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ORIGINAL RESEARCH

Core training and motion capacity: a study on joint range in amateur soccer

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Received: October 16, 2023

Accepted: December 18, 2023

Online Published: December 31, 2023

Abstract

This study investigated the effects of core training on functional movement capacity and range of motion in amateur soccer players. Twenty-nine amateur male volunteer soccer players participated in the study, including the experimental group (n = 15; age = 20.13 ± 1.55) and the control group (n = 14; age = 19.39 ± 1.08). The assumption of normality was made by employing the Kolmogorov-Smirnov test. The independent sample t-test was employed due to the normal distribution of the data. Statistically significant differences were observed between the groups in FMS, hip extension right-left, hip abduction right-left, hip internal rotation left, hip external rotation right-left, shoulder hyperextension right-left, ankle dorsiflexion right-left, and ankle plantar flexion right-left ($P<0.05$). No significant differences were found in the right-left knee flexion, right-left hip flexion, and right hip external rotation ($P>0.05$). According to the results of the study, core training improved FMS, hip extension right-left, hip abduction right-left, hip internal rotation left, hip external rotation right-left, shoulder hyperextension right-left, ankle dorsiflexion right-left, and ankle plantar flexion right-left range of motion parameters. These results suggest that including core training in the program is highly effective in improving the FMS and ROM in young soccer players.

Keywords: Core exercise, functional movement screening, range of motion, soccer.

Introduction

Core training is used for many purposes, such as general health, rehabilitation, and improving athletic performance (Arslan et al., 2021; Kurt et al., 2023). Improved balance, neuromuscular control, and trunk stability are needed for the effective and safe execution of the basic movements required in sports (Huxel & Andersen, 2013). Core strength is important in controlling and improving movement quality (Jones et al., 2013). However, with an increase in the stability strength of the core, the back remains healthy, good posture is maintained, balance and performance improve, and injuries can be prevented (Senthilkumar, 2019).

Assessment of dysfunctional movement patterns in sports can help health professionals and coaches prepare for post-injury rehabilitation and injury prevention training programs (Majewska et al., 2022). Various tests have been developed to assess functional movements, dynamic balance, and the complex nature of motor control (Cook et al., 2006a; Plisky et al., 2006). FMS and ROM tests are generally used to evaluate these characteristics in sports. The Functional Movement Screen (FMS) incorporates a set of seven distinct movement tests, including the deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability. These tests collectively contribute to a comprehensive assessment, yielding a total score ranging from 0 to 21 (Cook et al., 2006a; 2006b; Cook, 2010). These movement patterns assess hip flexion, internal-external rotation, shoulder abduction, shoulder adduction, and core stability (Kraus et al., 2014). It has been reported that participants with a total score above 14 are less likely to experience disability

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To Cite: Yılmaz, O. (2023). Core training and motion capacity: a study on joint range in amateur soccer. *Turk J Kinesiol*, 9(4), 287-292.
DOI: 10.31459/turkjkin.1376952

than those with a total score below 14 (Kiesel et al., 2007; Lisman et al., 2013).

Range of motion measurements assesses the musculoskeletal status and joint function (Milanese et al., 2015). Soccer is a game in which high-intensity movements such as sudden acceleration and deceleration, rapid change of direction, jumping, and landing are required to win and possess the ball (Soylu et al., 2022). These high-intensity movements can cause joint overloading, impairing the range of motion and injuries (Witvrouw et al., 2003; De-La-Cruz et al., 2020). Bradley & Portas (2007) stated that those with a low range of motion have a higher risk of injury. The range of motion of the joints is essential for performing soccer-specific skills (Bradley & Portas, 2007) and preventing injuries in the lower extremities (Garcia-Pinillos et al., 2015).

In previous studies conducted in the literature, core training has been applied to soccer players (Kim & An 2022; Daneshjoo et al., 2019), football players (Vurgun & Edis 2020), basketball players (Doğan et al., 2018), tennis players (Majewska et al., 2022), badminton athletes (Saberian Amirkolaei et al., 2019), goalball athletes (Mahrokh Moghadam et al., 2021), and swimmers (Kurt et al., 2023). However, few studies have investigated the effects of core training on knee flexion and hip flexion ROM in young, active men (Senthilkumar, 2019). Therefore, to contribute to the literature, we aimed to examine the effects of core training on FMS and ROM in soccer players.

Methods

This study investigated the effects of core training on functional movement capacity and range of motion in amateur soccer players.

Participants

The sample group of the study consisted of a total of 29 amateur male volunteer soccer players, including experimental (n = 15; age = 20.13 ± 1.55; height = 179.67 ± 4.59; weight = 69.24 ± 5.23) and control (n = 14; age = 19.39 ± 1.08; height = 178.60 ± 4.16; weight = 72.47 ± 8.61). Athletes generally have a six-year athletic background. There were five training sessions and one match in the weekly program. The ethics committee report of the study was approved by the Osmaniye Korkut Ata Üniversity Ethical Committee (2023-E.125484).

Procedure

The participants underwent a functional movement screening test and range of motion measurement. The tests were performed on different days. FMS tests were performed without warming. A goniometer was used to measure the range of motion. After the tests, the participants were randomly divided into experimental and control groups. The soccer players in the experimental group participating in the study were subjected to core training three days a week for eight weeks apart from soccer training. No core training program was applied in the control group.

Core training program

The sit-up, cross-crunchcross-crunh, leg raises, raised leg sit-ups, scissor kick, dynamic plank right-left side, kickbacks right-left side, side kickskiks with knee tap right-left side, clams right-left-side, bird-dog, glute bridge, swimming, mountain climbers, back extension, push-up, pus-up rotation, and long-stretch stretch movements were applied in 12 repetitions. After every four movements, 2 minutes rest was given.

Functional movement screening

Seven movements were performed: FMS deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability. Movements were scored between 0-3, with the highest score being 21 (Cook et al., 2006a, 2006b; Cook, 2010). It has been stated that participants with a total score of less than 14 on the functional movement screening have been shown to have a higher risk of disability than participants with a total score of more than 14 (Kiesel et al., 2007).

Joint range of motions

Ankle dorsi flexion and plantar flexion, knee flexion, hip flexion and extension, hip internal/external rotation, hip abduction, and shoulder hyperextension range of motion were measured (Otman et al., 2014).

Data Analyses

Data are presented as mean plus or minus ± standard deviation. The assumption of normality was made by employing the Kolmogorov-Smirnov test. A paired-sample t-test was employed because of the normal distribution of the data. The data showed normal distribution. Independent Sample T Test is used for comparisons between groups. The effect size in pairwise comparisons was determined using Cohen's d effect size (d). The study assessed the effect size (d) using a classification system that categorizes effect sizes as negligible (0.00-0.20), small (0.21-0.59), medium (0.60-1.19), big (1.20-1.99), very large (>2.00), and near perfect (>4.00) (Hopkins, 2000). Statistical analyses were conducted using the SPSS statistical package program (SPSS Inc., Chicago, IL, USA, version 26.0), with the significance level set at p<0.05.

Results

Comparison of joint range of motion post-test parameters of the core training group and the control group is presented in Table 1. Significant differences were observed between the groups in hip extension, hip abduction, hip external rotation, shoulder hyperextension, ankle dorsiflexion, ankle plantar flexion right-left, and hip internal rotation left (p<0.05). No significant differences were found in knee flexion, hip flexion right-left, and right hip external rotation (p>0.05).

Comparison of the functional movement capacity post test results of the core training group and the control group is presented in Figure 1. The analysis revealed a statistically significant difference in the functional movement capacity between the groups (P<0.05).

Table 1
Independent Sample t-test table of range of motion post test results of core training (n=15) and control groups (n=14).

Variables	Core Group	Control Group	Lower	Upper	Cohen's *d*	Descriptor	p*
	Mean ± SD	Mean ± SD					
Knee Flexion Right	125.00 ± 7.56	118.57 ± 6.84	-0.35	12.49	-	-	0.062
Knee Flexion Left	124.00 ± 7.37	119.64 ± 7.20	-2.29	11.57	-	-	0.172
Hip Flexion Right	120.67 ± 8.21	113.57 ± 7.95	-1.35	14.92	-	-	0.095
Hip Flexion Left	123.67 ± 8.12	116.79 ± 6.68	-0.35	12.49	-	-	0.062
Hip Extension Right	40.00 ± 9.82	31.07 ± 7.38	1.64	15.50	0.45	Small	0.019*
Hip Extension Left	40.00 ± 8.02	31.07 ± 8.59	3.58	13.56	0.47	Small	0.003*
Hip Abduction Right	67.00 ± 7.02	56.79 ± 6.39	4.81	15.19	0.61	Medium	0.001*
Hip Abduction Left	66.00 ± 6.60	60.71 ± 3.85	0.61	9.39	0.44	Small	0.029*
Hip Internal Rotation Right	44.00 ± 9.30	37.50 ± 9.95	-2.00	14.86	-	-	0.123
Hip Internal Rotation Left	41.00 ± 7.37	33.57 ± 8.64	0.54	15.17	0.42	Small	0.037*
Hip External Rotation Right	42.00 ± 3.68	33.21 ± 4.21	4.98	12.88	0.74	Medium	0.000*
Hip External Rotation Left	40.00 ± 4.63	31.07 ± 4.46	5.32	12.54	0.70	Medium	0.000*
Shoulder Hyperextension Right	62.00 ± 7.27	46.43 ± 10.82	9.55	22.59	0.65	Medium	0.000*
Shoulder Hyperextension Left	59.67 ± 6.94	46.79 ± 9.53	6.38	19.33	0.61	Medium	0.001*
Ankle Dorsiflexion Right	37.00 ± 5.92	20.36 ± 4.14	12.60	20.26	0.85	Medium	0.000*
Ankle Dorsiflexion Left	37.00 ± 5.61	20.00 ± 4.80	12.24	22.04	0.85	Medium	0.000*
Ankle Plantar Flexion Right	33.67 ± 3.52	29.64 ± 4.58	0.39	8.18	0.44	Small	0.034*
Ankle Plantar Flexion Left	31.00 ± 4.31	27.86 ± 4.26	0.28	6.86	0.34	Small	0.035*

** Significant difference between groups post-training*

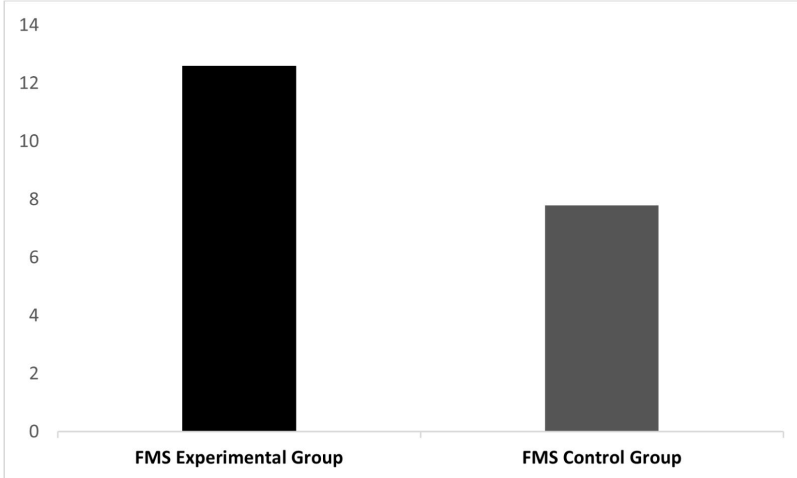

Figure 1. Independent Sample T test table of functional movement screening post test results of core training and control groups.

Discussion

This study investigated the effects of core training on soccer players' functional movement capacity and range of motion (ROM). The results showed that core training improved FMS, hip extension, hip abduction, hip external rotation, shoulder hyperextension, ankle dorsiflexion, ankle plantar flexion right-left, and hip internal rotation left the range of motion parameters. There was no significant difference in knee flexion right-left, hip flexion right-left, or hip external rotation right range of motion.

In a study conducted on soccer players, Kim & An (2022) applied a core training program for 12 weeks, two days a week, for 50 minutes, and found that it improved FMS. A similar study reported that 8-week core training improved FMS in soccer players (Daneshjoo et al., 2019). Doğan et al. (2018) reported that 8-week core training improved FMS in basketball players aged 12-14. A different study conducted on swimmers observed that a core training program was applied to athletes before swimming for eight weeks, four days a week, and improvement in FMS was achieved (Kurt et al., 2023). Majewska et al. (2022) reported that the core training program applied to female and male tennis players improved FMS. Another study on handball athletes stated that the core training program involved six weeks of improved FMS (Vurgun & Edis, 2020). Different studies have reported that core training programs using Swiss balls improved FMS in goalball athletes (Mahrokh Moghadam et al., 2021) and badminton athletes (Saberian Amirkolaei et al., 2019). Studies on college athletes have shown that core training programs improve FMS (Bagherian et al., 2019; Scepanovic et al., 2020). According to these results supporting the findings of the study, it can be said that core training can be used to improve functional movement capacity in athletes.

Senthilkumar (2019) stated that core training improved knee flexion and hip flexion ROM in a study of active young men. Since the core is located at the centre of all kinetic chains, it maximizes the kinetic chain performance of balance, movement control, and the lower and upper limb functions required in sports activities (Kibler et al., 2006). However, core stability can provide optimal gains in the range of motion by improving the body's ability to control the joint range of motion (Senthilkumar, 2019). In addition to these results, in a compilation study examining the effects of core training on physical capacity, it was stated that core training also improves physical characteristics such as agility, speed, strength and balance (Luo et al., 2023).

This study was limited by the small sample size and the relatively short duration of the core training program. These limitations may affect the generalisability of the findings to a broader population of amateur soccer athletes. They may have prevented the study from detecting more nuanced effects on functional motion capacity and joint range of motion.

Conclusion

According to the results of the present study, the core training program applied in addition to team training in amateur football players improved the functional movement capacity and range of motion of hip extension, hip abduction, hip external rotation, shoulder hyperextension, ankle dorsiflexion, ankle plantar flexion right-left and hip internal rotation left. According to these results, core training can improve the FMS and ROM of soccer players, which in turn can protect them from injuries.

Authors' Contribution

Study Design: OY; Data Collection: OY; Statistical Analysis: OY; Manuscript Preparation: OY; Funds Collection: OY.

Ethical Approval

The study was approved by the Osmaniye Korkut Ata Üniversity Ethical Committee (2023-E.125484) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

Funding

The authors declare that the study received no funding.

Conflict of interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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