

The Effect of Strengthening Exercise on Postural Balance and Functional Ability in Children with Flatfoot

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ABSTRACT

Background: Long-term flatfoot deformity will cause foot, ankle and knee pain. In addition, it will cause repeated acute trauma until foot deformity occurs. The constant pressure experienced by the muscles due to prolonged abnormal posture and repetitive movements will provide neurological adaptations and change biomechanics, causing muscle imbalance. One of the interventions that physiotherapy can provide in dealing with flatfoot is strengthening exercise. **Objective::** to determine the effect of strengthening exercise on postural balance and functional ability in flatfoot. **Method:** This study used a quantitative method of quasi-experimental type with a group pre-test and post-test design. The sample was 32 respondents with a purposive sampling technique. Measurement of postural balance using the pediatric balance scale and measurement of functional ability using the Oxford ankle and foot questionnaire. Strengthening exercise intervention with a dose of 3 times a week for 4 weeks. **Results:** Based on the Wilcoxon test, the results were obtained with a significance value on postural balance of 0.004 ($p < 0.05$) and functional ability of 0.008 ($p < 0.05$). **Conclusion:** There is an effect of strengthening exercise on postural balance and functional ability in flatfoot children.

Keywords: Child, Flatfoot, Strengthening Exercise

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INTRODUCTION

Childhood is a phase of play and movement exploration so it requires a lot of body muscle activity, especially the legs. The feet play a role in supporting body weight, if the support is not sturdy then the body often experiences injury. One of the problems that occur with the feet is *flatfoot*. *Flatfoot* is a condition that is mostly caused by physiological factors and does not require surgery. Normally the arch of the foot is formed in the first five years of life at an age range of 2-6 years. The arch of the foot plays an important role in *absorbing ground reaction forces* and supporting the body's weight during activities (Sativani et al, 2020).

In flatfoot, the position of the foot (*foot alignment*) will change towards pronation (hyperpronation). These changes will burden the muscles in the thighs, knees and feet to work harder to maintain body stability. The constant

pressure experienced by muscles due to prolonged abnormal posture and repetitive movements will provide neurological adaptation and change biomechanics, causing *muscle imbalance* (Nurjanati, 2018).

The prevalence of *flat foot* (21% to 57%) is reported generally in children from two to six years of age which decreases (13.4% to 27.6%) in primary school. In the adult population, it is reported to be around 5% to 14%. Meanwhile, the prevalence of *flatfoot* pathology in children aged 7-14 years is 10.3%, but this prevalence decreases with increasing age. In Surakarta City, Indonesia, a study of 1089 elementary school students found 299 students experienced *flatfoot*. Another study conducted in Jakarta, Indonesia with a total sample of 297 students found that *flatfoot* was found in children aged 5 years (40.32%) while in

children aged 5 to 10 years (22.15%) in older children from 10 years (15.48%) (Inayah 2020). One of the interventions that physiotherapy can provide to treat *flatfoot* is Strengthening Exercise. Some *strengthening exercises* that can be done are *heel raises*, *towel exercises*, and *ball exercises*. These three exercises are carried out to strengthen the intrinsic muscles of the legs as well as the muscles around the *pelvis*, thighs and knees due to the influence of biomechanical changes which result in *muscle imbalance* (Nurjanati 2018).

The purpose of writing this article can be divided into 2, namely:

1. To determine the effect of strengthening exercise on postural balance.
2. To determine the effect of strengthening exercise on functional abilities.

Physiotherapy management in cases of *flatfoot* uses *strengthening exercise* therapy in the form of *ball roll exercises*, *heel raises exercises*, and *towel curl exercises*.

Heel raise exercise is a static exercise that involves the stabilizing muscles that form the arch of the foot. To strengthen the gastrocnemius, apart from that, *heel raise exercises* can also improve static balance in children. The *heel-raise exercise* movement involves the muscles of the lower legs and feet. The *heel raises exercise* is carried out 3 times a week for 4 weeks with 10 repetitions in 3 sets (Sativani and Pahlawi, 2020). *Towel curl exercise* is an exercise program to improve the morphology of the medial longitudinal arch by activating the intrinsic muscles of the legs. This exercise involves shortening the legs with the toes pulled towards the heels without flexing the legs like "gripping" (Mas'ud 2019). Exercises were given 3 times a week for 4 weeks with 5 repetitions with resistance for 15 seconds (Sativani and Pahlawi 2020).

Ball roll exercise is a strengthening exercise carried out by stepping on and rolling a ball using the sole which aims to stretch the *plantar fascia* thereby increasing the height of the arch of the foot (Faila Syiva Nur Mahmudah 2020). This exercise is given 3 times a week for 4 weeks with a duration of 2 minutes (Nisa and Activah 2020).

METHOD

This research uses a *quasi-experimental* research type with a *one-group pre-post-test research design without a control design*. The subjects in this study were 32 students who suffered from *flatfoot*, with an age range of 6-10 years who were given *strengthening exercises* in the form of *ball roll exercises*, *heel raises exercises*, and *towel curl exercises* 3 times per week for 4 weeks. The research was conducted at SD N 1 Kleco Surakarta. The *flatfoot* measuring tool used is a *wet footprint* with the following procedure:

1. Fill a flat container using watercolour paint.
2. Put the feet in the container containing the watercolours.
3. Then stamp the feet on a piece of his paper.
4. Lift your foot so that it sticks to the imprint on the paper.



Picture 1. Wetfoot print

The measuring tool used for balance checks is the *pediatric balance scale* which consists of 14 assessments with a score of 0-4, where 0 is the inability to do it while 4 is the ability to do it without difficulty. The maximum score in this assessment is 56, a score of 56 indicates that there is a balance disorder in the child (Erden, Arslan, and Topbaş 2020).

The functional ability measuring tool used is the *Oxford ankle foot questionnaire* which consists of 15 questions with a value range of 0-4, where the value is 0 (always) to 4 (never).

The maximum number of assessments is 60, where the higher the score, the better the function (Burger et al. 2019).

56-60	2	3	6.3%	9.4%
Total	32	32	100%	100%

RESULT

1. Characteristics of respondents based on age

Table 1 by age

Age	N	%
6-7 Years	27	84.4%
8-10 Years	5	15.6%
Total	32	100%

2. Characteristics of respondents based on gender

Table 2 by gender

Age	N	%
Man	18	56.3%
Woman	14	46.8%
Total	32	100%

3. Characteristics of the postural balance category

Table 3 Postural Balance

PBS value	(n)		%	
	pre	post	pre	post
50-53	25	23	78.1%	71.9%
54-56	7	9	21.9%	28.1%
Total	32	32	100%	100%

4. Characteristics of functional capability categories

Tabel 4 Kemampuan Fungsional

OAFQ value	(n)		%	
	pre	post	pre	post
51-55	30	29	93.8%	90.6%

5. Effect test results

Tabel 5 Uji Pengaruh

Wilcoxon	Z	Asymp. sig.(2-tailed)
Postural Balance	-2.887 ^b	0.004
Functional Capabilities	-2.640 ^b	0.008

DISCUSSION

Based on the research results above, characteristics based on age show that the highest percentage of *flatfoot* conditions in children occurs in children aged 7 years. *Flatfoot* is a condition where the arch of the foot is not visible from birth and is buried in fatty tissue. The large number of *flatfoot* conditions in children under 10 years of age occurs because age is predicted to be the main factor influencing the occurrence of *flatfoot* conditions, and *flatfoot* conditions decrease as the child gets older. The reduction in *flatfoot* conditions in children occurs because most children experience the development of the longitudinal arch of the foot at the age of 3-5 years. This also occurs as a result of reduced fat in the medial arch of the foot and a permanent adjustment to the growth of the arch of the foot. This is also in line with research (Sativani and Pahlawi, 2020) which states that most flatfoot occurs at the age of 7 years because the high prevalence of flatfoot at that age can be caused by physiological characteristics and the continued development of the longitudinal arch in the first 10 years of a child's life.

The characteristics of respondents based on gender show the results of research based on gender where men tend to be more at risk of experiencing *flatfoot* compared to women. This is reinforced by research (Muadz, 2018) showing that the prevalence of *flatfoot* in boys is greater than in girls, allegedly due to differences in body anatomy, where the average value of valgus in boys is greater than in children. Woman. This can influence flexibility in maintaining static and

dynamic positions and provide stability when carrying out functional activities (Nurjanati, 2018). When someone experiences *flatfoot*, the most visible thing is a change in the structure of the soles of the feet that shifts or loses alignment. So boys are at greater risk of experiencing *flatfoot* compared to girls.

The characteristics of respondents based on balance checks using the *pediatric balance scale* explain that balance is related to the condition of *flatfoot*. Balance is a movement system that functions to control and maintain body functions involving the *neuromuscular, musculoskeletal* and cognitive systems with changes in the *centre of gravity* (Nisa and Aktivah 2020). Balance can be disturbed due to *flatfoot* conditions where the shape of the soles of the feet is flat which is caused by the loss of the medial longitudinal arch when standing and will appear when the soles of the feet do not touch the ground which will cause the balance to be disturbed (Mahendrayani et al, 2018) The impacts arising from *flatfoot* conditions can change the pattern Abnormal walking that causes fatigue and impaired balance. The effect of *flatfoot* on balance shows that the foot in the last part of the kinematic chain plays a very important role in static and dynamic positions (Kusuma, 2017). The feet play a very important role in supporting body weight and maintaining balance. If the support has problems it will cause hyperflexibility (Nurjanati, 2018).

Characteristics of respondents based on functional ability examinations show that *flatfoot* conditions will result in a decrease in balance which causes a decrease in functional ability and performance in the feet and ankles, decreased body alignment, reduced elasticity in ligaments and muscles (Awaliah, 2022). The pain that occurs in *flatfoot* is caused by inadequate intrinsic muscles stretching the ligament too much so that the medial side *collapses*. Abnormalities in the structure of the bones make muscles, ligaments and tendons work harder, resulting in changes in the longitudinal arch, as well as changes in foot *alignment* and changes in the *centre of gravity*. *Flatfoot* foot shape can cause changes in the *alignment* of the foot which affects the *plantar arch* when supporting body weight in a standing

or walking position, resulting in excessive loading (Mas'ud, 2019).

Strengthening exercise is one effort that can be done to restore the work of weak intrinsic muscles. Strengthening these muscles has an impact on changes in the medial longitudinal arch and its biomechanics. *Strengthening exercise* refers to the ability of muscle contractile tissue to produce tension and resultant force in the muscle (Nurjanati, 2018).

Heel raises exercises can improve foot arches and balance. The main strategy provided by the body to restore balance in response to sudden disturbances is the *ankle strategy* (Herawati, 2019). When doing *heel raises*, your body posture will lift one heel or both feet from the surface, so that the body will continuously maintain the *center of gravity* above the *base of support*. When doing *heel raises exercise*, muscle performance appears which refers to the muscle capacity to do work. Muscle performance is a complex component of functional movement and is influenced by all body systems including balance (Muadz, 2018).

Towel curl exercise can also train your grip on your toes and increase ankle stability when walking, running and climbing stairs (Utami and Syafri, 2021). *Towel curl exercise* aims to improve the functionality of the ankle by using the intrinsic muscles in the foot so that it can reduce the degree of *flatfoot*, automatically balance disorders in flatfoot can be resolved and the functional ability of the foot can also be resolved (Haryoko, 2023).

Ball roll exercise is an exercise that aims to stretch the *plantar fascia* thereby increasing the height of the arch of the foot. Apart from that, it focuses on strengthening the intrinsic muscles of the foot and can increase body stability in maintaining balance (Aktifah, 2021).

CONCLUSION

This research concludes that carrying out *strengthening exercises* in the form of *heel raises exercises, towel curl exercises, and ball roll exercises* carried out 3 times a week for 4 weeks, can improve postural balance and functional ability in *flatfoot* children aged 6-10 years according to test results. influence that has been exercised.

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