth can be measured directly, and the results can be trusted (Marimbi, 2019).

In this childhood, growth needs to be monitored so that children's growth and development are optimal, especially in the musculoskeletal system. If the child's growth and development does not take place optimally, eating will occur abnormalities or disorders, one of the abnormalities that often occurs during this period is the adequacy of the arch of the foot called *flat foot* (Soekanto, 2023).

The prevalence of flat foot in children worldwide according to the World Health Organization (WHO) ranges from 20 to 30% of (Imam & Untung, 2022). In Indonesia, in children aged 6 to 12 years, 299 (27.5%) students experienced flat feet and 790 (72.5%) students had normal arches. Boys have a higher level of flat foot than girls, the rate of flat foot in boys is 52%. and 36% in girls (R. F. Utami & Syafri, 2021). According to the Ministry of Health of the Republic of Indonesia (2016), flat foot cases in Indonesia in the population of elementary school age 7-12 years reached 27 million children. The number of flat foot cases in urban areas is 30%.

*Flat foot* is a condition when the arch of the foot is not visible from birth and is buried in fatty tissue (Anggriani & Utomo, 2023). Some of the factors that affect *flat foot* include *congenital*, rupture of the posterior tibial tendon, post trauma, inflammatory diseases, and obesity (Aulia, 2019). *Flat feet* are classified into three subtypes by Harris and Beath, namely *flat foot rigid* (RFF), flexible *flat foot* (FFF) and flexible flat foot with short *achilles tendon* (FFF-STA). FFF-STA causes pain and functional disability. *Flexible flat*

*feet* are physiological, do not cause any effects and do not require treatment (Adiputra & Wahyuni, 2022).

*Flat foot* appears as a result of too weak ligaments, loss of stabilizing muscle strength, i.e. posterior tibial muscles, abnormal load distribution or a combination of these factors. Flat foot abnormalities in the long term will cause pain in the soles of the feet, ankles and knees, in addition to that it will also cause repeated acute trauma so that it will cause deformities in the feet (Wardanie et al., 2013).

Children with *flat foot* conditions will cause signs and symptoms such as abnormal walking patterns, so they get tired easily and lose balance. Poor balance skills in children can make them more prone to falls and encounter obstacles when walking and can affect their productivity, even when exercising (Maharani et al., 2020).

Balance is to maintain the *center of gravity* (COG) against the *base of support* and the result of the work of the neuromuscular system as a feedback response to visual, vestibular, and somatosensory components (Boccolini et al., 2013). Equilibrium has two types, namely, static equilibrium and dynamic equilibrium. Static balance is the ability to maintain a fixed position and stance in place. Dynamic balance, on the other hand, is the strength to survive and defend the body when there is movement (Setyaningrahayu et al., 2021).

Balance is necessary when performing activities such as walking, running, and standing. If a person has low balance, it can result in being prone to falls and experiencing obstacles when walking. An abnormally growing arch of the foot or archus causes balance disorders, deformity continues, is prone to injury, and pain (A. R. Utami et al., 2024). Based on the above problems and looking at the impact caused by flat foot, researchers are very interested in conducting research on the relationship between flat foot and static balance in children aged 10-12 year.

## METHODS

This study is an analytical observational research with *a cross sectional design*. The research was conducted at the State Elementary School (SD) 1 Sesetan South Denpasar which was carried out in June-July 2025 and this research has received permission from the Research Ethics Commission of the Bali International University Nomor 01.058/UNBI/EC/V/2025.

The criteria for inclusion and exclusion of samples are as follows. Inclusion criteria is sample aged 10 – 12 years, male and female genders, be given permission by parents to be a sample in the study and sign an informed consent. The exclusion criteria are: injuries to the lower extremities and children with special needs

The population of this study consists of all students aged 10-12 years at SD Negeri 1 Sesetan South Denpasar, with a total of 92 students. The number of samples was calculated using the Slovin formula with a margin of error of 10% so that a sample of 48 people was obtained.

The research instrument used *wet foot print* and *clarke'a angle* to determine the degree of *flat foot*. Next, to find out the static balance using the *standing stork test.* The data obtained from the results of the research will be analyzed using *the Statistics Program For Social Sciences* (SPSS) software version 25. Some of the statistical tests that will be used by researchers include: descriptive statistics and *somers'd tests.*

## RESULTS

The sample in this study is female students at Elementary School (SD) Negeri 1 Sesetan South Denpasar. The characteristics of the sample can be seen based on age, gender and body mass index (BMI).

Table 1. Respondent Characteristics

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Age (year)** | **(n)** | **(%)** |
| 10 | 15 | 31,3 |
| 11 | 18 | 37,5 |
| 12 | 15 | 31,3 |
| **Gender** | | |
| Male | 23 | 47,9 |
| Female | 25 | 52,1 |
| **Body mass index (BMI)** | | |
| *Underweight* | 23 | 47,9 |
| Normal | 19 | 39,6 |
| Obesity | 6 | 12,5 |
| **Total** | **48** | **100** |

Based on table 1, it shows that the sample with the age of 10 years amounted to 15 people (31.3%), the sample with the age of 11 years



FISIO MU: Physiotherapy Evidences

ISSN 2722 – 9610
E –ISSN 2722 - 9629

amounted to 18 people (37.5%) and the sample with the age of 12 years amounted to 15 people (31.3%). Characteristics based on gender were obtained from 23 male and (47.9%) and 25 female (52.1%). Sample characteristics data based on body mass index (BMI) were obtained by a sample with *an underweight* BMI of 23 people (47.9%), a normal BMI of 19 people (39.6%), and an obese BMI of 6 people (12.5%).

Table 2. Cross-Degree Table of Arcus and Right Foot Balance

| Arcus Degrees | Right Foot Balance | | | | | | p |
|---|---|---|---|---|---|---|---|
| | Less | | Average | | Total | | |
| | f | % | f | % | N | % | |
| *Flat Foot* | 29 | 60,4 | 1 | 2,08 | 30 | 62,5 | 0,011 |
| Normal | 12 | 25 | 6 | 12,5 | 18 | 37,5 | |
| **Total** | **41** | **85,4** | **7** | **14,6** | **48** | **100** | |

Based on table 2, it can be seen that 29 people with a flat foot arcus with a balance of the right foot are less and 1 person with an arcus *flat foot* has an average balance of the right foot. Furthermore, 12 samples with normal arcus shape with less right leg balance amounted to 12 people and samples with normal arcus with an average right leg balance amounted to 6 people.

The somers'd result for the arch shape with static balance on the right leg was obtained a value of p=0.011 (p<0.05) which means that there is a significant relationship. So it can be concluded that there is a significant relationship between the shape of the arcus and the balance of the right leg in female students at the State Elementary School (SD) 1 Sesetan South Denpasar.

Table 3. Cross Table of Arcus Degrees and Left Leg Balance

| Arcus Degrees | Left Foot Balance | | | | | | p |
|---|---|---|---|---|---|---|---|
| | Less | | Average | | Total | | |
| | f | % | f | % | N | % | |
| ***Flat Foot*** | 29 | 60,4 | 1 | 2,08 | 30 | 62,5 | 0,011 |
| **Normal** | 2 | 5 | | 2,5 | 8 | 7,5 | |

Based on table 3, it can be seen that 29 people with a flat foot arcus with less left foot balance and 1 person with a flat foot archus has an average left foot balance. Furthermore, the sample that had a normal arcus shape with a left leg balance was less than 12 people and the sample that had a normal arcus with an average left leg balance amounted to 6 people.

The results in this study using *the somers'd hypothesis test* obtained the results that there was a significant relationship between the shape of the arcus and the balance of the left leg in students at the State Elementary School (SD) 1 Sesetan South Denpasar with a value of p=0.011 (p<0.05). So it can be concluded that there is a significant relationship between the shape of the arcus and the balance of the left leg in students at the State Elementary School 1 Sesetan South Denpasar.

## DISCUSSION

The most age characteristics in this study were 11 years old, which was 18 people (37.5%). Based on previous research conducted in East Africa, it was found that the condition of flat foot often occurs in early adolescence, namely 11-15 years old. The highest prevalence of flat foot was recorded in the age group of 11-14 years at 30.1%, while at the age of 15 years it was 9.9% (Abich et al., 2020). In a study in Indonesia by Utami *et al*., in 2024 it is stated that *flat foot* is more common in 9-year-olds and less in 12-year-olds. *Flat foot* in children aged 8–12 years can be caused by various factors, such as the body's ability to respond to gravity and the condition of the bone and ligament structures that are still developing. At this age range, some children still show flat feet because the process of forming and maturing bone and muscle structures has not been completely completed (A. R. Utami et al., 2024).

The results of the analysis test using *somers'd* obtained a value of p=0.011 (p<0.05) which means that there is a meaningful relationship between flat foot and static balance. This study is in line with previous research, namely there is a significant relationship between *ples planus (flat foot)* and static balance in students of SD Mojolegi Teras Boyolali based on the Chi-Square test with a value of p=0.000 (p<0.05) (Yasmasitha & Sidarta, 2020). Another study by Ramadhani and Romadhoni (2024), found that there is a positive correlation between flat feet and postural balance in children aged 7-12 years (Ramadhani & Romadhoni, 2024). Flat foot is a condition in which there is no longitudinal arch that causes part or all of the soles of the foot to touch the ground, a condition



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ISSN 2722 – 9610
E –ISSN 2722 - 9629

in which the medial arch of the foot is lost, and there is pressure on the subtalar joint resulting in internal rotation of the tibia (Arachchige et al., 2019; Safitri et al., 2019)

The relationship of the flat foot with balance is also attributed from the connection of the foot with the joints of the ankles, knees, and hips forming a kinematic chain of the lower body that regulates the balance of the body in a static and dynamic state. The legs are located at the furthest point of this chain and act as the support base for the kinematic chain. Based on this, it is believed that every small dynamic change in the legs affects posture control (Ghorbani et al., 2025). A person with *a flat foot* condition has weakness of the intrinsic muscles, so the support structure of the longitudinal arch can affect the body's leverage components during *foot strike* and *push oof* so that it can disturb balance (Latifah et al., 2021).

In the condition of flat foot when standing with one foot, there is a decrease in activity in m.Abductor hallucis, m. gastrocnemius, m.anterior tibialis, and m. vastus medialis. The hallucis abductor muscle acts as a dynamic stabilizer of the medial longitudinal archus, so that a decrease in activity in this muscle will result in a decrease in biomechanical ability, poor absorption of external forces, and postural imbalance. Weakening of the medial longitudinal arcus can also be caused by the eversion of the subtalar joint in the flat foot condition, resulting in a larger contact area than in normal feet. Although increased contact surface area in flat feet is thought to provide better support for postural stability, individuals with flat feet report poorer static and dynamic balance compared to individuals with normal feet (Arachchige et al, 2019).

Flat foot can also cause the leg and leg muscles to get tired more easily and cause cramps and pain due to overuse (Arachchige et al., 2019). The wide, flat shape of the flat foot without the presence of curves results in stiff body leverage compression when walking and running, resulting in loss of balance and fatigue quickly. Balance itself is needed in daily activities, such as walking, running, and standing (Antara dkk, 2017).

The shape of the arc and static balance can also be influenced by several factors, including:body mass index and physical activity. A high body mass index can increase the risk of flat foot through increased mechanical load on the medial longitudinal arch of the foot. Excessive load causes stretching of structures that function to maintain the shape of the arc, so that the height of the arch decreases and the legs become more pronate (Ghorbani et al., 2023). Based on the results of the study, children with *underweight* nutritional status have low muscle mass, including in the lower extremities. Low levels of physical activity and limited muscle strength can affect the function of the muscles that support the arch of the foot, such as *the abductor hallucistrophis* and *flexor hallucistrophis brevis*, thereby increasing the risk of *flat foot* due to weak support for the arch of the foot (Dewi et al., 2024). On the other hand, some children with obesity still have normal leg arches, especially if they engage in enough physical activity. This suggests that although excess body mass puts additional pressure on the legs, the muscle strength maintained through physical activity is able to maintain the arch structure of the legs (Ridge et al., 2019).

## CONCLUSION

Based on the results of the study on "the relationship between flat foot and static balance in children 10-12 years" it was found that there was a significant relationship between flat foot and static balance, with a significance value of p=0.011 with the strength of weak relationships. Therefore, there needs to be further research by paying attention to factors that can affect the research.

## ACKNOWLEDGEMENT

Gratitude was given to the Principal of State Elementary School 1 Sesetan South Denpasar for assistance in the research process, and sincere gratitude to all parties involved in this research.

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E –ISSN 2722 - 9629