Turkish Journal of Sport and Exercise /
Türk Spor ve Egzersiz Dergisi
http://dergipark.gov.tr/tsed
Year: 2024 - Volume: 26 – Issue 1 - Pages: 62-68
10.15314/tsed.1341626

Turkish Journal of Sport and Exercise
Türk Spor ve Egzersiz Dergisi
ISSN: 2147-5652
https://dergipark.org.tr/tr/pub/tsed

The Relationship Between Functional Movement Screening and Joint Range of Motion, Y-Balance Test and Countermovement Jump in Amateur Soccer Players

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Conflicts of Interest: The author(s) has no conflict of interest to declare.

Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

(Date Of Received): 11.08.2023 (Date of Acceptance): 30.04.2024 (Date of Publication): 30.04.2024
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Abstract

This study aimed to investigate the relationship between a functional movement screening (FMS) test and joint range of motion (ROM), lower quarter y-balance test (LQYBT), and countermovement jump (CMJ) performance in amateur soccer players. A study was conducted with 25 male amateur soccer players to assess their physical abilities using various tests. The tests included FMS, YBT, CMJ, ROM for shoulder extension, hip abduction, hip external rotation, and ankle dorsi/plantar flexion. Pearson's correlation test was used to examine the association between the variables. A significant positive correlation between the FMS and CMJ (r=0.424, p<0.05), FMS and right LQYBT (r=0.471, p<0.05), left LQYBT (r=0.459, p<0.05), shoulder righ extension (r=0.608, p<0.05), shoulder left extension (r=0.559, p<0.01), hip right abduction (r=0.536, p<0.01), hip left abduction (r=0.485, p<0.05), hip right external rotation (r=0.619, p<0.01), hip external left rotation (r=0.622, p<0.01), ankle right dorsiflexion (r=0.597, p<0.01), ankle left dorsiflexion (r=0.608, p<0.01), ankle right plantar flexion (r=0.541, p<0.01), ankle left plantar flexion (r=0.519, p<0.01) ROM. A moderate positive correlation was observed between the FMS and CMJ, right-left LQYBT, and right-left hip abduction ROM. A highly positive correlation was noted between FMS and ROM for shoulder right-left extension, hip external right-left rotation, and ankle dorsi/plantar flexion on the right and left sides. In this context, coaches, athletic performance specialists, and physiotherapists can use LQYBT, ROM and CMJ tests as well as FMS to evaluate sports performance and injury risk..

Keywords: Balance, functional movement screening, joint range of motion, jumping, soccer

Özet

Amatör Futbolcularda Fonksiyonel Hareket Taraması ile Eklem Hareket Açıklığı, Y-Denge Testi ve Dikey Sıçrama Arasındaki İlişki

Bu çalışma amatör futbolcularda fonksiyonel hareket tarama testi ile eklem hareket açıklığı, denge ve sıçrama arasındaki korelasyonu incelemek amacıyla yapılmıştır. 25 erkek amatör futbolcunun fiziksel yeteneklerinin çeşitli testler kullanılarak değerlendirilmesi amacıyla fonksiyonel hareket tarama testi (FMS), eklem hareket açıklığı (EHA) (omuz ekstansiyon, kalça abdüksiyon, kalça dış rotasyon, ayak bileği dorsifleksiyon ve plantar fleksiyon), Y denge testi alt ekstremite ve dikey sıçrama testleri yapılmıştır. İlişkiyi analiz etmek için Pearson Korelasyon testi kullanıştır. FMS ile dikey sıçrama (r=0,424, p<0,05), sağ ayak denge (r=0,471, p<0,05), sol ayak denge (r=0,459, p<0,05), omuz ekstansiyon sağ (r=0,608, p<0,01), omuz ekstansiyon sol (r=0,559, p<0,01), kalça abdüksiyon sağ (r=0,536, p<0,01) kalça abdüksiyon sol (r=0,485, p<0,05), kalça dış rotasyon sağ (r=0,619, p<0,01), kalça dış rotasyon sol (r=0,622, p<0,01), ayak bileği dorsifleksiyon sağ (r=0,597, p<0,01), ayak bileği dorsiflesiyon sol (r=0,608, p<0,01), ayak bileği plantar fleksiyon sağ (r=0,541, p<0,01), ayak bileği plantar fleksiyon sol (r=0,519, p<0,01) eklem hareket açıklıkları arasında pozitif bir korelasyon tespit edilmiştir. FMS ile CMJ, sağ-sol YBT, kalça abdüksiyon sağ-sol EHA arasında orta derecede pozitif ilişki ve omuz ekstansiyon sağ-sol, kalça dış rotasyon sağ-sol, ayak bileği dorsileksiyon sağ-sol, ayak bileği plantar fleksiyon sağ-sol EHA arasında ise yüksek derecede pozitif ilişki olduğu görülmüştür. Bu bağlamda antrenörler, atletik performans uzmanları ve fizyoterapistler, spor performansını ve sakatlık riskini değerlendirmek için FMS'nin yanı sıra LQYBT, ROM ve CMJ testlerini de kullanabilirler.

Anahtar Kelimeler: Denge, eklem hareket açıklığı, fonksiyonel hareket kapasitesi, futbol, sıçrama,

INTRODUCTION

Soccer players require advanced strength, speed, endurance, flexibility, balance, agility, technical skills, joint mobility, and functional range of motion to perform successfully. Various tests that measure these characteristics have been used to evaluate sports performance. Functional movement screening (FMS) is recommended to facilitate the evaluation of these patterns in sports practice (17). The FMS consists of seven basic motion component tests: deep squat, in line lunge, hurdle step, shoulder mobility, active straight leg raise, trunk stability push-up, and rotational stability. Each move was scored between 0-3 and itself. The total score ranges from 0 to 21 points (6, 7). Kisel et al. (12) stated that the risk of injury for soccer players with a total score below 14 is higher than those with a score above 14.

Functional movement capacity refers to the ability to perform basic motor skills under controlled conditions (7). Evaluation of functional movement generally includes the measurement of postural control, stability, flexibility, neuromuscular coordination, balance, and range of motion (6, 14). Functional movement screening is designed to identify general musculoskeletal status, functional ranges of motion, and asymmetries that may predict disability (6). FMS can assess a person's muscle strength, balance, range of motion, and coordination at one level (6, 7). Lower quarter y-balance test (LQYBT) is used to measure dynamic balance and neuromuscular control (4). The LQYBT measures balance in a one-leg stance and requires an individual to have strength, flexibility, and proprioception to perform the test adequately (3, 9). Range of motion (ROM) is a measurement that examines joint function and is used in the evaluation of musculoskeletal status (24).

According to Werner et al. (32) an excessive or insufficient range of motion in the joints can harm movement functionality and lead to disability. FMS, LQYBT, and ROM tests were used to predict negative outcomes. In some studies, it has been stated that the risk of disability is higher for participants with FMS total scores less than 14 (12, 19). It has been stated that LQYBT scores below 89.6% (29) and low ROM (2) are associated with disability risk. The FMS, ROM, LQYBT, and countermovement jump (CMJ) tests are frequently used by coaches, athletic performance specialists, and physiotherapists to improve athletic performance characteristics and to predict athletes with a tendency to injure. In this context, the aim of the study is to investigate the relationship between the FMS and ROM, LQYBT, and CMJ in amateur soccer players..

METHOD

Participants

The sample group of the study consisted of 25 amateur male soccer players (age; 19.76 ± 1.22 height; 180.18 ± 4.85, weight; 71.69 ± 6.69, body mass index; 22.08 ± 1.96). The tests were conducted during the preparation period before the competition. The team trained 5 or 6 training sessions per week.

Procedure

The tests were conducted on different days. The tests were carried out on different days, considering that it could negatively affect the athletes' performances. FMS tests were performed without warming. Joint range of motion measurements were performed with a goniometer. A standard warm-up of 15 minutes was performed before the other tests were performed. The research was conducted following the Declaration of Helsinki and was approved by the Ethics Committee of Osmaniye Korkut Ata University (E.119502).

Functional Movement Screening

The FMS test was performed in accordance with the guidelines. The scoring standards for the seven tests (Deep Squat, Hurdle Step, In Line Lunge, Shoulder Mobility, Active Straight Leg Raise, Trunk Stability Push-Up, Rotary Stability) ranged from 0 to 3, with 3 points for excellent condition (normal functional movement mode), 2 points for incorrect completion or compensatory movements, 1 point for completing the test when the body is unstable, and 0. for any pain during the test, and the maximum total score was 21 points (8). Before the test, the athletes do not apply any warm-up as stated in the test protocol. The movements applied in the test were performed sequentially and the scores were recorded.

Joint Range of Motion Measurements

Shoulder Joint Range of Motion

The measurements were conducted when the subject was in the prone posture. As was done during the shoulder flexion movement, the goniometer was positioned in the same manner. The absence of flexion movement in the trunk and abduction movement in the shoulder should be taken into consideration throughout the measuring process (25). The measurement was carried out in two attempts with a goniometer.

Hip Joint Abduction Range of Motion

The measurements were taken while the subject was lying on their back. When the goniometer was positioned, the pivot point was positioned on the projection of the trochanter major, which is located at the anterior portion of the femur. When the fixed arm is positioned, it is parallel to the portion of the spine that is anterior to the superior region. Positioning the moving arm so that it would follow the midline of the anterior femur area was the task at hand. During the performance of the measurement, there should be no external rotation of the hip. (25). The measurement was carried out in two attempts with a goniometer.

Hip Joint External Rotation Range of Motion

The person being measured sat with his legs hanging from the table from the knee. The pivot point of the goniometer was placed at the tuberosity of the tibial region. The fixed arm is placed parallel to the knee and ground, or it can be held perpendicular to the ground. The moving arm followed the tibial crista. There should be no abduction, adduction, extension, or flexion movements of the hip during the measurement (25).

Ankle Joint Dorsiflexion and Plantar Flexion

As the starting position of the ankle was 00 °, a right angle of 900 °was accepted between the 5th metatarsal and the fibula. During the measurement, the participant was in a supine or sitting position. Measurements were performed by placing a thin pillow under the knee (25).

Lower Quarter Y-Balance Test

The test was performed in three directions anterior, posteromedial and posterolateral. To score each of the three directions, the reach distances (measured in centimetres) were averaged and normalised to the participant's leg length. The LQYBT composite score was calculated using the following formula: anterior + posteromedial + posterolateral performance)/3 × lower extremity length (cm) × 100 (26). Before the test, the athletes underwent standard warm-up. Each athlete performed two trials on each foot.

Counter Movement Jump Test

The participant was instructed to complete the CMJ with an arm swing by crouching down to approximately 90º knee flexion and jumping as high as possible through maximum concentric contraction. Participants performed two practice jumps after warming up and the best score was recorded (20). Microgate jump mat was used for testing. Participants performed two jumps with a 6-second rest interval

Statistical Analysis

Normality of the distribution was tested using the Kolmogorov Smirnov test. The data were found to be normally distributed, and a Pearson's correlation test was applied. The 95% confidence interval (CI) was calculated. Statistical significance was set at $P < 0.05$. For the classification of effect size in correlation values, 0-0.30 weak correlation, 0.31-0.50 medium correlation, 0.51-0.70 high correlation and 0.71-1 correlation coefficient valid in the field of sports sciences, (R) was used (11). The SPSS 22 package was used in this study.

FINDINGS

Table 1. Correlation between FMS test results and ROM, LQYBT, CMJ

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1) FMS	1													
(2) CMJ	0.424*	1												
(3) LQYBT Right	0.471*	-0.033	1											
(4) LQYBT Left	0.459*	-0.066	-0.920**	1										
(5)Shoulder ROM Right	0.608**	0.102	0.301	0.389	1									
(6) Shoulder ROM Left	0.559**	0.078	0.404*	0.440*	0.927**	1								
(7) Hip Abd. ROM Right	0.536**	-0.008	0.334	0.435*	0.635**	0.634**	1							
(8) Hip Abd. ROM Left	0.485*	0.003	0.305	0.472*	0.691**	0.683**	0.842**	1						
(9) Hip Ext. Rot. ROM Right	0.619**	0.199	0.303	0.336	0.806**	0.857**	0.688**	0.769**	1					
(10) Hip Ext. Rot. ROM Left	0.622**	0.277	0.506**	0.583**	0.578**	0.581**	0.612**	0.778**	0.649**	1				
(11) Ankle DF ROM R	0.597**	0.381	0.331	0.343	0.443*	0.379	0.431*	0.321	0.461*	0.501*	1			
(12) Ankle DF ROM Left	0.608**	0.540**	0.141	0.132	0.517**	0.404**	0.384	0.323	0.516**	0.431*	0.823**	1		
(13) Ankle PF ROM Right	0.541**	0.069	0.460*	0.454*	0.695**	0.741**	0.549**	0.429*	0.744**	0.502*	0.621**	0.601**	1	
(14) Ankle PF ROM Left	0.519**	0.216	0.275	0.196	0.497*	0.466*	0.324	0.054	0.447*	0.130	0.491	0.602**	0.803**	1

Correlation is significant at the ** P < 0. 001, * P < 0.005, FMS: Functional Movement Screening, CMJ: Counter Movement Jump, Lower Quarter Y-Balance Test (LQYBT), ROM: Range of Motion, DF: Dorsiflexion, PF: Plantar Flexion, Ext: External, Rot: Rotation, Abd: Abduction

The study results indicate a significant positive correlation between the FMS and CMJ ($r=0.424$, $p<0.05$), FMS and right foot balance (LQYBT), ($r=0.471$, $p<0.05$), left foot balance (LQYBT), ($r=0.459$, $p<0.05$), shoulder extension right ($r=0.608$, $p<0.05$), shoulder extension left ($r=0.559$, $p<0.01$), hip abduction right ($r=0.536$, $p<0.01$), hip abduction left ($r=0.485$, $p<0.05$), hip external rotation right ($r=0.619$, $p<0.01$), hip external rotation left ($r=0.622$, $p<0.01$), ankle dorsiflexion right ($r=0.597$, $p<0.01$), ankle dorsiflexion left ($r=0.608$, $p<0.01$), ankle plantar flexion right ($r=0.541$, $p<0.01$), ankle plantar flexion left ($r=0.519$, $p<0.01$) ROM (Table 1).

DISCUSSION AND CONCLUSION

In the present study, the relationship between the FMS total scores of amateur male soccer players and CMJ, LQYBT, and shoulder, hip, and ankle joint ROM were investigated. A moderate positive correlation was observed between the FMS and CMJ, right-left LQYBT, and right-left hip abduction ROM. A strong positive correlation was noted between the ROM for shoulder extension on the right and left sides, hip external rotation on the right and left sides, and ankle dorsiflexion and plantar flexion on the right and left sides.

The FMS is the most widely used test to determine the most important perceived risk factors for injuries experienced in the past, fatigue and muscle imbalance in soccer without contact, and to predict the risk of injury in soccer teams (21). Studies have shown that there is a significant relationship between FMS test scores and sports injuries (22). It has been stated that by evaluating the asymmetric conditions in the body with the FMS test, the parts of the body that are asymmetrical can be determined, and in this way, the formation of injuries can be reduced (30). After these developments, the results of the relationship between the FMS and tests determining physical performance characteristics were investigated.

The FMS and LQYBT tests can be used to evaluate the coordination between movements and similar basic features, such as dynamic balance (18). In the present study, there was a moderately positive correlation between FMS and LQYBT total scores. In a similar study conducted on soccer players, it was stated that there was a positive correlation between FMS and LQYBT (29). In another study conducted with female soccer players, it was determined that there was a positive correlation between FMS total scores and LQYBT right and left scores (16). When we look at studies conducted in different branches, a positive correlation was observed between FMS total scores and LQYBT right and left scores in child tennis players (30). In other studies conducted on university-trained athletes, a positive correlation was found between the FMS total scores and total LQYBT scores (18, 31). In another study conducted on sedentary female and male individuals, a weak positive correlation was found between FMS and LQYBT total scores (15).

Silva et al. (28) stated that they found a positive relationship between FMS total score and CMJ in a similar study on soccer players. In a similar study conducted on professional soccer players, a positive correlation was found between FMS total score and CMJ (27). In another study conducted on child tennis players, a positive relationship was found between FMS and CMJ (30). In another study conducted on basketball players, a positive relationship was found between CMJ and FMS total scores and deep squat, in-line lunge, and active straight leg raise scores (1). Based on these findings, it has been stated that jumping ability can be improved along with the improvement of the general musculoskeletal condition, which can be defined by the composite FMS score or the deep squat, in-line lunge, and active straight leg rais subtests (1).

In this study, a moderately positive relationship was observed between FMS and right-left hip abduction ROM, and a highly positive relationship was observed between FMS and shoulder extension right-eft, hip external rotation right-left, ankle dorsiflexion right-left, and ankle plantar flexion right-left ROM. Few studies have investigated the relationship between FMS and ROM. In the deep squat, hurdle step, and in-line lunge subtests used in the FMS, controlled and conscious dorsiflexion movements of the ankle and flexion of the hip and knee were performed. This situation reveals common points between FMS and ROM in the lower extremities. Chimera et al. (5) stated that there is a positive correlation between FMS and lower extremity ROM and that FMS subtest movement patterns are affected by ROM in the lower extremities. It has been reported that ankle dorsiflexion is a determinant of squat depth in both men and women (13). In a study conducted on student athletes, it was stated that people with higher scores in a deeper squat and in-line lunge lower motion patterns had greater ankle dorsiflexion joint range of motion (10). Another study found a positive correlation between FMS and hip extension and ankle dorsiflexion in middle- and long-distance runners and a negative correlation between FMS and ankle plantar flexion (23). According to our findings and the results of previous studies, it can be said that advanced lower extremity ROM positively affects FMS results.

The results of the study showed that soccer players' FMS test scores and CMJ, LQYBT, and ROM test scores were positively correlated. These results can be used together with FMS, ROM, YBT, and CMJ results to evaluate sports performance and injury risk. In this context, it can be thought that CMJ, LQYBT, and ROM test results together with the FMS will provide an idea to trainers, athletic performance specialists, and physiotherapists to predict injuries.

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