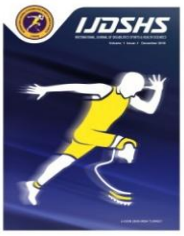

International Journal of
Disabilities Sports and Health Sciences

e-ISSN: 2645-9094

RESEARCH ARTICLE

The Effect of Taekwondo Training on Children's Functional Movement Screen (FMS) Scores and Athletic Performance Parameters

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Abstract

Taekwondo sport has a significant risk of injury. This can be reduced with a pre-accession screening tool that can identify the risk of injury. The Functional Movement Screen (FMS®) is used as a reliable clinical tool to predict athletes' injury risk. The aim of this prospective, single-blind observational study is to investigate the effect of taekwondo on functional movement analysis (FMS®) scores, balance, strength and vertical jump in school-age children. The research was conducted on athletes aged 7-18 (n=30) who have been attending taekwondo training for at least one year (n=15) and who have just started this education (maximum 2 weeks) (n=15). The demographic data of the children (age, gender, bmi*) were recorded, and the evaluation of FMS, balance, strength and vertical jump was applied by an evaluator who did not know which group the children were in. Among the children included in the assessment, the mean age of the group that received taekwondo training was 10.33± 2.12 years, and the mean age of the group that had just started education was 11.73± 2.12 years. No significant difference was found between groups in FMS®, strength, balance and vertical jump measurements ($p>0.05$). As a result, taekwondo training alone in children is insufficient in reducing the risk of injury and improving physical fitness parameters. We think that it would be appropriate to give additional corrective exercises together with taekwondo training. Moreover, this result emphasized the importance of pre-participation screenings once again.

Keywords
Balance, Functional Movement Screen, Strength, Taekwondo, Vertical Jump

INTRODUCTION

The literal meaning of taekwondo is "tae" to hit with a foot, "kwon" means to hit with a hand or a fist, and "do" is about art. In other words, the meaning of taekwondo is expressed as the art of kick and punch (Lee and Kim, 2007). The physical and physiological demands of modern-day taekwondo competition require athletes to be competent in several aspects of fitness (Bridge et al., 2014). It is a kind of sport with a high risk of injury due to physical forces and contacts applied to the athlete (Kazemi et al., 2009). Although the risk of musculoskeletal conditions and injuries is multifactorial, preliminary evidence suggests that neuromuscular and strength training programs may be beneficial for preventing the occurrence of these conditions (Teyhen et al., 2012).

The studies on the effects of sports throughout the growth period have not produced definitive results yet. In sports science, studies in the field of children and sports continue intensively (Top et al., 2018). Previous researches have reported the effects of Taekwondo training on children's physical fitness (Nam and Lim, 2019; Won, 2017). There is no conclusive evidence in the literature that taekwondo practice can improve anaerobic fitness or muscle strength. However, taekwondo training may have some benefits in

Received: 03 March 2021 ; **Accepted:** 22 May 2021 ; **Published:** 20 December 2021
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aerobic capacity, body composition (fat loss) and flexibility (Fong and Ng, 2011).

Studies investigating the effects of taekwondo sport on children's physical fitness and injury risks are insufficient in the literature. Main hypothesis of this study is; there is a difference between FMS scores of the participants. The aim of this study is to investigate the effect of taekwondo training on children's injury risk, functional sufficiency and physical fitness such as strength, balance and vertical jump.

METHOD

The study was designed as a prospective, single-blind, observational study with the approval of the University of Health Sciences Scientific Research Ethics Committee (21/172). Children between 7-15 years of age who have been attending taekwondo training for at least 1 year (n = 15) and who have just started this education (less than 2 weeks) (n = 15) were included in the study. Children with any injuries affecting the musculoskeletal system in the last 6 months were excluded from the study. The voluntary consent form was taken from both the parent and the child. Demographic information (age, gender, height, weight) of the children was recorded. The tests were administered by an evaluator who did not know which group the children were in.

Functional Movement Screen (FMS)

Injury risk analysis and functional status of the participants was performed with FMS. The FMS attempts to address multiple movement factors, with the goal of predicting general risk of musculoskeletal conditions and injuries. This system is designed to identify functional movement deficiencies and asymmetries that predict general musculoskeletal disorders and injuries, and its purpose is to be able to modify the movement defects identified through a personalized exercise prescription (Teyhen et al., 2012).

FMS® is a screening tool used to simultaneously evaluate multiple functional areas (balance, strength, range of motion) and increase the accuracy of risk identification in athletes. The subtests of FMS are deep squat, in-line lunge, hurdle step, shoulder mobility, trunk stability push up, active straight leg raise and rotary trunk stability. Each test is scored on a ranking scale of 0–3 to produce a composite score out of 21, with higher scores indicating better movement (Cook et al., 2014).

Strength Assessment

Grip strength was measured with a hand dynamometer (JLW Instruments, Chicago, USA) in order to have an idea about the general muscle strength of the participants (Wind et. Al, 2010). Participants grasped the dynamometer with full force with their dominant hand, the arm on the side of the body and the elbow at 90 degrees of flexion. Measurements were sequentially performed three times. The average of these measurements was recorded.

Balance Assessment

Participants' balance assessment was performed using the Y Balance Test (Linek et al, 2017). Before this test was performed, a device consisting of tape measure fixed to the ground in a straight line in medial, superolateral and inferolateral directions with an angle of 120-120-120 degrees in between was made with the help of goniometer (Cramer et al., 2017). Subjects stood on one leg (bare feet) in the center of the Y balance test setup, while the free side toe tip extended in medial, inferolateral, and superolateral directions. Children were asked to reach the furthest point they could reach and return to their former position and the distance they could reach was measured in cm (Linek et al., 2017; Westrick, 2012).

Vertical Jump

Vertical Jump Test was performed using Jump Meter (Takei Scientific Instruments Co., Ltd). Participants jumped as high as they could on sensitive ground, and the distance they jumped was determined in centimeters on the device. The best score of the athletes after jumping 2 times was recorded as the vertical jump value.

Statistical Analysis

IBM SPSS Statistics for Windows (Version 21.0. Armonk, NY: IBM Corporation) is used for analysis. Demographic data and FMS scores of the participants are shown via mean and standard deviations. One-Sample Kolmogorov Smirnov test was used to analyse the normality of the data. According to the results of this test, Mann-Whitney U test was used to investigate the differences between groups.

RESULTS

The demographic data of the participants are presented in Table 1. There was no statistical difference was found between groups in all parameters($p>0.05$) Functional Movement Scores of the participants are shown in table 2. There was asymmettries in both groups' Hurdle Step, Shoulder Mobility, Active Leg Raise subtests.

Group comparisons of FMS are shown in Table 3. There was no statistical difference between two groups ($p>0.05$)

Group comparisons of Y Balance Test, Vertical Jump Test and Hand Grip Strength evaluation are shown in Table 4. There was no statistical difference between two groups ($p>0.05$)

Table 1. Demographic data of the participants

Personal characteristics (n=30)	Group I (n=15)	Group II (n=15)
Gender (n)	4 female, 11 male	9 female, 6 male
Age (mean, ±)	10.33± 2.12	11.73± 2.12
Height (mean, ±)	1.36± 0.09	1.41± 0.04
Weight (mean, ±)	33.8± 8.16	39.8± 4.32
Body Mass Index (mean, ±)	18.03± 2.67	19.92± 1.39

Note: Group I: Taekwondo Group, Group II: New Beginners

Table 2. Mean functional movement screen scores of the individuals

FMS Parameters	Group I		Group II	
	Left	Right	Left	Right
Deep Squat	1.53		1,33	
Hurdle Step	1.53	1.6	1.66	1.8
In Line Lunge	1.2	1.2	1.4	1.4
Shoulder Mobility	2.2	2.4	2.33	2.6
Active Leg Raise	2.2	2.4	2.33	2.53
Trunk Stability Push-Up	1.13		1.4	
Rotary Stability	1.86	1.86	1.8	1.8
FMS TOTAL SCORE	11.33		12.26	

Note: FMS: Functional Movement Screen, Group I: Taekwondo Group, Group II: New Beginners

Table 3. Group comparisons of FMS scores

Parameters	Left		Right	
	Z	p	Z	p
Deep Squat	Z=-1.87 p= 0.227			
Hurdle Step	-650	0.515	-993	0.321
In Line Lunge	-1.175	0.240	-1.175	0.240
Shoulder Mobility	-472	0.637	-486	0.627
Active Leg Raise	-672	0.502	-519	0.604
Trunk Stability Push-Up	Z=-1.624 P= 0.104			
Rotary Stability	-482	0.630	-482	0.630
FMS TOTAL SCORE	Z=-1155 p= 248			

FMS: Functional Movement Screen

Table 4. Group comparisons of Y balance, vertical jump tests and hand dynamometer results

Parameters	Left		Right	
	Z	p	Z	p
Y Balance Posterolateral	-437	0.662	-083	0.934
Y Balance Posteromedial	-1308	0.191	-1560	0.119
Y Balance Anterior	-1018	0.309	-810	0.419
Y Balance Composite Score	-124	0.901	-332	0.740
Grip Strength	-1390	0.165	-601	0.548
Vertical Jump Test Score (Time)	Z= - 353 p= 0.724			
Vertical Jump Test Score (Height)	Z= - 353 p= 0.724			

Note: Mann Whitney U Test

DISCUSSION

Our study aimed to compare the results of functional movement analysis, strength, balance and vertical jump tests of children who received taekwondo training at least one year and have just started taekwondo training. According to the results of our study, there was no significant difference in FMS Scores, Y Balance Test, Grip Strength and Vertical Jump Test scores between two groups.

Numerous studies have shown a high injury rate in beginner taekwondo athletes (Lystad, 2009; Schlüter-Brust, 2011). It has also been stated that taekwondo athletes can be injured due to their musculoskeletal tissue strength and training method (Schlüter-Brust, 2011). There are studies in which injury risks of young taekwondo athletes (aged between 19 and 27 years) have been evaluated with FMS® (Razi, 2016). However, there is no study in the literature evaluating the risk of injury in children with FMS®. In our study, we also aimed to investigate whether the standard training program of taekwondo has a corrective effect for FMS®.

It has been stated in the literature that there is no difference between the FMS scores of beginner and experienced taekwondo players (Razi, 2016). Similarly, we determined that the risk of injury in children who have been attending taekwondo for at least one year is not different from those who have just started. This result suggests that taekwondo training should be done together with corrective exercises.There are studies in the literature stating that grip strength reflects general muscle strength (Wind et al., 2010). For this reason, we evaluated grip strength, which is a practical test, to get an idea of overall muscle strength.

Taekwondo athletes need muscular strength and endurance to effectively perform and sustain technical and tactical actions in a match (Bridge et al., 2014). Nevertheless, when the literature is reviewed, it appears that there is no conclusive evidence that taekwondo practice can improve anaerobic fitness or muscle strength (Fong and Ng, 2011). Heller et al. (1998) stated that arm flexion, knee extension, hand grip and explosive leg strength in elite taekwondo athletes were above the "norm" in both genders (Heller et al., 1998). For recreational taekwondo athletes, Toskovic et al. (2004) compared muscle strength between black belt practitioners and beginners and found that black belt practitioners had more power in the lower body than beginners, regardless of gender (Toskovic et al, 2004). Thompson and Vinueza (1991) stated that taekwondo training has no effect on force (Thompson and Vinueza, 1991).

Shirley et al. (2013), in their randomized controlled study, stated that taekwondo training increased isokinetic knee muscle strength in children with developmental coordination disorder, but had no effect on balance (Fong et al., 2013). In another study designed similarly to our study, they stated that taekwondo players with an average age of about 11 years had better muscle strength and vertical jump height compared to the control group with a similar average age (Jlid et al., 2016). However, we could not find any difference between the groups in terms of strength, balance and vertical jump height in our study.

We observed the effect of taekwondo training on strength in studies evaluating local muscle strength, and this effect is mostly on the

lower extremity. Taekwondo is characterized by fast and high strokes that require good flexibility and strength. The muscles of the lower limbs are crucial in explosive kicking, jumping and maintaining postures. It is reasonable to assume that taekwondo athletes can gain muscle strength through such bodyweight resistance exercises (Fong and Ng, 2011). The lack of effect on grip strength, which we evaluated in this study to get an idea of general muscle strength, may prove that taekwondo increases local muscle strength rather than general. However, the results of studies showing the effect of taekwondo on balance and vertical jump are similar to our results.

CONCLUSION

We determined that taekwondo training in children has no effect on FMS scores, which indicates the risk of injury, and these children have a high risk of injury. We think that combining taekwondo training with corrective exercises may reduce injury risks for children who participate this training. Secondly, taekwondo training should be arranged in a way to increase physical fitness parameters such as strength, balance and vertical jump in children. Limitations of this study were, low count of participants and absence of an isokinetic assessment of muscle strength.

Conflict of interest: The authors declare no conflict of interest. No financial support was received.

Ethics Statement

The studies involving human participants were reviewed and approved by the University of Health Sciences Scientific Research Ethics Committee (Date: 12.02.2021; Decision / Protocol number: 21/172). Written informed consent to participate in this study was provided by the patients/participants.

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How to cite this article: Atalay, G. and Atalay, E.S. (2021). The Effect of Taekwondo Training on Children's Functional Movement Screen (FMS) Scores and Athletic Performance Parameters. *Int J Disabil Sports Health Sci*;4(2):80-85.
https://doi.org/10.33438/ijdshs.900852