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The Effect of a Specialized Karate Corrective Exercise Program on Flat Feet and Foot Indices in Karatekas*

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Abstract

Amateur karate practitioners who suffer from flat feet are less successful than their other rivals. The athletes often have problems in their position in kata and explosive starts or fast reactions in Kumite. Since they suffer from flat feet, they are not resistant enough to the body's pressure on their feet. The researcher is now seeking to answer the question of whether a specialized karate training course can affect the pressure rate and amateur karate practitioners' flat feet. The current study is semi-experimental, using pre-test and post-test. The statistical population of this study included 20 individuals (10 with flat feet and 10 with normal). A foot scan machine evaluated the plantar pressure values in ten sole areas. The experimental group conducted specialized karate practices for 8 weeks, 3 sessions per week. Yet, the control group did not conduct a special practice at this time and continued their normal practices the same as before. The obtained data were analyzed using a covariance analysis test. This study showed that the rate of flat feet in the experimental group has improved after applying the corrective exercises ($p \leq 0.05$). Moreover, the planter pressure value was higher in the experimental group than in the control one ($p \leq 0.05$), which significantly improved after corrective exercises. The specialized karate exercises affect the sole, foot surface, and front foot pressure of amateur karate kids from 9-13 years old. Given the results of this study, identifying the amateur karate practitioners with flat feet using the tests of this study is recommended to be reformed through the corrective program. Moreover, the findings of this study showed that the plantar pressure value in people with flat feet is more than the control group. It was assumed that the increase in plantar pressure could be because of ankle overpronation. This value significantly decreases after using corrective exercises.

Keywords: Flat Feet, Corrective Exercises, Amateur Karate Practitioners, Plantar pressure

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INTRODUCTION

Decreasing the height of the inner longitudinal arch of the foot is called flat foot, created due to muscle weakness and the factors such as ligamentous laxity, tibial torsional deformity, and presence of accessory navicular bone, congenital vertical talus, and tarsal coalition. Yet today, a combination of such factors is accepted (Gondo et al., 2019; Nagaraja, 2019).

The prevalence of flat feet has been high in kids, so Echarri and Forriol have reported their prevalence in 3 to 4-year-old children at 79% and 5 to 8-year-old ones at 40% (Echarri & Forriol, 2003). Pfeiffer et al. (2006) reported its prevalence in 3 to 6-year-old children as 44%. The tendency to do martial arts has significantly increased in recent years, so more than 75 million people are doing martial arts only in adolescence (Moore et al., 2020). Karate is a martial art based on kicking, consisting of fists, kicks, knees, elbows, and open-handed techniques such as knife-hand. The striking techniques, joint locking, restraint, throwing, and hitting Kyushu points are also trained in some styles (De Oliveira, Lopes & Sonoda-Nunes, 2019; Jakhel, 2019; Pal et al., 2020).

People whose feet arch is not normal can experience different pathomechanics and physiological consequences based on Janda's theory based on chain performance of the body (Alter, 2004). They might first complain about the problems of rotation inward, such as the knee, pelvic, and lower back pain (Graham et al., 2012). The complications of excessive stretching and walking on the fingers to compensate for flat feet mostly lead to secondary problems such as having pain in walking, foot deformation, severe heel pain, bunion, hammertoes, and back pain rooted in flat feet (Burns & Crosbie, 2005; Meehan & Brage, 2003). Johnson et al. (2019) have stated that overpronation affects anterior cruciate ligament injuries. Previous researchers (Daneshmandi et al., 2011; Daneshmandi & Saki, 2011) have also confirmed the mentioned results.

Since the power transmission levels and body weight in sports activities change in flat feet complication, the person with such a complication is more likely to suffer from lower limb injuries than a person with a normal foot arch (Fakoor et al., 2016). In karate, the foot attracts landing and jumping force, which frequently happens on one foot of karate practitioners, so the person with flat feet can be exposed to early joint pain, arthritis, and balance problems (Fakoorrashid & Daneshmandi, 2013). This case is capable of decreasing the professional sports life of athletes significantly.

Many studies have investigated the effectiveness of corrective exercises on flat feet complication; Achachlouei et al. figured out that their exercise program did not significantly affect the improvement of flat feet (Achachlouei et al., 2012). On the other hand, Fakoor et al. believed that corrective exercise significantly affects flat feet improvement (Fakoorrashid & Daneshmandi, 2013). Many studies have also stated that the combinational effect of corrective exercises and medical orthoses is more suitable than corrective exercises or orthosis alone (Andreasen et al., 2013). Yet, there is no study about the effect of specialized exercises in a specific sports field on this complication. Also, electrical stimulation is very important for treating and increasing muscle strength (Saatchian et al., 2021). Still, previous studies have less

attention to the effects of electrical stimulation on the treatment and improvement of flat feet. This study investigates the effect of a specialized karate exercise on flat foot and foot indexes in karate practitioners.

METHOD

The current study is semi-experimental and conducted as a field survey. The statistical population of this study included 150 girl and boy karate practitioners 9 to 13 years old with a minimum of 3 months' experience of doing this field (The participants' conditions for including in the test of this research were only the condition of complete physical and psychological health and the Participants' conditions for excluding the test of this research were the unwillingness of individuals to participate in the research). In the study, first, the people with flat feet were identified using a foot sole scan machine, and ultimately, 24 girl and boy athletes with flat feet were selected through the targeted non-randomly method, filling the consent form voluntarily as the statistical sample. The statistical sample was divided into two experimental groups of 12 individuals and a control group of 12 individuals (Table 1). The groups were equalized as much as possible in terms of complication severity and anthropometric characteristics. All participants were healthy during the study. The people with uncorrectable refractive illness or defects, history of injury, fracture or surgery of the lower limb, abnormal range of motion of the lower limb joints, and serious orthopedic problems were excluded from the study through medical health questionnaire.

Table 1. Demographic information of the participants

Variable / Group	Gender (Male/ Female)	Age(Year) Mean±SD	Weight(Kg) Mean±SD	Height(Meter) Mean±SD	Experience(Month) Mean±SD
Experimental	Male=4 Female=8	11±1.3	38±2.4	1.3±0.03	9±2
Control	Male=4 Female=8	11±1.7	36±3.6	1.4±0.05	9.4±3

During participants' foot analysis by foot scanner (Device model: PT-scan 4452F100, made in Iran), they were asked to walk normally so that one time the right foot and one time the left one were put on the machine during walking. The machine was set so that one time the right foot and one time, the left one of the participants was put on the plate. It was simultaneously conducted for both feet, and the participant was asked to put both feet on the plate and stand up to the foot scan was completely conducted (Trigano & Bechor, 2020; Wang, 2010). The related information to the foot scan was respectively recorded for the experimental and control group in table 2.

Table 2. Pre-test information of the participant in the Experimental and Control group

Foot Analysis (Peak pressure)			
	Group	**Mean (Peak pressure)**	**Mean±SD**
Pre-test	**Experimental**	349.62	9
	Control	361.78	138.02
Foot Area (Peak pressure)			
	Group	**Mean (Peak pressure)**	**Mean±SD**
Pre-test	**Experimental**	72.00	25.66
	Control	73.84	25.69

Exercise program

The exercise program included 8 weeks of specialized exercises in karate. After the warm-up, the experimental group conducted specialized exercises in the specialized exercise program for half an hour (Table 3). At the end of the exercise, this group used to do their normal exercises in the club. After the warm-up, the control group did their daily exercises and did not participate in specialized exercises. Finally, both groups used to cool down. The time of each session, from warm-up to cool down, was one hour and a half. The exercise program used to be held for 8 weeks and 3 sessions per week. 24 exercise sessions were implemented. The exercise program used to be changed weekly, meeting the principles of overload and exercise science.

Table 3. 8 Weeks specialize Karate Exercise program for Experimental group

Exercise / Week	MaeGree	Mami (Shomen) Neko Ashi Dachi	Kin Geri	Foot Dance
First	Start with 20 repeats and 30 repeats at the end of the week	Start with 30 repeats with a 5-second hold and end of the week with 50 repeats with a 15-second hold	--------	--------
Second	Start with 30 repeats and 40 repeats at the end of the week	Start with 35 repeats with a 15-second hold and end of the week with 55 repeats with a 15-second hold	Start with 20 repeats, and end of the week, 30 repeat Without hold	--------
Third	Start with 40 repeats and 50 repeats at the end of the week	Start with 40 repeats with a 15-second hold and end of the week with 60 repeats with a 15-second hold	Start with 20 repeats, and end of the week, 30 repeat Without hold and continue with a 5-second hold	The week started with 2 min And the end of the week, with 5 min repeat
Forth	Start with 40 repeats and 50 repeats at the end of the week	Start with 40 repeats with a 15-second hold and end of the week with 60 repeats with a 15-second hold	Start with 20 repeats, and end of the week, 30 repeat Without hold and continue with a 5-second hold	The week started with 2 min And the end of the week, with 5 min repeat
Fifth	Start with 40 repeats and 50 repeats at the end of the week	Start with 40 repeats with a 15-second hold and end of the week with 60 repeats with a 15-second hold	Start with 20 repeats, and end of the week, 30 repeat Without hold and continue with a 5-second hold	The week started with 2 min And the end of the week, with 5 min repeat
Sixth	Start with 40 repeats and 50 repeats at the end of the week	Start with 40 repeats with a 15-second hold and end of the week with 60 repeats with a 15-second hold	Start with 20 repeats, and end of the week, 30 repeat Without hold and continue with a 5-second hold	The week started with 2 min And the end of the week, with 5 min repeat
Seventh	The exercises were a combination of techniques in which the subject sat on Dachi Nekoashi Dachi Mahami and performed a MaeGree or kangaroo kick or used kicks while dancing, repeating, and counting as before.			
Eighth	The exercises were a combination of techniques in which the subject sat on Dachi Nekoashi Dachi Mahami and performed a MaeGree or kangaroo kick or used kicks while dancing, repeating, and counting as before.			

Research Ethics

The ethical approval of the research was obtained by the decision of the ethics committee of Imam Reza International University No. 63 and dated 2021/09/29.

Data Analysis

Research data were analyzed through descriptive statistics and inferential statistics. In this study, an analysis of covariance test was used to evaluate the effect of 8 weeks of karate training on flat feet. Using analysis of covariance, researchers can confidently evaluate the effectiveness of their experimental method.

RESULTS

At the end of 8 weeks of exercises and post-test data collection, the researcher analyzed the pre-test and post-test information. The results of variance analysis in pre-test and post-test values show a significant difference in the experimental group (sig=0.001) (Table 4).

Table 4. Analysis of variance, results of the difference between pre-test and Experimental post-test group in, control and experimental group, pre-test, and post-test of the control group

	Sum of Squares	df	Mean Square	F	Sig
Correct Model	228249.09	2	545.11	29.257	0.001
Pretest	182466.209	1	182466.209	46.776	0.001
Experimental and control group	56113.315	1	56113.315	14.385	0.001
Error	66313.290	17	3900.819		
Total	3729193.090	20			

The results obtained from analyzing the foot surface values in the experimental and control group and intragroup showed such values significant in the post-test of experimental and control groups (sig=0.001) (Table 5).

Table 5. Results of the foot surface difference between pre and post-test Experimental group in control and experimental group, pre-test, and post-test of the control group

	Sum of Squares	df	Mean Square	F	Sig
Correct Model	10289.56	3	5144.78	9.547	0.001
Pre-test	9576.978	1	9676.978	89.251	0.001
Experimental and control group	922.014	1	922.014	8.593	0.009
Error	1824.159	17	107.303		
Total	152358.118	20			

DISCUSSION

The current study investigates the effect of a specialized corrective program of karate on the improvement of flat feet and the plantar pressure in karate. This study showed that the rate of flat feet and plantar pressure has improved in the experimental group after applying corrective exercises ($p \leq 0.05$). In the case of the effect of corrective programs on the navicular drop test, the current study results are generally consistent with the findings (Fakoorrashid & Daneshmandi, 2013; Kolooli vd., 2014). The reason for that might be the duration and number of study samples. Given the previous studies, the reason for flat feet in amateur karate practitioners might often be because of heterogeneity in the flexibility and strength of the muscles of the legs and soles of the feet, wearing inappropriate shoes and bad walking habits, standing in the shape of the toes facing inwards outwards. This type of flat foot is usually flexible, and it might even be normal when the person does not tolerate his weight on his feet. Additionally, muscles and ligaments supporting the foot's arch will be gradually weak during aging so that they cannot maintain foot arches. The bad habit of walking in amateur karate practitioners, which might have remained in the past as a sustainable disorder because of doing hard activities, causes them to have flat feet.

Given that internal muscles of the sole are more active in people suffering from flat feet, the muscles get tired more. The solution for it is to strengthen and increase the endurance of these muscles so that they can tolerate the amount of pressure. Exercise therapy has suitable effects on improving feet' sole complications under the condition that the person does it correctly (Sadeghi & Azadinia, 2011). Moreover, in a study, Mahdavi et al., (2015) investigated the effect of an 8-week program of corrective movements, emphasizing the strengthening of posterior tibialis muscle on the improvement of flat feet in 21-year-old male students of Ardebil. In this study, the participants were divided into experimental and control groups of 22, and they conducted the corrective program for 8 weeks. Before and after the exercise program, the Staheli index and navicular drop values were recorded. Brody index was used to evaluate navicular drop, and smooth plate, talcum powder, footprint registration, and Staheli formula were used for Staheli index. The findings showed no significant difference between the experimental and control groups in the pre-test. Still, in the post-test, the experimental group showed better performance in both tests than the control group, which is consistent with the current study (Kim et al., 2016).

On the contrary, the results of this study are not consistent with the study of Achachlouei et al. (2012), who conducted their study on 30 females and 20 males from 12 to 15 years old. They investigated the effect of 6 weeks of exercise on improving flat feet. Finally, they did not observe any significant differences in improving flat feet before and after exercise (Achachlouei et al., 2012). The difference in the results can be due to differences in the mean age groups of the statistical sample between this study and theirs as well as selection and type of exercises. Feuerbach and Grabiner (1993) concluded that in people with flat feet, after using the brace, the posture deviates in both anterior, posterior, and external directions. The rate of flat feet decreases, and the balance will be better (Feuerbach & Grabiner, 1993). In the case of the effect of corrective exercises on the improvement of plantar pressure, the major factors of flat feet occurrence have been stated as over-pronation of the ankle. Since the rate of plantar pressure in the interior part of the sole is more in the experimental group than control one, this case can be

attributed to the existence of overpronation in karate practitioners suffering from flat feet during the stance phase walking cycle. While the rate of pronation increases the value of muscle strain on the tendons of the anterior tibialis, posterior tibialis, long flexor muscles of the big toe, and the long flexor muscle of the toes. Increasing the muscle strain rate in these tendons can also be a pivotal risk factor in the occurrence of flat feet and an increase in plantar pressure (Sharma et al., 2011; Willems et al., 2006). Therefore, the increase in plantar pressure can be due to biomechanical differences between karate practitioners with flat feet and control groups. Finally, the data of this study support the mentioned hypothesis based on the increase of plantar pressure in the interior part of the ankle in people with flat feet, which is likely due to the effect of overpronation of the ankle.

CONCLUSION

Given the obtained results of this study, it is recommended to be reformed through a corrective program. The significant improvement of the navicular drop in the experimental group showed the need for these people to the corrective exercises. Moreover, the findings of this study showed that the value of plantar pressure is more in people with flat feet than in the control group. It was assumed that the increase in plantar pressure could be due to the overpronation of the ankle. This plantar pressure value has significantly decreased after using corrective exercises.

Conflicts of Interest: The authors declare that they have no conflict of interest.

Authors' Contribution: All three authors have made a substantial and intellectual contribution to the study and approved it for publication.

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