



## The relationship between flat foot and Q-angle in elementary school students

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### ABSTRACT

**Background:** Elementary school students have unique characteristics. Each child has their ways of doing their activities. In its activities, of course, there are risks, especially in the lower extremities, namely flat foot, which is the condition of the medial arch treading with the ground or flat due to emphasis on the medial part, excessive or over foot conditions will result in an increase in valgus shape in the knee joint; thus the degree of quadriceps angle (Q-angle) can increase. This study aims to determine the relationship between flat foot and Q-angle in elementary school children in Kusamba Village, Dawan District, Klungkung Regency.

**Objective:** This study aims to determine the relationship between flat feet and Q-angle.

**Methods:** Observational analytical cross-sectional design that uses simple random sampling techniques with a sample of 51 people

according to predetermined inclusion and exclusion criteria. Data were collected with a wet footprint test and Clark's angle to find a flat foot and Q-angle with a 360° goniometer.

**Results:** The analysis test results obtained a result of  $p=0.000$  ( $p<0.05$ ), so it can be explained that there is a significant relationship between flat foot and Q-angle. The results of the spearman-rho analysis obtained a moderate relationship with the value of the correlation coefficient on the right flat foot with a right Q-angle of 0.527 and the left flat foot with a left Q-angle of 0.597 which means the direction of the relationship is unidirectional.

**Conclusion:** Based on the study's results, it can be concluded that there is a moderate, unidirectional, and meaningful relationship between flat foot and Q-angle in elementary school children in Kusamba Village, Dawan District, Klungkung Regency.

**Keywords:** children, elementary school, flat foot, Q-angle.

**Cite this Article:** Putra, D.G.G.K., Putra, I.P.Y.P., Saraswati, N.L.P.G.K., Dewi, A.A.N.T.N. 2023. The relationship between flat foot and Q-angle in elementary school students. *Physical Therapy Journal of Indonesia* 4(2): 133-137. DOI: 10.51559/ptji.v4i2.115

### INTRODUCTION

Elementary school students have unique characteristics and differ from one child to another. Child has their disadvantages and advantages. Every child has their ways of doing their activities. Activity or activities carried out by children, of course, has risks for the child, including problems with posture. Body posture can be divided into two parts, namely, the upper and lower extremities. Especially in the lower extremities, the feet have a crucial function in supporting the body, but the feet can experience structural changes due to some factors.<sup>1</sup>

One condition that is not normal in the foot's shape is a flat foot or flat foot where the inner arch (arcus medialis) does not form when the child stands.<sup>2</sup> Flat foot, also known as pes planus, is a malformation characterized by the collapse or disappearance of the medial longitudinal arch of the foot.<sup>3</sup> It is related to hindfoot valgus deformity and forefoot abduction.<sup>4</sup> Flat foot is usually asymptomatic and is normal in children aged 6 to 7.<sup>5</sup> The longitudinal arch normally develops in the first ten years of life. However, some children may not have a proper arch before adulthood.<sup>6,7</sup>

Research conducted in Surakarta aged 6-12

found 27.5% of 1089 children experienced flat feet.<sup>8</sup> The consequences that will be caused by a flat foot in the long term will be pain in the soles of the feet, fatigue, ankles, and knees that limit walking activities.<sup>9</sup> Following the theory of biomechanics, when the pronation condition exceeds the limit, it will result in internal rotational pressure on the foot so that there is an angulation problem in the patellar tendon and excessive pressure on the lateral side of the facet patella, therefore the condition of the foot that is excessive or over will result in an increase in valgus shape in the knee joint followed by an increase in the value of the quadriceps angle (Q-angle). This condition can indirectly be related to the degree of Q-angle.<sup>10</sup>

Q-angle is the angle formed from the intersection between two imaginary lines measured between the axial tendon M. quadriceps femoris that divides the patellar ligament in two to the tibial tubercle and the line drawn from the superior anterior spina iliaca (SIAS) to the mid-patella when the knee is in an extended state.<sup>11</sup> Q-angle is often used in measurement parameters in assessing knee problems.<sup>12</sup> Basically, women have a higher degree of Q-angle compared to men. The normal Q-angle

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Received : 2023-03-30

Accepted : 2023-05-29

Published : 2023-07-11

in women ranges from 14°-17° while in men, 10°-14°.<sup>11</sup> Factors influencing increased Q-angle include ligament and capsular flexibility, congenital abnormalities, muscle contractures, trauma, flat foot, age, activity, and gender.<sup>13</sup>

Little research still examines the relationship between flat feet and Q-angle in Indonesia. Researchers want to clarify whether there is a relationship between flat feet and Q-angle. Based on research conducted by Bella Aulya Safitri in 2019, it was found that there was a relationship between flat foot and Q-angle in children aged 9-12 years with normal BMI in West Denpasar State Elementary School.<sup>14</sup> Research conducted by Meiza Anniza in 2020 found a relationship between footprint test and Q-angle in 12-year-old children at SMP Muhammadiyah 2 Gamping Yogyakarta.<sup>15</sup> In this study, researchers will use child subjects aged 10-12 years. This is because the age of 10 years is the limit of arch growth, and there will be no significant changes in the shape of a person's arch.<sup>16</sup> This age is the age of growth and development, where the child's motor begins to be well coordinated. This period has enormous potential to optimize all aspects of child development, including motor development in the form of good growth and development needed to carry out daily activities.<sup>17</sup> Because of this, the researcher intends to raise the relationship between flat foot and Q-angle in elementary school students in Kusamba village, Dawan district, Klungkung regency.

## METHODS

This study used a type of analytical observational study with a cross-sectional design. The independent variable is a flat foot, and the bound variable is a Q-angle. This research has been reviewed by the Research Ethics Commission of the Faculty of Medicine, Udayana University / Sanglah Hospital Denpasar, with the number 228 / UN14.2.2.VII.14 / LT / 2023 and passed the ethical feasibility test. The research will be conducted on February 20 and 27, 2023, at SD N 2 Kusamba and SD N 3 Kusamba.

The research sample was 51 students aged 10-12 years who were obtained through a simple random sampling method with sufficient inclusion and exclusion. The inclusion criteria in this study were status as active students at SD Desa Kusamba, aged 10-12 years, had typical vital signs, flat foot arcus pedis shape measured by footprint test, had physical activity classified as very low, low and moderate, had underweight or normal BMI and voluntarily became a research subject by signing a consent form. While the exclusion criteria are having injuries (fractures, strains, sprains, dislocations)

in the lower extremity, using walking aids and experiencing functional limitations in walking independently, experiencing ligament and capsular flexibility, having congenital abnormalities, and experiencing muscle contractures.

The procedure for conducting the study is that the researcher will calculate the degree of the flat foot using a wet footprint test and calculate with Clarke's angle. Then proceed with measuring the Q-angle degree using a 360° goniometer. This study consisted of 2 data analyses, the first being a univariate analysis, which aimed to present a general picture of age, BMI, physical activity, flat foot, and Q-angle. The second is bivariate analysis, which uses non-parametric *spearman-rho* to determine the value of the strength of the relationship between 2 variables.

## RESULTS

From a total of 51 respondents, the descriptive characteristics of the respondents in this study were obtained; namely, age, gender, BMI, and dynamic balance can be seen in the following table.

Table 1 shows the age range of research subjects aged 10 and 12. The most is the age of 11 years, which is 25 people (49%). The study subjects were more male, amounting to 27 people (52.9%). In the table, it can be seen that the most BMI categories are underweight categories, as many as 39 people (76.5%). The highest physical activity category was moderate, with as many as 43 people (84.3%).

In Table 2 respondents with normal right Q-angle were found the most in the right flat foot of degree I, which was 31.4%. Respondents with abnormal right Q-angle were most prevalent in the right flat foot of degree I, which was 25.5%.

In Table 3 respondents with normal left Q-angle were found the most in the left flat foot of degree I, which was 33.3%. Respondents with abnormal left Q-angle were most prevalent in the left flat foot of degree III, which was 23.5%.

Based on *Spearman's Rho* test, the *p*-value on the right flat foot with the right Q-angle is 0.000. At *p*-value of the left flat foot with the left Q-angle is 0.000. Proving the right and left flat feet against the right and left Q-angles in elementary school children aged 10-12 years in Kusamba Village, Dawan District, Klungkung Regency, has a significant relationship. It is known that the value of the correlation coefficient on the right flat foot with a right Q-angle of 0.527 and the left flat foot with a left Q-angle of 0.597 means the direction of the relationship is unidirectional with the strength of the medium relationship.

**Table 1. Characteristic respondents**

Variable	Frequency (n)	Percentage (%)
Age		
10	20	39.2
11	25	49
12	6	11.8
Gender		
Men	27	52.9
Women	24	47.1
BMI		
Underweight	39	76.5
Normal	12	23.5
Physical Activity		
Low	8	15.7
Moderate	43	84.3

**Table 2. Cross table Right flat foot with right Q-angle**

Right Flat Foot	Right Q-angle				Total	
	Normal		Abnormal		n	%
	N	%	n	%		
I	16	31.4	13	25.5	29	56.9
II	1	2	11	21.6	12	23.5
III	0	0	10	19.6	10	19.6
Total	17	33.3	34	66.7	51	100

**Table 3. Cross table Left flat foot with left Q-angle**

Left Flat Foot	Left Q-angle				Total	
	Normal		Abnormal		n	%
	N	%	N	%		
I	17	33.3	9	17.6	26	51
II	2	3.9	11	21.6	13	25.5
III	0	0	12	23.5	12	23.5
Total	19	37.3	32	62.7	51	100

**Table 4. Correlation of flat foot with Q-angle**

Variable Correlation	Correlation	P-value
Right Flat Foot against Right Q-angle	0.527	0.000
Left Flat Foot to left Q-angle	0.597	0.000

## DISCUSSION

The characteristics of respondents in this study are based on age taken with inclusion criteria in elementary school students in Kusamba Village, Dawan District, Klungkung Regency, aged 10-12 years, with a total of 51 elementary school students taken through a simple random sampling technique, namely by first selecting subjects according to criteria in the affordable population and then choosing the required subjects randomly based on the sequence number of data that appears on the random calculator on the computer system. In this study, 20 elementary school students aged ten years (39.2%), 25 elementary school students aged 11 years (49.0%), and at the age of 12 years, as many as six elementary school students (11.8%). This result is slightly in line with research conducted

by Karthika in 2022, which states that flat foot in children is a physiological condition that improves with age.<sup>18</sup>

In the characteristics of the sample based on sex from a total of 51 research subjects, 27 men (52.9%) and 24 women (41.1%) were obtained. According to BMI, the category most experienced by students is underweight, with as many as 39 people (76.5%), followed by normal BMI, with as many as 12 people (23.5%). Based on the category of physical activity, the most is the moderate category, as many as 43 people (84.3%), followed by the low category, as many as eight people (15.7%).

Based on cross table 2 between the right flat foot and the right Q-angle, on the right flat foot I degree, 16 people (31.4%) with the right Q-angle are normal, while the abnormal ones are 13 people (25.5%). In contrast, the right flat foot degree II Q-angle right is normal for as many as one person (2%) and abnormal for 11 people (21.6%). Grade III right flat foot has a normal right Q-angle of 0 people (0%) and an abnormal one of 10 people (19.6%). Based on cross table 3 between the left flat foot and the left Q-angle, on the left flat foot of degree I, 17 people (33.3%) with the left Q-angle are normal while the abnormal is nine people (17.6%). At the same time, the left flat foot of degree II Q-angle left normal for as many as two people (3.9%) and abnormal for as many as 11 people (21.6%). Grade III left flat foot has a standard left Q-angle of 0 people (0%) and an abnormal one of 12 (23.5%).

From Table 4, based on the non-parametric test of *Spearman's Rho*, the results obtained a relationship between the right flat foot and the right Q-angle with a value of  $p=0.000$  ( $p<0.05$ ). They obtained a relationship between the left flat foot and the left Q-angle with a value of  $p=0.000$  ( $p<0.05$ ). So it can be concluded that a significant relationship exists between the flat foot and Q-angle in elementary school students aged 10-12 in elementary school in Kusamba Village, Dawan District, Klungkung Regency. Furthermore, from the results of the data above, it is known that the correlation coefficient is  $r=0.527$  on the right foot, namely the right flat foot and right Q-angle, and  $r=0.597$  for the left foot, namely the left flat foot and left Q-angle. Thus, the relationship between the right and left flat foot to the right and left Q-angles is moderate.

This is similar to a previous study conducted by Bella Aulya Safitri in 2019 by looking for the relationship of the flat foot with Q-angle in children aged 9-12 years with normal BMI in West Denpasar State Elementary School a significant relationship of the right flat foot to right Q-angle ( $r=0.334$ ). A significant relationship exists between the left flat foot and the left Q-angle ( $r=0.399$ ). Based on the

objectives and results of the study, it was concluded that there was a statistically significant relationship ( $p < 0.05$ ) between the flat foot and Q-angle in children aged 9-12 years with normal BMI in West Denpasar State Elementary School.<sup>14</sup>

Normally, the joint reduces the rotational force between the legs and feet so that there is no excessive outward or inner circular movement when the foot is treading on a surface.<sup>19</sup> However, on a flat foot, the foot will experience subtalar and midtarsal pronation movements as long as the foot touches or treads on the surface, changing the torque of rotation of the tibia and femur.<sup>20</sup> If the foot is biomechanically functioning in constant rotation, then the entire foot will undergo excessive internal rotation. The excess pressure from internal rotation on the foot causes problems in patellar tendon angulation and excessive pressure from the lateral side of the patella.<sup>14</sup> In theory, the internal os femur causes increased contact pressure on the lateral facet side of the patella. Therefore, excessive pronation of the leg will cause pain in the anterior knee.<sup>21</sup> Thweight bearing position will result in the load being evenly divided on both lower extremities; if one of the legs is more pronated, it can result in asymmetry of the frontal plane with short limbs on the pronation. Continuous stress can cause pain and inflammation.<sup>14</sup>

This study has the advantage of researching specifically on children, whereas, in Indonesia, few examine the relationship between flat feet and Q-angle. So that it can be used as an input in the development of research; as a result, deficiencies in this study were obtained in other static measurements not performed. This study only uses a wet footprint test in flat foot examination, so other static measurements, such as heel valgus angle, can be used as input in future research.

## CONCLUSION

Based on the results of research and analysis tests conducted, it can be concluded that there is a significant relationship ( $p < 0.05$ ) between Flat Foot and Q-angle in elementary school children in Kusamba Village, Dawan District, Klungkung Regency.

## ETHICAL CLEARANCE

The Research Ethics Commission, College of Medicine, Universitas Udayana, stated that this research is ethically feasible with number 228/UN14.2.2.VII.14/LT/2023.

## CONFLICT OF INTEREST

This study has no conflicts of interest.

## FUNDING

This study received no grants from any institution.

## AUTHOR CONTRIBUTIONS

DGGKP prepares study designs, collects data, processes data, and writes manuscripts. IPYPP, NLPGKS, and AANTND are directing data collection and revising the manuscript.

## ACKNOWLEDGMENT

The authors thank all parties involved in this study.

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