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Original Research

The Effect of Long-Term Use of Custom Insole on Agility in Adult Flat Foot Case

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ABSTRACT

Background: *Adult Flat foot is a condition in which the foot does not have the normal arch of the foot and occurs in adulthood. Someone who experiences flat feet will tend to decrease the quality of walking, including activities that require agility or agility. One of the treatments that can be given for flat foot cases is the provision of a custom insole in the form of medial arch support. Medial arch supports are designed to control the alignment and function of the foot and lower limbs and are used to limit movements such as overpronation.*

Objective: *To decide the long-term impact of utilizing custom insoles on nimbleness in grown-up flat-foot cases.*

Method: *The inquiry about the plan could be a quasi-experimental sort of investigation with a one-group pre and post-test. The research subjects were 18 students who experienced flat feet. Each investigated subject was given a custom insole mediation for six months and observed every two months. Information examination in this consideration utilised the Combined Tests T-test and the Wilcoxon test.*

Results: *Statistically, there was a significant effect on the use of custom insole on agility as measured by the EST method (t = -3.05, p-value = 0.002), measured by the T-Test method (t = 5.91, p-value = 0.000), and measured by the IAT (z = -2.21, p-value = 0.016).*

Conclusions: *The use of a custom insole affects increasing agility in flat foot conditions, so it is recommended to use a medial arch support in flat foot conditions.*

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INTRODUCTION

Total energy expenditure (TEE) is the energy expended during the oxidation of energy-producing macronutrients during 24 hours. Physical activity level (PAL) is energy expenditure that exceeds baseline and TEF. Physical activity is the most variable energy component. Activity-related energy expenditure is the energy required to move the body (ie, perform muscle work) during thermogenic (eg, swinging, maintaining posture and daily activities) and voluntary (eg, exercise, sports) activities (National Academies of Sciences 2023). Feet are the parts of the human body that bear the most pressure when standing. Analysis of the pressure distribution of the sole helps to find out the interface pressure between the sole surface of the foot and the sole of the shoe (Asmi et al. 2020).

In common, the shape of the average longitudinal curve is separated into three sorts, specifically typical foot, level foot, and cavus foot. A typical foot could be a condition where the pedis contains a typical curve or curve.(Dion et al. 2023) Flat foot, often called pes planus or flat foot, is a condition of the foot where the curve of the foot is lost, which is controlled by the flat shape of the foot. Cavus foot, also known as pes cavus, can be a condition where the arch of the foot is high (Azzahra, Purwaningastuti & Citrawati 2020). If the medial longitudinal arch is low or even has no arch it will cause a flat foot (Namsawang et al. 2019). Patients with flat feet require more muscle activity during walking due to the lack of medial longitudinal arches and increased pressure on the second area of the metatarsal during the stance phase, so patients with flat feet have a longer gait cycle than children. normal leg (Setyawan et al. 2023).

Level foot or pes planus may be a condition where the average longitudinal curve is misplaced, coming about in level feet. Level feet in address happen when all parts of the foot are joined to or near to the ground (Sahabuddin 2016). The curve of the foot that does not develop ordinarily causes adjust disarranges, insecurity, complaints of weakness when strolling for a long time, the heel of the shoe tires rapidly, intemperate damage and torment(Dion et al. 2023). Agility is greatly influenced by the ability to move the legs. This illustrates that someone with a flat foot shape has poor physical activity abilities, namely agility compared to someone who has a normal foot shape. (Sahri, Sugiarto & Widiantoro 2017).

Agility is a person's ability to change direction, make quick stops, and perform fast and smooth movements, efficiently and repeatedly without losing balance (Wijianto, Yunnita & Dewangga 2021). Agility is influenced by many factors, including speed, strength, balance, and coordination. Agility can be interpreted as the ability to quickly change the direction of the body or body parts without disturbing the balance. Also, repeatedly changing the direction of movement of the body such as running back and forth requires alternating contractions of certain muscle groups (Sahri et al. 2017).

The prevalence of flat feet (21-57%) is often reported in children aged 2-6 years, decreasing (13.4-27.6%) in primary school. In the adult population, it is about 5 to 14 percent. At the same time, the prevalence of flatfoot pathology in children aged 7-14 years is 10.3%, but with increasing age, the prevalence decreases. In a study of 1,089 elementary school students in Surakarta, Indonesia, 299 students were found to have clubfoot. Another study conducted in Jakarta, Indonesia, with a total of 297 students, found that clubfoot was found in 5-year-old children (40.32%) and 5-10-year-old children (22.15%) in older children over 10 years. old (15.48%) (Salma Ripdianawati 2023).

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Treatment of flat feet is done with an orthosis (plantar or medial arch support) (Özgün et al. 2024).The medial arch support is a lightweight spongy material stretching from the heel to the forefoot. On the medial side, a protrusion is formed which is used to support the arcus pedis of the foot, which is placed directly below the sustentacular of the talus and the navicular bone of the foot (Siswiyanti & Syafi'i 2015).

Custom insole is a foot orthosis installed on the medial longitudinal arch. Medial arch support is designed to control the alignment and function of the feet and lower limbs and is used to limit movements such as overpronation. Apart from that, custom insoles can also function to increase agility (Setyawan et al. 2016). The working mechanism of custom insoles in treating flat feet is that the medial part is formed into a curve which is used to support the arch. The heel pad will dampen or reduce the compressive force on the heel. Plantar foot pressure will be distributed to the arch support, metatarsal shaft, heel, to the forefoot. Biomechanically, the medial wedge will support the weight of the foot, especially the mid foot (middle of the foot) as a shock absorber, thus preventing pronation of the foot which disrupts balance. Foot orthoses with medial arch support, metatarsal pads, and heel cups can increase agility (putriningsih, 2018).

In this study agility was measured by 3 (three) methods, namely the green side step test (ESST), T Test, and Illinois Agility Test (IAT).

The Edgreen Side Step Test (ESST) measures lateral agility and body control. The way to measure it is as follows: the starting position starts from the leftmost cone to standardize the starting position, and a distance of 1 m is marked with a cone, which allows easier scoring. The raters were positioned in front of and behind the subject. Subjects started in a standing position behind the leftmost cone and were instructed not to cross their legs during the test. On the "start" command, the subject walked to the right until his right foot touched or passed the outer cone. The subject then steps to the left until his left foot touches or passes the outside of the cone. Subjects walked back and forth to the outer cone as quickly as possible for 10 seconds. Subjects were awarded one point for each cone passed.

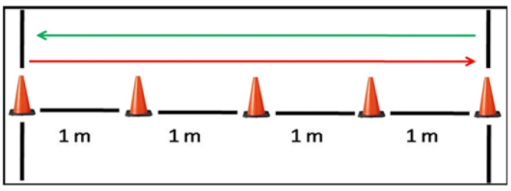

Figure 1. The Edgreen Side Step Test (ESST)

The T-Test is used to measure agility and body control for forward, backward, and sideways movements evaluating the ability to change direction quickly while maintaining balance without losing speed. The measurement procedure is as follows, starting with the command "start", the subject runs as fast as possible forward to the middle cone, sideways to the right 5 m to the right cone, sideways to the left 10 m towards the leftmost cone, and then back to the middle cone. The subject then runs or moves backwards as fast as possible to cross the finish line. The researchers calculated the time taken in seconds. Disqualification is determined if the subject fails to carry out the command as instructed, fails to reach the finish line.

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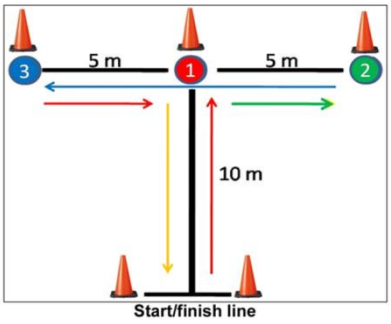

Figure 2. The T-Test

The Illinois Agility Test (IAT) is identified as a test that provides a good indication of a person's ability to accelerate, decelerate, change different directions, and run at different angles. The procedure for carrying out this test is as follows: the trajectory is marked by cones, with the four central cones positioned 3.3 meters apart and the four corner cones positioned 2.5 m from the central cone. The subject begins the test behind the starting line with his arms at his side and his head facing to the side or facing forward. At the command "start", the subject ran forward past the marks provided then turned around and then ran zigzag along the row of cones in the middle then returned to the starting line by running zigzag. The subject then runs or moves as fast as possible to the second mark and once again, the subject is asked to cross the finish mark with their feet. Finally, the subject turns around and runs or moves as fast as possible across the finish line. The time to complete each trial was recorded in seconds.

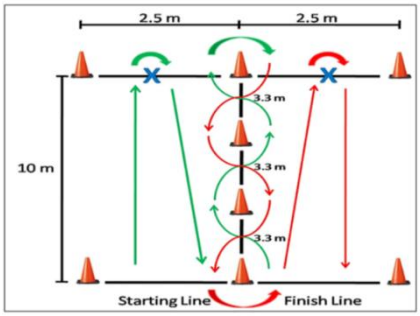

Figure 3. The Illinois Agility Test (IAT)

MATERIALS AND METHOD

The inquiry about the strategy utilized in this consideration is quantitative. The sort of investigation utilized in this consider may be a quasi-experimental inquiry about the plan with one group pre-test and post-test, which may be an estimation ponder that employments as it were one bunch taken as investigate subjects without a comparison bunch. This thinking points to consider the impact of the long-term utilization of custom insoles on changes in nimbleness in level foot cases. This research was conducted on November, 2022 at the Poltekkes Kemenkes Surakarta, Department of Prosthetic Orthotics, with 18 students who experienced flat feet as subjects.

In this study, there are two variables, the independent variable is custom insole. A dependent variable is agility. Agility was measured using 3 methods, namely the Edgreen Sidestep Test (ESST), T-Test, and the Illinois Agility Test (IAT).

The typicality test utilized was Shapiro Wilk since the amount of information was less than 50 (Amanda, Chandra Isabella & Mirwanti 2019). A few pieces of information were not regularly dispersed, so the information was considered unusual, and the speculation test utilised was Wilcoxon. There is normally distributed data, so the data is considered normal, and the hypothesis test used is the Paired Sample T-Test. Ethical clearance has been given Poltekkes Kemenkes Surakarta with number LB.02.02/1.1/693.6/2021.

RESULTS

The investigative strategy utilized in this think about is quantitative. The sort of investigation utilized in this ponder could be a quasi-experimental inquiry about a plan with one group pre-test and post-test, which may be an estimation ponder that employments as it were one bunch taken as inquire about subjects without a comparison gather. This study aims to study the effect of the long-term use of custom insoles on changes in agility in flat foot cases. This research was conducted at the Poltekkes Kemenkes Surakarta, Department of Prosthetic Orthotics, with 18 students who experienced flat feet as subjects.

Table 1. The Characteristics of Continuous Data Subjects

Variable	n	Min.	Max.	Mean	Std. Dev
Age	18	19	22	19.89	0.96
Weight	18	39	120	62.28	19.48
Height	18	1.50	1.71	1.58	0.07
BMI	18	16.66	41.52	24.7	6.60

The comes about of table insights on the characteristics of the investigated subjects, persistent information, shows that the normal esteem of BMI within the inquire about subjects was 25.60, which agrees with WHO was included within the corpulence bunch I.

Table 2. The Characteristics of Categorical Data Subject

Variable	f	Percentage (%)
Gender		
Male	3	16.7
Female	15	83.3
Sports Activity		
Active	8	44.4
Passive	10	55.6

The descriptive statistical results of the characteristics of the categorical data subjects showed that of the total research subjects, namely some 18 students, the majority were female, namely as many as 15 students (83.3%) and most students were active in sports, as many as 8 students (44.4%). There are student sports activities including jogging, swimming, basketball, badminton, volleyball, cycling, and climbing.

Table 3. Normality Test Data

Variable	*p-value*	*α*	Description
Pre EST	0.074	0.05	Normal
Post EST	0.016		Abnormal
Pre-T Test	0.991		Normal
Post T Test	0.567		Normal
Pre IAT	0.143		Normal
Post IAT	0.933		Normal

The results of the normality test with the Shapiro-Wilk test showed that the variables with normal distribution are pre-EST, pre-T-Test, post-T Test, pre-IAT, and post-IAT. Whereas for post EST the data is not normally distributed.

Table 4. Hypothesis Test with Wilcoxon for EST Method

Variable	Mean	t	*p-value*
Pre EST	16.07	-3.05	0.002
Post EST	18.47		

The results of the Wilcoxon test on agility with the EST method obtained a different value before and after the intervention of -3.05 with a p-value of 0.002 where the p-value <0.05, it can be concluded that there is a difference in agility before and after the intervention, but it is statistically significant.

Table 5. Hypothesis Test with Paired Sample T Test for T Test Method

Variable	Mean	t	*p-value*
Pre-Test	20.88	5.91	0.000
Post-test	29.05		

The results of the Paired Sample T-test on agility using the T-test method obtained a different value before and after the intervention of 5.91 with a p-value of 0.000 where the p-value <0.05, it can be concluded that there is a difference in agility before and after the intervention, but it is statistically significant.

Table 6. Hypothesis Test with Paired Sample T Test for IAT Method

Variable	Mean	t	*p-value*
Pre IAT	26.05	2.21	0.016
Post IAT	24.93		

The comes about of Combined Test T-test on deftness with the IAT strategy got diverse esteem sometime recently and after the intercession of 2.21 with a p-value of 0.016 where the p-value < 0.05, it can be concluded that there's a distinction in deftness sometime recently and after the mediation, but it is factually noteworthy.

DISCUSSION

The type of research used in this study was quasi-experimental research with a one-group pre-test and post-test design. This study aimed to determine the long-term effect of using custom insoles on agility in adult flat-foot cases. The subjects in this study were 18 students of the Prosthetic Orthotic Department of the Surakarta Ministry of Health Polytechnic who suffered from flat feet.

According to the age of the students, subject characteristics range from 19 to 22 years. This age is a young age or the age of puberty. Young or pubertal children can make finer and more coordinated movements, but rapid growth can cause temporary recklessness. This will occur in the elements forming agility at the age of the child to the age of puberty (Istiqomah & Suyadi 2019). Characteristics of the subject according to student body weight has a range of 39 – 120 kg. Someone who is overweight tends to have slow motion, this is caused by the extra burden and lack of flexibility of the body when carrying out the movement (Ramadhani & Riyanto 2018).

The method used in this research was to provide custom insole intervention without any other intervention to flat foot sufferers, their agility level was then measured using carried out 3 measurement methods, namely the green side stpe test, T test, and Illinois agility test.

Bivariate descriptive statistical test using the Paired Sample T Test and Wilcoxon test obtained a significance value as measured by the EST method (t = -3.05, p-value = 0.002), measured by the T-Test method (t = 5.91, p-value = 0.000), and measured by the IAT (z = -2.21, p-value = 0.016). This means that there is a significant effect of long-term use of custom insoles on agility in adult flat foot cases.

Research on the long-term effect of custom insole use on agility in the case of adult flat foot at the Surakarta Ministry of Health Polytechnic with a sample of 18 students who met the inclusion and exclusion criteria set by the researcher. The conclusion drawn is that there is a long-term effect of custom insole use on agility in adult flat-foot cases.

The decision was made based on the results of the Wilcoxon test and the Paired Sample T Test which obtained a significance value of the EST method (t = -3.05, p value = 0.002), measured by the T-Test method (t = 5.91, p value = 0.000), and measured by the IAT (z = -2.21, p value = 0.016). The condition for the hypothesis to be accepted is a p-value < 0.05. Based on the above data the significance value of the three data is less than 0.05, it can be concluded that the "hypothesis is accepted". This means that there is a long-term effect of using a custom insole on agility in adult flat-foot cases. This is in line with (Sahri et al. 2017) that normal arches have a better tendency in terms of agility compared to flat feet. A person with a flat foot shape has poor physical activity abilities compared to someone who has a normal foot arch. This poor physical activity will certainly have an impact on the quality of other activities, such as the problem of physical agility (agility). Because a person's physical agility is influenced by factors of speed, strength, balance, and coordination.

This is in line with research conducted by (Robert W. Gregory et al. 2018)which states that insoles can improve an athlete's performance and are designed to prevent injury. The statement made by the research subject was that the research subject felt comfortable when using the insole which enabled the research subject to optimize movement when playing futsal. This statement is supported by a study conducted by (Lam et al. 2019) which shows that insoles or foot orthoses can improve sports performance by increasing the perception of comfort in the wearer and is in line with research conducted by In line with research conducted by (Syafi'ie & Wartanto 2022) which explains that insoles can increase agility in futsal players.

Use of medial arch support for stress distribution, with reduced pressure on standing and walking(Setyawan et al. 2023). The wider the area supported, the flatter and wider the pressure distribution, so that the pressure obtained is smaller and makes the wearer more stable and balanced (Saadah, Furqonita & Tulaar 2015). Providing medial arch support is very effective in reducing the eversion of the ankle, stabilizing the longitudinal arch of the foot, placing the weight more evenly, improving body balance, and improving walking function. The medial arch support functions as a support in the hope that the support base can be evenly distributed over the entire surface of the foot so that the support base is wider, and the balance is more stable (Y.A 2017).

With this medial arch support, the weight support will become more stable, can control the biomechanics of the foot and restore normal alignment of the foot and ankle. It was also stated that the use of medial arch support has an effect on reducing knee valgus, providing support on the medial longitudinal is used to minimize stress on the medial longitudinal arch, making the medial longitudinal arch more stable and also improving body alignment so as to reduce the degree of valgus knee in flat foot conditions (Imas Nicavia et al., 2022).

Medial arch support is able to improve foot structure to prevent abnormalities in bones, muscles, tendons and ligament laxity. Therefore, medial arch support is designed to control the alignment of the foot and lower extremity function and limit overpronation of the foot (Latifah et al., 2021).

According to (Nagano & Begg 2018)the insole has direct contact with the foot and directly controls the pressure on the foot and ankle joint which will ultimately affect a person's walking pattern. The insole is also designed to facilitate a person's gait mechanism so that the wearer does not feel excessive stress on the feet and all joints in the lower limbs when used in daily activities. (Hsieh, Peng & Lee 2018) argue that the working mechanism of the medial arch support is to keep the foot in a neutral position, namely by keeping the subtalar joint in a neutral position to correct forefoot abduction and hindfoot pronation. Contours from the medial side that are made higher or in line with the contours of the arc also help keep the talar head in a neutral position. This process will occur while standing in a weight-bearing position to ensure the foot is in a neutral subtalar position when in contact with the medial arch support. The medial arch support extends the support area when standing in a static position because the medial side surface has a protrusion that can be used to support the medial longitudinal arch and also provide stability to the foot. It is hoped that by giving this medial arch support, the longitudinal arch of the pedis becomes more stable, weight support becomes more even, and body balance improves so that it can correct deformities such as agility.

CONCLUSION

The findings of this study, which investigated the long-term effects of custom insoles on agility in adult flatfoot patients, demonstrate a statistically significant improvement in agility as measured by three different methods: the EST method, the T-Test method, and the IAT method. These results suggest that custom insoles can be a beneficial intervention for individuals with flatfoot who experience difficulties with agility. It is hoped that this research will contribute to the development of effective solutions for flatfoot sufferers.

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