International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

RESEARCH ARTICLE

Comparison of Functional Movement Analysis (FMS) and Core Performance in Children Who Attended and Didn't Attend Karate Training

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Abstract

Karate athletes perform many high-intensity actions during matches. However, as with all sports disciplines, training can result in overload or injury. To minimize the risk, it is necessary to make a reliable assessment. The Functional Movement Screen (FMS ™) can be used as a reliable clinical tool to predict athletes' injury risk. The aim of this study is to examine the functional movement scores of school-age children attending karate sports training and to compare them with the control group. Secondly, core strength and core endurance parameters were evaluated. The research was conducted on children aged 8-11 who have been attending karate training for at least one year within the Ministry of Youth and Sports (n=14) and who have just started this education (maximum 2 weeks) (n=14). Among the children included in the assessment, the mean age of the group that received karate training was 9.35 ± 2.12 years, and the mean age of the group that new beginners were 9.78 ± 0.8 years. There was a significant difference in hurdle step (both sides), shoulder mobility (right side), trunk stability push-up, rotary stability (both sides) and total FMS score between groups (p<0,05). In addition, a significant difference was found between the groups in the core flexion endurance parameter (p<0,05). As a result, we can say that karate training improves physical fitness in school-age children.

Keywords
Children, Core, Functional Movement Screen, Karate, Performance.

INTRODUCTION

Modern karate has its roots in the Okinawa islands in Japan (Jansen et al., 2017). Karate consists of kihon, kata, and kumite training. Kihon includes basic techniques while kata and kumite are two types of competition (Ma and Qu, 2017). The discipline is complex and requires considerable physical and mental resources. It usually takes hard, long-term training to automatize and efficiently apply all the techniques (Jukic et al. 2017).

Karate training includes general development exercises, which create the basis for specialized training. Athletes display high explosive muscle strength, balance, and flexibility, which is of key importance in this discipline (Chaabene et al., 2012, Giampietro et al., 2003, Boguszewski et al., 2015). Muscle groups that need to be strengthened include abdominal and lower limb rim areas (Tabben et al., 2014, Gloc et al., 2012, Boguszewski et al., 2011) These muscles ensure stable posture during movements and fighting (Truszczynska et al., 2015). However, as with all sports disciplines, training may cause overload or injuries (Gloc et al., 2012, Boguszewski et al., 2011, Truszczynska et al. 2015).

Received: 28 April 2022 ; **Accepted:** 20 August 2022; **Published:** 20 December 2022
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Functional movement is maintaining proper mobility and stability while performing functional movement patterns (Okada et al., 2011). These movement patterns include sport-specific activities. Flexibility, strength, passive range of motion, motor patterns, core stability, and proprioception have each been cited as possible risk factors for injury. However, the presence of only one risk factor is insufficient to be cited as a cause of injury (Frost et al., 2012, Bahr and Krosshaug).

In many cases, mobility, stability, strength, or neuromuscular control imbalances may not be identified during traditional screening and assessment. These problems, previously acknowledged as significant risk factors, can be identified using the Functional Movement Screen (FMS®). FMS is a battery of seven tests that assess fundamental movement patterns to identify dysfunctional, asymmetrical, and painful movements that could contribute to future injuries (Cook et al., 2014, Cook et al., 2014).

Studies investigating the effects of karate training on children's core performance and injury risks are insufficient in the literature. This study aims to investigate the effect of karate training on children's core performance and injury risk. The main hypothesis of this study is; that there is a difference in core performance and FMS® scores between participants.

MATERIALS AND METHODS

The study was designed as a prospective, single-blind, observational study with the approval of the University of Health Sciences Scientific Research Ethics Committee (21/640). Children between 8-11 years of age who have been attending karate training for at least 1 year (Group I) (n = 15) and who have just started this education (less than 2 weeks) (Group II) (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. The number of volunteers was determined by the G-Power analysis program (Faul et al., 2007). The required sample size was at least 16 individuals for each group, with 80% power and 5% error according to the study (n=32) (Chang et al., 2020).

Functional Movement Screen (FMS®)

The injury risk analysis of the participants was evaluated with FMS scores.

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).

Core Strength

The core strength of the participants was evaluated using the Stabilizer device (Pressure biofeedback unit - Pressure Biofeedback Unit, Chattanooga Group Inc., Hixson TN37343 USA Chattanoga®). The stabilizer is a simple pressure transducer consisting of a three-chamber air-filled pressure bag, a catheter, and a sphygmomanometer gauge (Chattanooga, 2005). The test was performed on the mat in the prone position. For this, the participant lay in the prone position, arms on both sides, neck straight and head relaxed in the midline. First of all, the participant was taught how to contract the abdominal muscles (especially the participant’s body was hanging down from the table as the spina iliaca anterior superiors aligned with the table edge, the hands were crossed at the shoulders and the feet were in the supported position. The test was initiated when horizontality was achieved and the duration to maintain this position was recorded by using a stopwatch. In the flexion-rotation test, the participant lay on his/her back with the hips and knees flexed to 90 degrees, with his/her hands clasped and extended to the thighs. Both knees of the participant were supported by the physiotherapist. The participant did sideways combined trunk flexion and rotation, touching the outside of the physiotherapist's right hand first, then returning to the starting position, and then touching the opposite hand. He/she was asked to touch the maximum number of times in 90 seconds. Only correctly performed repetitions were counted (Moreau et al., 2001, Brotons-Gil et al., 2013). participant’s body was hanging down from the table as the spina iliaca anterior superiors aligned with the table edge, the hands were crossed at the shoulders and the feet were in the supported position. The test was initiated when horizontality was achieved and the duration to maintain this position was recorded by using a stopwatch. In the flexion-rotation test, the participant lay on his/her back with the hips and knees flexed to 90 degrees, with his/her hands clasped and extended to the thighs. Both knees of the participant were supported by the physiotherapist. The participant did sideways combined trunk flexion and rotation, touching the outside of the physiotherapist's right hand first, then returning to the starting position, and then touching the opposite hand. He/she was asked to touch the maximum number of times in 90 seconds. Only correctly performed repetitions were counted (Moreau et al., 2001, Brotons-Gil et al., 2013).

Statistical Analysis

Descriptive statistics of the participants are given as mean and standard deviation. Statistical analysis is applied via SPSS version 21.0 (IBM Inc., Armonk, NY, USA) software. The normality of the data was investigated with the One-Sample Kolmogorov Smirnov test, and non-parametric tests were used to analyze the differences since the normal distribution was not achieved. Group comparisons are done with the Mann-Whitney U test.

RESULTS

The demographic data of the participants are presented in Table 1. Functional Movement Screen scores of the individuals are shown in Table 2. Group comparisons of FMS scores are presented in Table 3. There was a significant difference in hurdle step (both sides), shoulder mobility (right side), trunk stability push up and rotary stability (both sides) between groups. Additionally, a statistically significant difference was found in the total FMS scores of the groups. There was also a significant difference between the groups in the core flexion endurance parameter.

Table 1. Demographic data of the participants

Personal characteristics (n=28)	Group I (n=14)	Group II (n=14)
Gender (n)	7 female, 7 male	14 female
Age (mean, ±)	9.35± 1	9.78± 0.80
Height (mean, ±)	1.33± 0.07	1.42± 0.06
Weight (mean, ±)	39.14± 4.78	39.62± 5.59
Body Mass Index (mean, ±)	22.08± 1.4	19.63± 2.29

Group I: Karate 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	1.5		1,21	
Hurdle Step	1.85	1.85	1.35	1.42
In-Line Lunge	1.42	1.35	1.5	1.71
Shoulder Mobility	2.71	2.85	2.5	2.42
Active Leg Raise	2.07	2.07	1.85	1.85
Trunk Stability Push-Up	1.42		1.07	
Rotary Stability	1.5	1.64	1.14	1.14
FMS TOTAL SCORE	12		10.21	

FMS: Functional Movement Screen Group I: Karate Group, Group II: New Beginners

Table 3. Group comparisons of FMS scores

FMS Parameters	Left		Right	
	z	p	z	**p**
Deep Squat	Z=-1.54 p= 0.121			
Hurdle Step	-2.054	0.04	-2.011	0.044
In-Line Lunge	-556	0.578	-1.684	0.092
Shoulder Mobility	-877	0.380	-1.742	0.082
Active Leg Raise	-836	0.403	-836	0.403
Trunk Stability Push-Up	Z=-2.143 P= 0.032			
Rotary Stability	-1.987	0.047	-2.660	0.008
FMS TOTAL SCORE	Z=2.097 p= 0.036			

FMS: Functional Movement Screen, Note: Mann Whitney U Test

Table 4. Group comparisons of core performance

Parameters				
	Group I	Group II		
	Mean± SD	Mean± SD	Z	p
Core Strength	6.14± 3.69	7.71± 4.33	-788	0.430
Core Flexion Endurance	49.41± 23.10	33.49± 14.84	-1.976	0.048
Core Extension Endurance	91.42± 34.31	76.05± 49.07	-1.378	0.168
Core Flexion-Rotation Endurance	31± 8.78	26.57± 10.32	-1.128	0.259

SD: Standard Deviation, Group I: Karate Group, Group II: New Beginners

DISCUSSION

As a result of our study, we determined that karate training improves core endurance and reduces the risk of injury in school-age children. FMS is a simple screening test that enables the determination of the functional deficiencies and asymmetry of the participants. The high repeatability of the test is an important advantage. It forms the basis for function-oriented rehabilitation planning. In this way, it is possible to reduce the risk of injury and eliminate the risk factors for the occurrence of injuries (Garrison et al., 2015, Boguszewski et al., 2013, Letafatkar et al., 2014).

The screen has been found to have high (Minick et al., 2010) to good inter-rater and moderate intra-rater reliability in the adult population (Teyhen et al., 2012). It has also been used in children to access functional fitness, to evaluate the relationship between FMS™, children’s weight status, and physical inactivity, as well as athletic performance (Mitchell et al., 2015, Duncan and Stanley, 2012, Duncan and Stanley 2013, Yildiz, 2018). Similar to our study they stated that 23 karate athletes aged 10-12 had better FMS scores than the control group. In the study, in men, the highest result was obtained in shoulder mobility and the lowest result was obtained in push-ups in trunk stability. No significant differences were noted between the dominant and non-dominant sides for any group and any exercise (Boguszewski et al., 2015). Higher results on the FMS test in karate athletes may indicate smaller functional limitations that may result from training. Ma and Qu also stated that karate training contributes to the development of motor skills in primary school children (Ma and Qu, 2017).

In our study, we found that karate athletes achieved better core stabilization results than the control group. Karate athletes use explosive movement patterns such as punching and kicking. Therefore, they need trunk stabilization to improve the quality of movement. Because during all these lower and upper extremity movements, trunk activation starts earlier, regardless of the speed of the extremities (Hodges and Richardson, 1997). Kamal in his study to investigate the effects of core strength training on the spinning wheel and some physical variables for young female karate athletes observed a significant increase in all these parameters in the core strength training group (Kamal, 2015). The increase in core stabilization can also improve sports performance in children, and this may lead to the development of self-confidence in the child. In our study, we found that FMS performed better in push-up and trunk stability tests in children doing karate. High core stabilization may have resulted in higher FMS scores. In this regard, Mitchell et al.'s study with school-age children supports our study with similar results. In this study, they stated that the FMS total scores of 77 children aged 8-11 were associated with core stability results (Mitchell et al., 2015)

Limitations of Study

The study could have been done with more participants, taking into account different age groups.

Conclusion

It may be a good option for school-aged children to be directed to karate training to improve their physical fitness and diminish sports-related injury risk.

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: 15.11.2021; Decision / Protocol number: 21/640). Written informed consent to participate in this study was provided by the patients/participants.

Author Contributions

Study Design, ESA and GA; Data Collection, ESA; Statistical Analysis, ESA; Data Interpretation, ESA and GA; Manuscript Preparation, ESA and GA; Literature Search, ESA, and GA. All authors have read and agreed to the published version of the manuscript.

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How to cite this article: Atalay, E.S. and Atalay, G. (2022). Comparison of Functional Movement Analysis (FMS) and Core Performance in Children Who Attended and Didn't Attend Karate Training. *Int J Disabil Sports Health Sci*;5(2):90-96. https://doi.org/ 10.33438 /ijdshs.1110316