

The Effect of Strengthening Ball Roll Exercise and Strengthening Heel Raises Exercise on Static Balance in Children with Flat Foot in Sragi Subdistrict

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ABSTRACT

The arch of a foot that is not formed normally is called a Flat foot. Flat foot can cause balance disorders in children. How to improve static balance can be done with strengthening ball roll exercise and strengthening heel raises exercise. The purpose of this study was to determine the effects of strengthening ball roll exercise and strengthening heel raises exercise on static balance in children's flat foot at Sragi District. This study using quasi experimental design (non randomized control group pretest posttest design) consists of two groups, in control group consisted of 24 respondents, and in experiment group there are 24 respondents. The results of Wilcoxon test in control group showed $p > 0,05$ and p value in experiments group is $p < 0,05$, it means there is an effect of strengthening ball roll exercise and strengthening heel raises exercise on respondents's static balance. The Mann Whitney U test, which was used as a defference test, obtained $p = 0.443$ on the right foot and $p = 0.000$ on the left foot. It means that was difference in the effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on static balance in experiments group compared to the control group.

INTRODUCTION

The process of growth and development starts from conception and continues to adulthood through several stages. The

optimum growth and development is the result of the interaction of intrinsic factors and environmental factors, including physical, biological, and psychosocial environments

so that it gives different results for each child (Putri YR, 2018). Abnormalities that occur on the soles of children's foot, which is the arch on the sole has an abnormal shape called flat foot (Indardi, 2015).

The prevalence of flat foot in Indonesia is equivocal over the years. The prevalence varies according to various factors such as different age groups and different methods. Sahabuddin (2016) revealed that 58 children of 8-12 years experienced flat foot. The results of Nisa's research (2020) in Wonokerto Subdistrict, Pekalongan Regency, found that 59 children of 9-10 years experienced flat foot.

Flat foot is classified into 2 types; unilateral flat foot and bilateral flat foot. Unilateral flat foot is a condition that is only found on one foot. Bilateral flat foot can be found on both feet (Kisner & Colby 2012, p. 260). Flat foot may cause balance disorders, which will affect the adequacy level of balance, due to the lack of arch of the foot sole (Sari, 2018). In society, flat foot is not considered a concern but a normal condition.

Balance comprises 2 types, static and dynamic. Static balance is a condition to maintain the body in a still position (Kusuma 2017, p. 3). One of the factors that can influence static balance is flat foot. The research by Syafi'i et al. (2016) reveals that

23% of flat foot children could balance only 38.5 seconds, while children with normal arch could maintain static balance on average 78.2 seconds.

According to Mahendrayani (2018), balance can be defined as the capacity of the body to maintain the correct position when moving or doing activities. Balance is essential in life, balance can be observed from the balance during sitting, standing, and walking position. The balance problems can be a risk factor for falls.

Flat foot significantly affects balance. The primary function of the foot is to support body weight, to carry the body when walking, running, and standing. Flat foot shape may cause balance disorders such as body sway, persistent anomalies, quick fatigue in a long walking, and pain (Kumullah, 2019). Children with bilateral flat foot have a poor balance because both feet are flat and there is no support, while unilateral flat foot, the balance of the body is still supported by the other foot so that the balance can be maintained.

Treatment of flat foot by physiotherapy should be done as early as possible in order to treat the arch. Treatment of flat foot at primary school age is only to prevent deformities in adulthood (Nisa, 2020). Physiotherapy measures that can be performed to optimize the static balance of flat foot children include balance exercise, strengthening exercise,

walking exercise with feet, and the use of medial arc support (Darwis 2016, pp. 28-30).

Physiotherapy treatment often used is strengthening exercise. Strengthening Exercise is a muscle-strengthening exercise, in which strengthening exercises for the flat foot are performed on the feet and toes. Ball roll exercise and heel raises exercise are two exercises that are easy to perform. Research by Kusuma (2017) found that the mean score of pretest and posttest was 1.9829, which increased to 4.7657, showing that strengthening exercise interventions have a positive effect on static balance in flat foot sufferers. The description above made stimulate researchers to understand the effect of strengthening ball roll exercise and strengthening heel raises exercise on the static balance of flat foot children in Sragi Subdistrict.

METHODS AND MATERIALS

The design of this research is quasi-experimental (non-randomized control group pretest-posttest design) with a population of all children with flat foot in Sragi Subdistrict. The sample according to the inclusion and exclusion criteria consisted of 48 respondents with bilateral flat foot conditions. The study began with anamnesis and condition assessment of flat foot for the entire population and then by using purposive sampling technique, 24 respondents were drawn in each group.

The study was conducted from February to March 2019. The study was divided into 2 groups, the control group and the experimental group, in which the experimental group was treated with interventions of strengthening ball roll exercises and strengthening heel raises exercises. Prior to the intervention, a pre-test was conducted in both groups in the form of a static balance measurement using a one-legged stance test, where respondents were instructed to stand on one foot and the time of their standing ability was measured with a stopwatch.

The Strengthening ball roll exercise was performed in a sitting position on a chair by rolling the ball on the sole of the foot for 2 minutes for 12 times which aims to stretch the plantar fascia and increase the arch of the foot. Strengthening heel raises exercise was done in a standing position on tiptoes with both hands against the wall, it was performed 2 sets or 8 reps for 5 minutes and done with a frequency of 12 times. Strengthening ball roll exercise and strengthening heel raises exercise interventions were carried out with a 2 minutes treatment with a frequency of 2 times a week for 4 weeks.

RESULTS AND DISCUSSION

The results of research on the effect of strengthening ball roll exercise and strengthening heel raises exercise on static

balance in children with flat foot of pre post intervention are as follows:

a. Description of a static balance of the right and left foot in the control group

The resultsof the static balance of the right foot before intervention in children with flat foot obtained a mean of 2.54, median of 2.50, standard deviation of 1.1.03, min score of 1, and max score of 4.The static balance of the right foot after intervention obtained mean of 2.17, median of 2.00, standard deviation of

0.868, min score of 1 and max score of 4. The results of the static balance of the left foot before intervention in children with flat foot obtained mean of 2.13, median of 2.00, standard deviation of 0.850, min score of 1 and max score of 4. The static balance of the left foot after intervention showed mean of 2.13, median of 2.00, standard deviation of 0.850, min score of 1 and max score of 4. The complete resultsare displayed in Table 1.

Static Balance	Mean	Median	SD	Min	Max
Right foot before	2.54	2.50	1.1.03	1	4
Right foot after	2.17	2.00	0.868	1	4
Left foot before	2.54	3.00	1.062	1	4
Left foot after	2.13	2.00	0.850	1	4

Table 1. Mean of static balance of the right foot and left foot in the control group.

b. Static balance of the right foot and left foot in children with flat foot before and after strengthening heel raises exercise and strengthening ball roll exercise interventions.

The results of the static balance of the right foot in children with flat foot before strengthening heel raises exercise and strengthening ball roll exercise interventions obtained mean of 3.25, median 3.00, standard deviation of 0.532, min score of 2 and max score of

4. The results of the static balance of the right footafter strengthening heel raises and strengthening ball roll exercises interventions obtained mean of 1.21, median of 1.00, standard deviation of 0.415, min score of 1 and max score of 2.

The results of the static balance of the left foot in children with flat foot before strengthening heel raises exercise and strengthening ball exercise interventions obtained mean of 3.04, median of 3.00, standard deviation of

0.500, min score of 2 and max score of 4. The results of the static balance of left foot after strengthening heel raises exercise and strengthening ball roll

exercise interventions showed mean of 1.13, median of 1.00, standard deviation of 0.338, min score of 1 and max score of 2. The results are presented in Table 2.

Static Balance	Mean	Median	SD	Min	Max
Right footbefore	3.25	3.00	0.532	2	4
Right foot after	1.21	1.00	0.415	1	2
Left foot before	3.04	3.00	0.550	2	4
Left foot after	1.13	1.00	0.338	1	2

Table 2. Mean of static balance of the right foot and left foot in the intervention group before and after strengthening ball roll exercise and strengthening heel raises exercise interventions.

c. Test Results The effect of strengthening ball roll exercise and strengthening heel raises exercise on static balance in the Control and Intervention groups

The results of statistical analysis using the Wilcoxon test in the right foot control group Pre-Post obtained Z score of 0.300, p value (Asymp. Sig 2-tailed) of 0.224 (> 0.05), hence H_0 is accepted. It implies that there was no effect of static balance before and after the intervention. The left foot control group Pre-Postacquired Z score of 0.208, p value (Asymp. Sig 2-tailed) of 0.057 (> 0.05), thus H_0 is accepted. It means that there was no effect of static balance after pre-post intervention. The test results of

right foot Pre-Post in the intervention group and control group obtained Z score of -4.421, p value (Asymp. Sig 2-tailed) of 0.01 (< 0.05), so H_0 is rejected, meaning that there was an effect of static balance before and after the intervention. The results of Pre-Post in the left foot intervention group showed Z score of -4.518, p value (Asymp. Sig 2-tailed) of 0.01 (< 0.05), hence H_0 is rejected, meaning that there was an effect of static balance before and after strengthening ball roll exercise and strengthening heel raises exercise interventions. The complete results are shown in Table 3.

Group	Z	P Value
Control		
Pre-Post Right Foot	0,300	0,224
Pre-Post Left Foot	0,208	0,057
Intervention		
Pre-Post Right Foot	-4,421	0,01
Pre-Post Left Foot	-4,518	0,01

Table 3. Test Results of the effect of strengthening ball roll exercise and strengthening heel raises exercise on static balance in control and intervention groups

d. The difference test results of the effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on static balance in control and intervention groups

The difference test of the effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on static balance in control and intervention groups showed that the data were not normally distributed so to determine the mean of unpaired difference test in the control group and intervention group, it utilized the Mann Whitney U Test. The results of statistical analysis using the Mann Whitney U Test obtained a p

value (Asymp. Sig. 2-tailed) of 0.443 in the postintervention of right foot in the control group and intervention group (> 0.05), hence H_0 is rejected, meaning that there was no different effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on the right foot on static balance in children with flat foot in control and intervention groups. The p value was 0.001 (< 0.05) on the left foot, thus H_0 is rejected, which denoted that there was a difference in the effectiveness of the strengthening ball roll exercise and the strengthening heel raises exercise on the left foot on static balance in children with flat foot in the control group and the intervention group. The results are shown in Table 4.

Group	P Value
Post Intervention Right Foot	
Control Group and Intervention Group	0,443
Post Intervention Left Foot	
Control Group and Intervention Group	0,000

Table 4. Difference test results of the effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on static balance in control and intervention groups.

DISCUSSION

Balance is an important factor in a human being's life, one main balance that may affect other balance is static balance (Kusuma 2017, p. 3). Kisner & Colby (2012) state that children with flat foot cause a poor fulcrum that will affect their balance.

Balance disorder in respondents of this study was caused by flat foot. It is in line with the research by Abrar (2018) that there was a relationship between flat foot and balance, with a score of 0.001 and a correlation value of -0.787. The results of the previous study indicate that there were a strong correlation value and a negative relationship, meaning that the higher the score of flat foot, the lower the balance score is. Another research with similar results is the research conducted by Nuriyana (2019) that 38 out of 80 flat foot students experienced static balance disorders.

Another factor that can improve balance is muscle strength. Muscle strength is related to the neuromuscular system and the ability of the nervous system to stimulate muscles to contract, in which the increase in activated muscle fibers affects the strength so that the ability to maintain balance increases (Nisa, 2020).

The intervention used in this study is strengthening heel exercises. This intervention

can increase the relaxation of muscles and ligaments so that it is possible to reduce stiffness and can improve static balance. This theory is in line with the research by Herawati (2019) that strengthening can improve static balance. Strengthening heel raises exercise was performed by tiptoeing repeatedly. This exercise can cause the gastrocnemius and plantaris muscles to contract so that muscle strength increases, which stimulates the brain to maintain anatomy in a balance condition.

Another intervention used in this research is strengthening ball roll exercise. A strengthening ball roll exercise was carried out by rolling a tennis ball on the sole of the foot. These exercises can increase blood supply to the lower extremities. The repeated rolling motion of the ball on the soles of the feet can relax the muscles and ligaments and can form the arch of the foot, thus it is believed that strengthening ball roll exercise can improve static balance. In this study, after respondents were given the intervention of strengthening ball roll exercise for 2 minutes with a frequency of 2 times a week for 4 weeks, it showed a significant effect on improving the static balance of children with flat foot. This study is according to the research by Nisa (2020) with the result of p value < 0.001 , which means that strengthening ball roll exercise has an effect on the static balance of children with flat foot.

Another result found in this study is a difference in the effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on the left foot on the static balance of children with flat foot in control group and intervention group. This finding is similar to Khairi's (2017) research that there was an increase in the balance of children with flat foot after the intervention of heel raises exercise. Another result found in this study is no difference in the effectiveness of strengthening ball roll exercise and strengthening heel raises exercise on the right foot on static balance in children with flat foot in control and intervention groups. This result is in line with Muadz's (2018) research that there was no difference in the effect of heel raises exercise and towel curl exercise on increasing static balance in children with flat foot aged 5-6 years. Strengthening ball roll exercises and strengthening heel raises exercises are exercises that focus on strengthening the intrinsic muscles of the feet and can improve the stabilization of the muscular strength. It occurs as there is an increase in proprioceptive stimulation so that it can maintain body position in order to remain balanced. Thus, these two interventions are equally effective in increasing static balance in children with flat foot.

CONCLUSIONS AND SUGGESTIONS

Interventions that had been given to respondents conclude that the strengthening ball roll exercise and strengthening heel raises exercise interventions had an effect on static balance in children with flat foot obtain statistical analysis results of p value (asympt. sig. 2-tailed) < 0.001 (<0.05).

For future studies, researchers suggest an early detection of flat foot tests and conduct education on how to prevent this condition in children. In addition, it is necessary to carry out exercises for children who have been detected flat foot to minimize the risk of various body problems due to flat foot conditions.

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