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The Relationship Between Functional Movement Test (FMS) Results and the Athletic Performance of Young Football Players

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Abstract

This study aims to compare the average Functional Movement Screen (FMS) score of young football players with their average jump, sprint, agility, and Y-balance test scores. This research was conducted with the voluntary participation of seventeen (17) young male athletes. Before the start of the study, the participants were informed about the content of the study. To ensure the consistency of the results of the study, they were asked not to perform any physical activities in the last 48 hours before our study. After the height and weight measurements of all participants, they were exposed to the Y-balance, vertical jump, 30 m speed test, and T-test of agility, which were all motor tests based on football. After 48 hours, in the second part of the measurement, the FMS test was applied three times, and the best score was recorded. The SPSS 25 package program was used to analyze the data. The Shapiro-Wilks normality test was used to determine whether the data were normally distributed, and Pearson correlation analysis was performed because it showed a normal distribution. The participants' data were given as minimum, maximum, average, and standard deviation. The results showed that the FMS scores of the football players were moderately related to the athletic performance test scores. Therefore, trainers and athletic performance specialists are recommended to support the relationship between FMS and physical performance capacity more.

Keywords: Football, Functional Movement Test, FMS, Athletic Performance, Injury

Genç Futbolcularda Fonksiyonel Hareket Test (FMS) Sonuçları ve Atletik Performans İlişkisi

Öz

Bu çalışmada, genç futbolcuların fonksiyonel hareket analizi (FMS) skor ortalamaları ile sıçrama, sprint, çeviklik ve y balans test sonuçları ortalamalarının karşılaştırılması amaçlanmıştır. Bu çalışma 17 genç erkek sporcunun gönüllü olarak katılımıyla gerçekleştirilmiştir. Çalışmaya başlamadan önce katılımcılara çalışmanın içeriği hakkında bilgi verilmiştir. Çalışmanın sonuçlarının tutarlılığı açısından çalışma gününden önce son 48 saat hiçbir fiziksel aktivite yapmamışlardır. Tüm katılımcıların boy ve kilo ölçümleri alındıktan sonra futbola özgü motorik testlerden Y balance, dikey sıçrama, 30 m sürat testi ve çeviklik T testi uygulanmıştır. 48 saat sonra ölçümün 2. kısmı olan FMS testi 3 tekrar uygulanarak en iyi skor kaydedilmiştir. Verilerin analizinde SPSS 25 paket programı kullanılmıştır. Verilerin normal dağılıp dağılmadığı Shapiro Wilks normallik testi ile yapılmış olup veriler normal dağılım gösterdiği için Pearson Korelasyon Analizi yapılmıştır. Katılımcıların tanımlayıcı istatistikleri minimum, maksimum, ortalama ve standart sapma olarak verilmiştir. Sonuçlar, futbolcuların FMS puanlarının atletik performans test sonuçları ile orta düzeyde ilişkili olduğunu göstermektedir. Bu nedenle atletik performans uzmanlara ve antrenörlere FMS ile fiziksel performans kapasitesi arasındaki ilişkiyi güçlendirmeleri önerilebilir.

Anahtar Kelimeler: Futbol, Fonksiyonel Hareket Testi, FMS, Atletik Performans, Yaralanma

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Introduction

Football involves a number of one-sided skills that contribute to musculoskeletal asymmetries and injuries among players. The incidence of football-related injuries varies from 7.4 to 47.5 injuries per 1000 hours of play, with this variability attributed to methodological differences such as injury type, subject training level, age, gender, and variations in research design (Fousekis et al., 2012; Fousekis et al., 2010; Hawkins et al., 2001; Woods et al., 2004). Approximately 20% of game injuries and 40% of practice injuries are classified as non-contact injuries (Hootman et al., 2007). Currently, sports medicine specialists are emphasizing the improvement of movement patterns rather than focusing exclusively on the rehabilitation of specific joints as a strategy to reduce the risk of injury (Kiesel and Voight, 2007; Parchmann et al., 2011; Bennett et al., 2022).

The use of athletic performance testing is widespread in assessing an athlete's current performance, measuring the effectiveness of training, and establishing sport-specific norms. Accurate testing is critical for predicting potential changes in athletic performance due to training and for identifying outstanding athletes, which is of great importance to strength and conditioning practitioners (Parchmann et al., 2011). Poor motor skill or reflex inhibition causes secondary mechanisms to replace primary mechanisms, resulting in injury. These weaknesses can be identified through clinical examination (Beck and Wildermuth, 1985).

Cook designed the Functional Movement Test (FMS) in 2006 to identify movement deficits and body asymmetry (Cook et al., 2006). Predicting an athlete's risk of injury through the FMS test provides coaches with preliminary information to plan individualized training (Chang et al., 2020). The movement quality assessment process includes 7 different movement patterns, including the assessment of basic movement patterns that support athletic performance, such as sprinting, jumping, and changing direction. Adequate joint mobility, joint stability, neuromuscular control, muscle flexibility, and coordination are required to perform these movements competently. Therefore, researchers have suggested that risk factors for noncontact injuries are modifiable when defined by movement patterns, right-left asymmetry, or balance abnormalities (Bennett et al., 2022).

The FMS, Y-Balance Test, and Dynamic Balance Test are some of the screening tools that are used clinically to evaluate the risk of injury based on abnormal movement patterns and asymmetry. These tests can also be used as clinical tests to predict the risk of sports injuries, since poor physical fitness, inappropriate movement patterns, and inadequate sensorimotor control are important factors in sports injuries. The FMS is a commonly used test to identify movement deficits and body asymmetry and can assess general musculoskeletal conditions to predict injury risk (Chang et al., 2020).

The aim of this study was to investigate the relationship between FMS results and jump, sprint, agility, and Y-balance test performance in young football players, assuming that the optimal FMS score is higher than 14 and that functional movement quality is strongly related to athletic performance.

Method

Research Group: Seventeen (17) young male football players living in XXX Province and playing on the Higher Education Student Loans and Dormitories Institution (KYK) team participated in this study. Before the start of the study, the participants were informed about the content of the research. For the consistency of the study results, they were told not to do any physical activity for 72 hours before the study day and to come well rested. The height and weight of all participants were measured in the laboratory of the Faculty of Sports Science of XXX University at 15:00 in the afternoon, and vertical jump, agility, sprint, and Y-balance tests, which are branch-specific motor tests, were measured. After 72 hours, the second part of the measurement, the Functional Movement Test (FMS), was performed, recording the best score with 3 repetitions of each movement. In addition, the FMS measurements were performed by a licensed expert.

Data Collection Tools

Height/Weight: Height is measured in cm on a height scale of 0.001 m accuracy, feet with heels together, head upright, and eyes looking forward. Weight was measured using a digital scale with a sensivity of 100 grams. The person wore shorts, a T-shirt, and gym socks, without shoes. Care was taken to ensure that the person being weighed on the scale was not moving and was standing upright without any support (Akın et al., 2004).

Measurement Methods and Scoring Criteria for the Functional Movement Test: The FMS incorporates seven movement patterns to provide a thorough evaluation of functional movement. It assesses overall functional mobility. These seven tests include the deep squat, the hurdle step, the bench lunge, shoulder mobility, the active straight leg raise, the push-up, and rotational stability. In addition, three clearance tests that correspond to specific FMS assessments are conducted to check for pain during internal rotation and flexion of the shoulder, as well as at the end of the range of motion of spinal flexion and extension (Minick et al., 2010). The assessment requires demonstration of the ability to proficiently perform seven basic movement patterns using muscle strength, flexibility, range of motion, coordination, balance, and proprioception. Each of these movement patterns is scored on a scale from zero to three (0-3), with a score of three indicating a normal level of performance. Scores for the seven patterns are combined into a composite score. An ideal FMS score falls within the range of 14.0 and is used as a benchmark for the assessment of the risk of sports injuries (Zang et al., 2022).

Implemented Motoric Tests

Vertical Jump Test Protocol: After explanining the vertical jump (CMJ) test protocol to the athletes, the test was performed on a jump mat (SmartSpeed; Fusion Sport, Brisbane, Australia). During the CMJ jump test, athletes were instructed to keep their hands on their hips, their trunks upright, and to jump explosively immediately after a squat-down. The athletes performed 2 jumps with a rest period of 30 seconds between each attempt, and the best values were recorded in centimeters (Yamauchi and Koyama, 2022).

Agility T-test: Subjects trained for 5 minutes before participating in the test. They used a warm-up period that lasted for 5 minutes. Following this, each player was permitted to attempt the test once with low intensity running in order to familiarize themselves with the test. The participant commenced the test from a position of advantage, positioned behind a cone marking the start and finish lines. Subsequently, the subject ran forward in a straight line, touching the cone 10 m away, with the head and body facing forward, 5 m with side sliding steps. He ran towards the right at maximum speed and touched the sign, again with sliding steps for 10 m. He then proceeded to run to the left, 5 m from the center point of the test. He touched the sign on his left, 5 m from the center. Following his leftward movement, the player proceeded 5 m to the center point of the test on the right side. He then took 10 m-steps to a new mark and, with his back turned to the finishing point, accelerated backwards at maximum speed until he passed through the photocell to conclude the test. Each player’s trial lasted 5 minutes. It was conducted twice, with a rest interval, and the best test value was evaluated. A five-minute rest interval was observed between trials to ensure complete rest. The three trials with the highest exertion levels were selected for analysis (Arı et al., 2020).

Sprint Protocol (30 m SP): Photocells were installed at the beginning, 30th meter and end of the 30-meter track. Participants were instructed to wait in a standing starting position 50 cm behind the starting line and to commence sprinting upon command when they were ready. Athletes were permitted two attempts, and their best scores at the conclusion of the trials were recorded as the test score (Seyhan, 2019, Özbar et al., 2020). The athletes' 30 m speed performance was recorded using the Newtest (Oulu, Finland), with the best of two maximum speed attempts conducted with three-minute rest intervals (Köklü et al., 2009).

Y-Balance Test: The YBT is a rehabilitative tool that was first presented by Gray (1995) as a clinical and research instrument. It comprises a series of single-limb reaches in which the nonstance limb is used to reach a particular point along one of eight predetermined lines on the floor (Gray, 1995; Gribble, 2003). The lines, which are spaced 45 degrees apart, create a grid that radiates from a central point. Depending on the position of the stance arm, the reaching orientations are indicated as anterior, anteromedial, anterolateral, medial, lateral, posterior, posteromedial, and posterolateral. The objective is for the individual to position the stance arm in the center of the test material, establish a stable base of support there, and maintain that position for the maximum reach distance in one of the designated directions. The participant extends their limb along each reach line as far as they can while standing on one limb. These specifications should be followed when using YBT for research, rehabilitation, and injury evaluation. A greater distance reached indicates stronger dynamic postural control. The reach distance values are utilized as an indication of dynamic postural control. To gauge deficiencies or advancements in dynamic postural control, these evaluations can be performed on limbs that are injured and those that are not, as well as before and after an intervention. According to existing research, the YBT can offer objective measures to differentiate between deficits and improvements in dynamic postural control caused by lower extremity injury and induced fatigue, provided that the participant receives the proper instruction and application and that reaching distances are normalized (Gribble et al., 2012).

In this study, participants completed six rounds of repeated warm-ups in each direction. The exams were then administered three times, with the highest score being assessed. The difference between the two sides was calculated using the procedure outlined below to create a composite score.

(Anterior + Posteromedial + Posterolateral) x 100 (3 x Lower extremity length)

The minimum lower extremity length required to compute the composite score is the Spina iliaca anterior. This was determined by measuring the distance between the superior and medial malleolus using a stiff tape measure.

Data Analysis: The statistical analysis was conducted using the SPSS 20.00 statistical program. The Pearson correlation test was employed to evaluate the relationship between performance variables, with a significance level of $p<0.05$. Additionally, the arithmetic means and standard deviations of the obtained data were calculated.

Results

A total of seventeen (17) athletes' data were utilized in this study, which was conducted to compare the Functional Movement Test (FMS) results in football players with jumping, sprint, agility, and Y-balance test performances. The SPSS 25 package program was employed to analyze the data. The Shapiro-Wilks normality test was used to determine whether the data were normally distributed, and the Pearson correlation test was applied since the data exhibited a normal distribution. Table 1 presents the descriptive statistics of the participants.

Table 1: The Descriptive Statistics of the Participants

	N	X̄	S
Height	16	176,56	4,77
Weight	16	71,12	6,55
Age	16	21,47	1,54

Table 2: The Averages of the Athletes' Performance Tests

	N	X̄	S
Vertical Jump	16	36,12	5,28
Post Medial Right	16	89,12	5,95
Post Lateral Right	16	85,56	6,33
Anterior Right	16	66,93	6,2
Post Lateral Left	16	85	8,59
Post Lateral Left	16	89,12	5,51
Anterior Right	16	64,81	5,77
Sprint	16	6,43	8,95
T_test	16	11,66	0,74

Table 3: The FMS Movement Patterns and the Total FMS Score Averages of the Athletes

	N	X̄	S
Deep Squat	16	2,05	0,8
Hurdle Step	16	1,52	0,51
In Line Lunge	16	1,64	0,70
Shoulder Mobility	16	2,52	0,62
Active Straight Leg Raise	16	1,82	0,72
Push-up	16	1,17	0,52
Rotational Stability	16	1,58	0,50
Total Score	16	12,35	2,78

The Table 3 presents the correlation between the vertical jump, 30-meter sprint, agility, and the Y-balance performance tests conducted on the participants and the FMS test.

Table 4: The Relationship Between Performance Tests and FMS Test applied to the Participants.

		DS	HS	ILL	SM	ASLR	Push-up	RS	Total Score
Vertical Jump	**r**	**0,48**	0,397	0,469	0,122	0,227	-0,006	0,323	0,488
	p	**0,06***	0,128	0,067	0,653	0,398	0,981	0,223	0,055
Post Medial Right	**r**	0,418	**0,562**	0,101	0,257	0,449	0,164	-0,042	0,44
	p	0,107	**0,023***	0,71	0,337	0,081	0,544	0,877	0,088
Post Lateral R.	**r**	**0,602**	**0,754**	0,359	0,182	0,306	-0,046	0,042	**0,52**
	p	**0,014***	**0,001****	0,171	0,501	0,25	0,865	0,877	**0,039***
Anterior Right	**r**	0,342	0,205	0,171	-0,166	0,068	-0,245	-0,196	0,11
	p	0,195	0,445	0,528	0,539	0,801	0,361	0,466	0,686
Post Medial L.	**r**	0,058	0,426	0,029	-0,301	-0,054	0,37	-0,113	0,096
	p	0,831	0,1	0,914	0,257	0,842	0,158	0,678	0,722
Post Lateral L.	**r**	0,282	0,219	0,115	0,262	0,471	-0,046	0,126	0,339
	p	0,291	0,414	0,67	0,327	0,066	0,865	0,641	0,199
Anterior Right	**r**	0,031	0,151	0,165	-0,421	-0,004	0,006	0,211	0,008
	p	0,911	0,576	0,543	0,104	0,988	0,981	0,432	0,978
Sprint	**r**	**-0,553**	-0,454	**-0,538**	-0,356	-0,109	0,333	-0,423	**-0,514**
	p	**0,026***	0,078	**0,032***	0,176	0,687	0,208	0,103	**0,042***
T_test	**r**	-0,454	**-0,534**	-0,175	-0,35	**-0,534**	-0,005	0,154	-0,444
	p	0,077	**0,033***	0,516	0,184	**0,033***	0,985	0,568	0,085

*:P<0,05; **:p<0,01 Active Straight Leg Raise: ASLR, Rotational Stability: RS, Shoulder Mobility: SM, In Line Lunge: ILL, Hurdle Step:HS, Deep Squat: DS

Following the implementation of the analytical procedures employed to compare the relationship between the performance tests applied to the participants and the FMS values, a statistically significant negative correlation was identified between the FMS total score and sprint performance (r =-0.524, p = 0.042). Conversely, a moderately positive correlation was observed between post-lateral right performance (r=0.052, p=0.039). From the FMS measurements, a moderate positive correlation was observed between the obstacle step score averages and the post-medial right (r=0.562, p=0.023), while a high level positive correlation was detected with the post lateral right (r=0.754, p=0.001). A similar relationship was seen between the obstacle step average score and agility performance (r=-0.534, p=0.033). From the FMS tests, a moderate relationship was determined between the deep squat movement pattern and vertical jump, post lateral right, and sprint performance (r=0.48, p=0.06; r=0.602, p=0.014; and r=-0553, p=0.026, respectively). A moderately negative relationship was identified between the sequential lunge movement pattern and sprint performance (r=-0.538, p = 0.032). Similarly, a moderate negative relationship was observed between the active straight leg lift movement pattern and agility (r =-0.534, p = 0.033).

Discussion

The hypothesis was confirmed by the results of this study, which demonstrated that there are relationships between preseason Functional Movement Test (FMS) movement screening and athletic performance measures in youth football players. After comparing FMS test results with jump, sprint, agility, and Y-balance test performances in football players, a statistically significant negative relationship was detected between FMS total score and agility performance (r=-0.547*, p = 0.023). A statistically important relationship was identified between the high stepping score averages derived from FMS measurements and the Y-balance (right) measurement averages (r = 0.671, p = 0.004). Similarly, a statistically significant relationship was observed between active straight leg lifting and Y-balance (right) and agility performances (r = 0.498, p = 0.05 and r =-0.538, p = 0.032, respectively). Both the Sequential lunge and Obstacle Step tests reflect whole-body coordination and integration ability in horizontal orientation (Okada et al., 2011). Moreover, the Obstacle Step test assesses knee and hip flexion, as well as single-leg postural control. Consequently, these tests are of significant importance in the context of sprint and agility performance. In this study, a moderately positive correlation was observed between the obstacle step test score averages derived from FMS measurements and post-medial right (r = 0.562, p = 0.023), while a high level positive correlation was detected with post-lateral right (r = 0.754, p = 0.001). In his article, Bennett identified significant but low correlations between YBT performance, another test used to predict disability, and physical performance variables (r: 0.21~0.36) (Bennet et al., 2022). These results indicated a potential relationship between FMS test total scores and performance measurements. Agility performance is of paramount importance in football players. A lack of agility performance may increase the risk of injury in football players. One of the most significant findings of this study is the identification of a negative correlation between the FMS test total score and agility performance. A study examining the relationship between athletic performance and FMS score reported similar results to this study (Zhang et al., 2022). In his study on elite football players in 2019, Lee found a statistically significant negative relationship between the agility performance of football players and the FMS test total scores (p = 0.039) (Lee et al., 2022). The findings of this study are like those of our study. In their study with young athletes at risk of injury in 2020, Chang et al. compared FMS test scores with balance and vertical jump performance. The results indicated a statistically significant relationship between balance performance and FMS trunk stability, while no significant relationship was found with jumping performance. The results of this study demonstrate that deep squat and hurdle step measurement values, which are FMS test patterns that measure hip mobility, are related to Y-balance test results. In another study, a negative relationship was found between the agility T test and active straight leg lifting from FMS measurements at the level of p <0.05 (Şahin et al., 2018). In our study, a statistically significant relationship was found between the agility T test and active straight leg lifting from FMS measurements at the level of p = 0.032. This relationship may result in enhanced agility performance in athletes with improved hip mobility. However, although movement quality is important in relation to a person's physical performance capacity, it is unlikely that there will be a strong relationship between FMS scores and standardized physical performance measures. Consequently, if movement quality plays a role in physical performance capacity, this effect would account for only a small share of the performance components.

Conclusion and Recommendations

The research yielded moderately statistically significant findings between balance and flexibility skills, sprint performance, and the Functional Movement Test (FMS) total score. Additionally, the results indicated a moderate relationship between hip mobility and agility, and sprint performance. These findings are significant in predicting the risk of injury among athletes. However, it is important to note that FMS is a test that aims to indicate the risk of injury rather than describing physical performance. Consequently, this study provides evidence that FMS is not designed to predict performance but only to identify underlying movement limitations that are hypothesized to cause disability.

The limitations of this study are that it was conducted on young football players. Therefore, it may not be correct to generalize the study results. It is important for researchers to plan their studies in different groups to determine the relationship between disability and performance in order to better understand the subject. Concurrently, it has been asserted in certain studies that when evaluating injury risk, researchers should consider not only the scores on screening tools such as FMS and YBT, but also the athlete's past injuries. Rather than presuming that an athlete has a higher risk of injury due to poor performance on these tests, evaluating past injury history in conjunction with performance on these tests and subsequent injury risk will permit a more accurate prediction. It is postulated that an individual engaged in training in accordance with this information will be a more reliable means of optimizing the athlete's performance. Consequently, it is recommended that practitioners enhance the relationship between FMS and physical performance capacity.

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