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The Effect of Tightrope Walker Exercise on the Static Balance of Children Aged 4-7 Years with Flat Foot Conditions at KB Islamic Kindergarten Sultan Agung 2 Semarang City

Fitratun Najizah[1], Shella Dhika Rahmawati [2], Cintya Putri Anisah[3], Sofia Mardiana[4]

[1,2,3,4] STIKES Kesdam IV/ Diponegoro Semarang

Email: fitratun.najizah@gmail.com, shelladhika@gmail.com, cintyaputria04@gmail.com, sofiamardiana32@gmail.com

Abstract. *Balance is the ability to maintain the body in the center of mass of the body against a fulcrum to oppose gravity in a position that is influenced by the sensory system, musculoskeletal and external effects. Flat foot is a musculoskeletal disorder in children. At the age of 5-6 years is a period of developing children's motor skills, especially balance, which is very good when stimulated in the form of games. One stimulation to improve the balance of flat foot children aged 4-7 years is tightrope walker training. The aim of this study was to determine the effect of tightrope walker training on the balance of children with flat feet aged 4-7 years. This research is a quasi experiment with a pre and post test design approach, namely the sample in the treatment group was given tightrope walker training for 4 weeks with a frequency of 2 times a week. Balance measurement uses the one legged stance test. Data analysis in this study used statistical tests with a significance level of 0.05 using the sample paired t-test. The results of statistical tests show that there is a significant influence between giving tightrope walker training on the static balance of children with flat foot conditions. The implementation of tightrope walker training for flat foot children is recommended for static balance problems in children. The conclusion of this research can be implemented that tightrope walker training has an influence on the balance of children with flat feet aged 4-7 years.*

Keywords: *tightrope walker, balance, flat foot, children aged 4-7 years.*

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INTRODUCTION

Man on generally very need balance For make a movement. Balance is the ability to maintain body in center mass body (*center of masses*) to field fulcrum (*baseof support*) to fight gravity *(center of gravity)* is influenced by the process sensory or system nerve, motor or musculoskeletal And effect outside (Bacolinni, 2013)

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** Fitratun Najizah fitratun.najizah@gmail.com*

Like which has explained in on something balance body can influenced by motor and musculoskeletal. Especially leg muscle strength, knees, hips, as well as the strength of ligaments and the anatomical arrangement of bones. One of Musculoskeletal disorders in children are *flat feet* . In children with *flat foot* where the surface of the sole of the foot is flat due to the presence of accumulation of fatty tissue in the medial arch area of the foot and is influenced by Loose ligaments and weak leg muscle strength, unstable joints subtalar (*talonavicular joint*) and position the heel towards inversion so that position foot become No stable And condition balance less than optimal.From research conducted by Roohi *et. al* (2013) and Dabholkar *et. al* (2012) that there are differences in static and dynamic balance and agility Which significant on child *flat foot* And foot normal. Beside That sign And other symptoms What will arise as a result of *flat feet* is pain in the feet, pain limbs lower, pain in knees, and back behind (Harris *et. al.* , 2004).

Based on study on child *preschool* with *flat foot* in Austria on child age 3-6 year with flexible *flat foot* as much 44% And <1% with *flat foot* pathology (Pfeiffer *et. al.* , 2006). According to Evans (2008) in Wardanie (2013) number of child population in world who experienced *flat foot* around 20-30% of children. The number of *flat foot* children aged 3 years is 54% andage 6 Years 21% (Kun *et. al.* , 2011).

Exercise balance on child with condition *flat foot* very important because if a child has less than optimal balance, then that child unable to function properly. Based on research conducted by Ross *et. al* (2011) that gross motor training in children *with flat feet* and hypotonus gets results the good one. Exercise The main thing is for children *flat foot* is *stretching, strengthening* And increase proprioception And *postural balance* (Halabchi, 2013). From observation introduction found that more from 50% student Sultan Agung Islamic KB-TK 02 Semarang City which is aged 4 - 7year have foot *flat foot* with balance Which not enough Good.

Balance on child age 4 -6 year Not yet formed with optimal, therefore we can optimize the child's balance by play therapy. According to Hildayani (2002) in Mawaddah (2011), it is lacking more 80% from a number child Which experience disturbance development, so that result difficulty on arrangement balance body. Regulation of body balance children need in play activities Wrong the only one *tightrope Walker*. *Tightrope Walker* is game For train children's balance by walking in one line and without Dropping an object on your head requires complex movements so that get a position Which balanced.

LITERATURE REVIEW

Balance

Children's development can develop optimally in carrying out agile movements if their bodies are healthy, their nutrition is met and they are educated properly and well, therefore the motoric development of children is very important when compared to other developments for children, examples of things that can be done are related to balance in children. If a child experiences delays in motor function during their developmental stages, then the child will experience delays in the developmental phase.

Balance is a system where the brain regulates the somatosensory system, there are important structures in it in the form of *visual, proprioceptive, vestibular* , and musculoskeletal in the form of muscles, joints, soft tissue, thus causing a response and as a result changes occur internally and externally in the body, in the brain including, basal ganglia, cerebellum, association area as balance regulators (Sahabuddin, 2016).

Balance is one of the most important parts or things in activities where everyone needs balance in maintaining their body position, a lack of balance ability can result in children being vulnerable to falls and experiencing obstacles when children start to move or carry out daily activities (ADL), resulting in a decrease in children's productivity. , as a result the child becomes inactive, unenthusiastic, lethargic and lazy.

Balance *is* divided into two parts, namely balance in a still position (static) and dynamic balance which is related to moving, maintaining the force of gravity, determining the direction and speed of movement, and making automatic postural adjustments to maintain posture and stability in various existing conditions and circumstances. . During a child's growth and development period, most of the child's soles experience thickening of the soft tissue on the inner side (medial), this situation will decrease as the child grows, which makes balance disturbed.

Flat feet

a. Definition of *flat feet*

Most children have normal longitudinal curves that develop at the age of 2-5 years and only 4% of them persist after the age of 10 years. The flat feet that we often encounter are mostly the result of weak foot ligaments, bone structure abnormalities, muscle imbalance and ligament weakness. One of the disorders most frequently encountered by pediatricians is flat foot, which is found in around 28%–35%, will experience thickening in the soft tissue and will decrease as it grows (Pudjiastuti, *et al* 2012).

Disruption of the shape of the soles of the feet (flat feet) is an abnormal form of the feet where during the growth stage the inner arch of the foot (arcus medialis) does not form or disappears when the child stands (Harjanto, 2009).

Flat feet are seen medically as where there is no arch or usually referred to as feet that are flat or have a flat shape that touches the ground so that the entire surface of the sole of the foot almost sticks even to the point of sticking to the ground or a flat surface. Classification of flat feet is based on congenital factors and acquired factors. Congenital factors themselves differentiate between flexible flat foot and rigid flat foot. The long-term consequences for the shape of the feet will be pain in the soles of the feet, fatigue, ankles and knees, limiting walking activities, as well as acute trauma that occurs repeatedly, causing deformities in the feet, which can be identified by looking at the way you walk. children due to obesity, tibia varum, genu valgum, muscle and ligament weakness can be the main factors that increase the severity of flat feet (Harris *et al* , 2004).

b. Mechanism Maintain Arcus Longitudinal Medial

According to (Snell, 2006) mechanism arcus longitudinal:

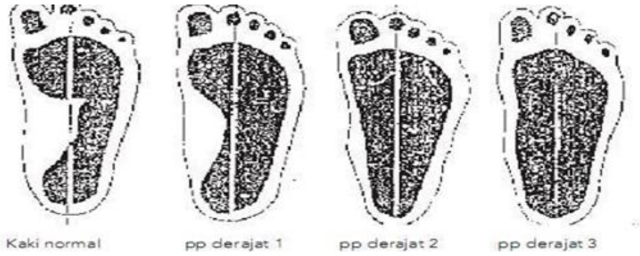
1. shape : like a hanger Which maintain talus, on surface proximal os navicular Which sunken jointed with caput, Next, the proximal surface of the medial caniform bone is slightly concave jointed with navicular.
2. Tied become One on part side lower bone **:** by ligament- ligament longus, plantar brevis, And ligament yag more strong as well as biglike the ligaments in the dorsalis, the most important are the ligaments calcaneo naviculare. Expansion tendinous from tibial insertion posterior.
3. What binds the two ends of the arch together: is the plantar aponeurosis,part medial muscles flexor digitorum brevis, muscles abductor hallucis,muscles flexor hallucis longus, And on part Which medial m. flexor digitorum longus, brevis.
4. Which hangs the arch from above: m.tibialis anterior, and posterior as well as ligament which exists medial part wrist joint foot.

c. Degree *Flat Foot*

According to (Syafi'i, M et all 2013) The degree of *flat foot* is divided into 3 degrees that is :

1. Degree 1: the foot still has an arch, although very little, on the sideThe concave medial axis of the foot has a mean value of + SB equal to -1.13+(0.64) cm.
2. Degree 2: the foot has no arch at all, does not pass through axis and has a rectilinear shape, the average value for degree 2 is -2.58 +(0.10)cm.
3. Degrees 3: on degrees This, foot not only No Have arkus, HoweverAlso formed corner

in mid foot which direction to outside And limit medial fingerprint footprint foot shaped convex And No pass axis, average value degrees 3 is -3.33 + 0.45) cm.



Picture 2.2 Deg curved on foot (Lutfie, 2010)

Etiology from *flat foot ,* among them as follows (Sahabuddin, 2016)

a. Usually happen Because from born or congenital (congenital).

b. Due to trauma, excessive activity previously resulted in rupture of the tendon tibialis posterior.

c. fracture on ankles with malunion (fail connect).

d. Disease inflammation, like arthritis.

e. Obesity.

Balance Measurement

One legged stand balance test is a simple test in general used to determine static balance ability, carried out with One foot parallel with surface And foot the only one bent 90°with eye open and eye closed with hand placed hips (Shingjergji, 2013).

One legged stance balance is done by standing, one leg parallel with the surface and the other leg bent, resulting in a posture increase so that balance moment circumstances static can achieved, usually requires optimal work of the muscles on the side body Which lean on, with increase ability on system somatosensory which is responsible for conveying information to the central nervous systemWhich is part from brain, And increase ability muscle in the ankles as well as For control in do movement moment stand up (Ridjal, 2016).

Connection flat foot with balance

Feet have two main functions, namely supporting body weight and as a lever for stepping and carrying body partswhen walking, standing and running, so it can be said to be a part recipient various style deformity. Form footprint foot Which flat without arches are less capable of functioning as a rigid lever system for bring up body.

Decline curvature bone palm foot cause somebody experience problem known as term foot flat (*flat feet*) Which influence balance body children, Which relate with neurological system of the brain and vestibular system, if this occurs in an individual person No just hard walk, but Also experience problem balance the body doesn't stable, deformity continues, complaint tired when walk long, shoe partheel fast wear, injury on usage excessive And flavor painful (Idris, 2010).

METHOD STUDY

Types of research

This research uses quantitative research methods with a *quasi-experiment research design* . Research approach with *pre-test* and *post-test design* in the experimental group. Observations of static balance were carried out twice, namely before the intervention and after the intervention. The total sample was 11 school children with the inclusion criteria being children aged 4-7 years, having *flat feet* , and being in good health.

A measuring instrument used to measure the static balance of children aged 4-7 years with *flat foot condition* with *one legged stance balance.* Data collection was carried out by measuring the child's static balance with the first observation (*pre-test*) carried out before giving *the tightrope walker exercise* while the second observation (*post-test*) was carried out after giving *the tightrope walker exercise* . Data analysis in this study used statistical tests with a significance level of 0.05 using *paired sample t-test.*

Tools/Instruments

The measuring tool used is *the One Leg Stand Balance Test* . *One Leg Stand Balance Test* is a simple test that is usually used to determine static balance abilities, carried out with one leg parallel to the surface and the other leg bent 90° with eyes open and eyes closed with hands placed on the hips.

Data

Data collection was carried out by providing explanations to the research subjects, providing *informed consent* to the parents of prospective respondents, providing information about the aims and objectives of the research, asking for the consent of the respondents' parents by signature. Respondents had their static balance measured as *pretest data* . Respondents then received the *tightrope walker exercise game* in 8 meetings, then static balance measurements were taken again as *post test data* .

RESEARCH RESULT

Univariate Analysis

Table 5.1 Distribution of Respondent Characteristics based on Age and Gender

Characteristics	Category	f	%
Age	4-5 years	4	36.4
	5-6 years	5	45.5
	6-7 years	2	18.1
Gender	Man	6	54.5
	Woman	5	45.5

Based on table 5.1 above, the characteristics based on the age of the majority of children are 5-6 years old (45.5 %). Meanwhile, based on gender , the majority of child respondents were male (54.5%).

Table 5.2 Distribution of Respondent Characteristics based on BMI (Body Mass Index)

BMI	f	%
Underweight (<13.5)	0	0
Normal (13.6-19.6)	9	81.9
Overweight (20.4-22.6)	2	18.2
Obesity (>22.6)	0	0
Total	**11**	**100**

Based on table 5 . 2 above, characteristic k Based on BMI, the majority of respondents' results were in the normal category (81.9%).

Table 5.3 Distribution of Respondent Characteristics based on Degree of *Flat Foot*

Degrees of *Flat Foot*	f	%
Degree I	5	45.5
Degree II	6	54.5
Total	**11**	**100**

Based on table 5 . 3 above, characteristic k Based on the degree of *flat foot* of respondents , it was found that 5 children (45.5%) had degree I and 6 children (54.5%) had degree II.

Table 5.4 Frequency Distribution of Respondents Based on Static Balance
Before and after being given *the Tightrope Walker Exercise*

Characteristics	Before		After	
	f	%	f	%
Bad	0	0	0	0
Below average	1	9.1	0	0
Above average	2	18.2	3	27.3
Good	5	45.4	3	27.3
Very good	3	27.3	5	45.4

Based on table 5 . The 4 above show static balance before being given *the Tightrope Walker Exercise.* There was 1 child whose static balance was below average, 2 children above average, 5 children good and 3 other children very good. A different picture was obtained after being given *the Tightrope Walker Exercise* , namely the number of children with very good static balance was 5 children (45.4%) out of a total of 11 children.

Bivariate Analysis

Table 5.5 Differences in Static Balance Values Before and After being given *Tightrope Walker Exercise* (n=11)

	Mean±SD	***p* value *(paired samples t-test)***
Before Training	9.73 ± 1.181	0,000
After Training	8.53 ± 1.093	

Based on table 5.5 above, the test results show that the *p* value = 0.000, meaning the p value <0.05, which means Ha is accepted and Ho is rejected. So it can be concluded that there is an influence on giving *tightrope walker exercise* on improving static balance in children before and after giving *tightrope walker exercise* .

DISCUSSION

This research is a *quasi-experimental research* with *a one group pre and post test design,* to determine the effect of giving *tightrope walker exercise* to children at KB-TK Islam Sultan Agung 02 Semarang aged 4 to 7 years with *flat foot conditions* and decreased static balance. The sample in this study consisted of 11 people who met the inclusion criteria and exclusion criteria. The research was conducted for 4 weeks with a frequency of 2 times a week.

Respondent Characteristics based on Age and Gender

Based on table 5.1, the results of the characteristics assessment based on the age of the majority of children aged 5-6 years (45.5 %). Meanwhile, based on gender , the majority of child respondents were male (54.5%). According to research by Soetjiningsih in 2014, the development of children aged 5-6 years is very rapid, shown by good balance in walking on catwalks, jumping over objects, jumping, walking straight, and standing on one leg for 10 seconds.

Boys are at greater risk of experiencing *flat feet* than girls. The prevalence of *flat feet* in boys is 57.4% and in girls is 42.6%. The greater prevalence of *flat foot* in boys compared to girls is thought to be due to differences in the anatomical shape of the body, where *the rearfoot* *angle* (average value of valgus) in boys is greater than in girls. It is known that the angle (degree) of the lateral and medial plantar arches in girls is greater than in boys (Antara, 2017).

Characteristics of Respondents based on BMI (Body Mass Index)

Based on table 5 . 2, the majority of respondents' characteristics based on BMI were in the normal category (81.9%). Someone who has a normal BMI value tends to have better static balance scores compared to people who do not have a normal BMI. The body's balance function involves, among other things, muscle strength activity and the accumulation of adipose tissue. Muscle strength is the ability of a muscle or group of muscles to produce tension and power during maximal effort both dynamically and statically . Muscle strength is produced by maximum muscle contraction. Strong muscles are muscles that can contract and relax well. If the muscles are strong then balance and daily activities can run well. An increase in Body Mass Index will affect muscle strength, so that if the muscles are weak and body mass increases, body balance problems will occur when standing or walking (Greeve, 2007).

Respondent Characteristics based on Degree of *Flat Foot*

Based on table 5 . 3 above, characteristic k Based on the degree of *flat foot* of respondents , it was found that 5 children (45.5%) had degree I and 6 children (54.5%) had degree II. As a person gets older, the condition of a person's *flat feet* will get worse if it is not treated from the start. Deformity in the subtalar joint causes imbalance and excessive eversion, resulting in children who have *flat feet* grades 1, 2 and 3 being less able to maintain balance standing on one leg for a long period of time (Antara, 2017).

The Effect of Providing *Tightrope Walker Exercise* on the Static Balance of Children Aged 4-7 Years with *Flat Foot Conditions*

Based on the results of *the paired sample t-test, the p* value = 0.000, meaning the p value <0.05, which means Ha is accepted and Ho is rejected. So it can be concluded that there is an influence on giving *tightrope walker exercise* on improving static balance in children before and after giving *tightrope walker exercise.*

Based on research conducted by Ross *et. al (2011) that gross motor training for flat footed and hypotonous* children produces good results. The main exercise for *flat foot children* is *stretching* , *strengthening* and improving proprioception and *postural balance* (Halabchi, 2013). Children need to regulate body balance in play activities, one of which is *the tightrope walker* .

Flat foot condition is a musculoskeletal disorder in children. At the age of 5-6 years is the period for developing children's motor skills, especially balance, which is very good, given stimulation in the form of games. One stimulation to improve the balance of *flat foot children* aged 5-6 years is *the tightrope walker* .

Tightrope walker is a game to train children's balance by walking in one line without dropping objects on their heads, requiring complex movements to achieve a balanced position. In *tightrope walker training* , walking in a line and with a small support will require complex movements, which will activate 3 sensory systems, namely visual, somatosensory and vestibular which adapt to body position and the environment. Information received from these 3 systems will be conveyed by the tectocerebellaris tract via cranial nerve VII to the vestibular nucleus and cerebellum. The resulting information from the vestibular nucleus and cerebellum will be conveyed to the motor neurons which innervate the proximal, neck and back muscles through the spinal cord with a fast reaction so that the musculoskeletal system works so that it can control the postural muscles to maintain balance. Repeated exercise and contractions will cause muscle fibers to enlarge so that muscle strength increases and balance improves (Dienty, 2015).

CONCLUSIONS AND SUGGESTIONS

This research proves that *tightrope walker exercise* has an effect on the static balance of children aged 4-7 years with *flat feet* at the KB Islamic Kindergarten Sultan Agung 2, Semarang City . For future researchers to be able to conduct research on the condition of *flat feet* with decreased balance, it can be measured using *the one leg stand balance test* and checking the shape of the foot using *the wetfoot 15 print test* . Added to this are more varied ages and research times which should be taken into account when students have semester exams and holidays so that there are no conflicts with the research schedule.

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