

Research Article / Araştırma Makalesi

## Effect of competition level on functional movement screening scores in soccer players: a retrospective study

### *Futbolcularda yarışma seviyesinin fonksiyonel hareket taraması skorlarına etkisi: retrospektif bir çalışma*

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#### ABSTRACT

**Objective:** The purpose of this study is to examine and compare the scores of the functional movement screen (FMS) of professional male soccer players in different leagues.

**Materials and Methods:** Previously collected data of 64 athletes who were competing in three different soccer leagues, using the FMS test battery procedure were analyzed. Asymmetry and dysfunction rates, total FMS scores, scores of FMS subgroups and scores of each test were compared.

**Results:** There was no statistically significant difference between the FMS scores of soccer players who were competing in different leagues ( $p>0.05$ ). In addition, the difference between motor control, mobility and reflex core stabilization subgroup scores were not statistically significant ( $p>0.05$ ). When the tests were compared individually, only the rotatory stability test score was found to be statistically significantly different ( $p<0.05$ ).

**Conclusions:** The rate of asymmetry and dysfunction is high in professional soccer players along with the scores of FMS tests were not significantly different according to the levels of players playing in the professional league, except for the rotation stability test. Players in the top professional league have higher scores in the rotation stability test and less dysfunction. Therefore, postural control is affected by the professional league level in soccer.

**Keywords:** Football, injuries, musculoskeletal system

#### ÖZ

**Amaç:** Bu çalışmanın amacı farklı liglerde oynayan profesyonel erkek futbolcuların fonksiyonel hareket taraması (FMS) skorlarını incelemek ve karşılaştırmaktır.

**Gereç ve Yöntemler:** FMS test bataryası prosedürüne göre üç farklı futbol liginde yarışan 64 sporcunun daha önce toplanan verileri analiz edildi. Asimetri ve disfonksiyon oranları, toplam FMS skorları, FMS alt gruplarının skorları ve her testin skorları karşılaştırıldı.

**Bulgular:** Farklı liglerde yarışan futbolcuların FMS skorları arasında istatistiksel olarak anlamlı bir fark saptanmadı ( $p>0.05$ ). Ayrıca motor kontrol, mobilite ve refleks kor stabilizasyonu alt grup skorları arasındaki fark istatistiksel olarak anlamlı değildi ( $p>0.05$ ). Testler ayrı ayrı karşılaştırıldığında, sadece rotasyon stabilite test puanı istatistiksel olarak anlamlı düzeyde farklı bulundu ( $p<0.05$ ).

**Sonuçlar:** Profesyonel futbolcularda asimetri ve disfonksiyon oranı yüksek olup rotasyon stabilite testi dışındaki FMS testlerinin skoru profesyonel lig düzeyine göre farklı değildir. Bununla birlikte üst profesyonel ligdeki futbolcuların rotasyon stabilite testinden aldıkları skor daha daha yüksek ve disfonksiyon oranı daha düşüktür. Dolayısıyla postüral kontrol futbolda profesyonel lig düzeyinden etkilenmektedir.

**Anahtar Sözcükler:** Futbol, yaralanmalar, kas iskelet sistemi

#### INTRODUCTION

Soccer is a sport that involves complex movement patterns such as changing directions, bouncing, shearing, kicking the ball (1). These complex movements are affected by many factors such as neuromuscular control, stability, force, and movement width (2). These factors are very important in determining optimal performance without musculoskeletal injury (3). There are multiple evaluation methods for these factors. However, concepts that evaluate these

movement components together and the body as a whole give better and applicable results (4,5). One of the tools developed is the functional movement screen (FMS) which became popular in recent years (6-9).

FMS can be used as a tool for predicting injury and performance. FMS has been reported to have limitations in estimating individual performance (6). However, some studies claim that some of the performance changes in young soc-

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cer players can be determined with the FMS test battery (7,8). On the other hand, FMS was reported to be effective in predicting musculoskeletal injuries in team sports (6). In particular, it has been shown that there is strong correlation between the score of each movement pattern and the injuries (9).

Another focus of the research are the factors that determine or affect the FMS scores. Age and FMS results were found to be related. It was reported that the FMS threshold score was reached towards the end of the adolescent period, and the score increased during this period (10). Gender is another variable that determines FMS scores. Women's FMS scores are lower than men's (11). Another factor affects FMS scores: athletes with a history of injury score lower in the FMS (12). Playing positions of athletes also affects FMS scores (13).

It is known that many factors such as balance, muscle strength, and technical skills in soccer differ according to the level of the league (14,15). Thus, it can be expected that the FMS scores of players will also be affected by the level of the league they are playing in. There is evidence that FMS scores in female soccer players are affected by the level of competition (16), but the rates of functional deficit and asymmetry in different category professional male soccer players are not known yet. Are there similar deficits or asymmetries in all professional categories for male soccer players? Is there a relationship between competition level and FMS scores in male soccer players? Is playing in the professional league a determinant for the FMS score for male soccer players? In the light of these questions, we hypothesized that FMS scores will be affected by the level of competition, that is to say, FMS scores of professional soccer players in the upper leagues will be higher. This study aimed to examine and compare the FMS scores of professional male soccer players in different leagues.

## **MATERIALS and METHODS**

### **Study Design**

The study utilized a retrospective design to determine the relationship between FMS score and competition level. The dependent variables of interest included composite, subgroup and individual scores of FMS tests. The study was approved by the Non-Drug and Medical Device Research Ethics Committee of Necmettin Erbakan University Faculty of Medicine (meeting number 93 held on 13.09.2019, decision number 2019/2065). The study was conducted according to the Declaration of Helsinki. Informed consent was requested from the participants or their relatives, when applies.

### **Functional Movement Screen**

FMS consists of a series of tests that are short-term, easy to apply and do not require complex measuring equipment. With FMS tests, functional movement deficits and asymmetries related to neuromuscular control, reflex core stabilization and range of motion can be demonstrated (17). The test battery consists of seven movement patterns. These seven movement patterns are observed and scored between zero and three (18,19). Athletes with an FMS total score of  $\leq 14$  are more likely to experience a musculoskeletal injury than those with a higher score (20,21). Threshold points considered are  $\leq 6$  for motor control,  $\leq 4$  for mobility, and for reflex core stabilization (22,23). The FMS test battery is highly reliable for the same and different testers, but there are doubts about its validity (24).

### **Functional Movement Screen Test Battery Procedure**

Physical data of the soccer players were recorded before the test and the inclusion criteria of test battery were queried. The athletes were provided with the appropriate clothing (shorts, t-shirts and rubber shoes). All assessments were made after all the participants took a day off training. Soccer players were evaluated according to the FMS test protocol and data were recorded. The test protocol was performed using the official FMS kit. The FMS expert explained each test and the participants performed the tests three times. Best scores of participants from each test were recorded. For the tests performed bilaterally, the lowest score for the right and left sides was accepted as the test score. The total score was obtained by collecting the score of seven tests. Deep squat, hurdle step and inline lunge test scores were added to calculate the motor control score; shoulder mobility and active straight leg raise test scores were added to calculate the mobility score, and trunk stability pushup and rotatory stability test scores were added to calculate the reflex stabilization score (17-21).

Exclusion criteria of the test battery were as follows: having any musculoskeletal injury at the time of testing, having conducted high-intensity training within 24 hours prior to the application of the test protocol, verbally reported fatigue, having consumed alcohol within 48 hours prior to the application of the test protocol, having taken anti-inflammatory, muscle relaxant or pain medication within 48 hours prior to the application of the test protocol, and having consumed a stimulant substance like caffeine within 12 hours prior to the application of the test protocol. In addition, data of soccer players who received 0 from any tests were not used in the analysis of the data (13).

### **Data Preparation**

The data were collected in Antalya in December 2018. All soccer players were evaluated by a sports physician and a physiotherapist. The data were analyzed in September

2019. A total of 64 professional male soccer players were included in the study. Twenty three of them were soccer players in Super League, 23 in the First League and 18 in the Second League. Four participants were excluded because of existing musculoskeletal injury, likewise three because they scored 0 on their FMS tests, and two because they reported fatigue.

**Analysis of Data**

All data were analyzed using SPSS statistical software (version 21, IBM Corporation, Armonk, NY). Descriptive data, statistics for each FMS test score, subcategory scores and total FMS score were calculated. The physical characteristics of the participants, rates of dysfunctions and asymmetries in the groups were used. Continuous variables were expressed as means ± standard deviation, median (minimum and maximum values), and categorical variables as percentages. Shapiro-Wilk test was used to examine the fit for normal distribution. One-way Anova test was used in the analysis of the data that met the parametric test assumptions, and the Kruskal-Wallis test was used in the analysis of the data that did not provide the parametric test assumptions. The Chi-square test was used in the analysis of percentage distributions. p<0.05 was considered significant.

**RESULTS**

Data of 64 soccer players compatible with study area criteria were analyzed. Soccer players in the Super League, First League and Second league were grouped as Super Group (SUG), First Group (FIG) and Second Group (SEG), respectively. Physical characteristics of participants are given in Table 1.

**Table 1.** Physical characteristics of the participants

Parameter	SUG	FIG	SEG	p
Age (yr)	28.7 ± 3.8	27.0 ± 4.6	20.9 ± 1.9	<0.001 <sup>a</sup>
Weight (kg)	77.2 ± 6.5	72.9 ± 5.1	73.6 ± 5.1	0.077 <sup>b</sup>
Height (cm)	180.5 ± 6.0	180.3 ± 7.1	180.6 ± 5.8	0.358 <sup>b</sup>

SUG: Super League soccer players, FIG: First League soccer players, SEG: Second League soccer players; p<sup>a</sup>: one-way Anova test, p<sup>b</sup>: Kruskal-Wallis test; \*: p<0.05

Deep squat, inline lunge and rotary stability were the most frequent (43.5%) dysfunctional patterns in the SUG. In FIG and SEG, rotatory stability (73.9%, 77.8%) was found to be the test with the most dysfunction. Rotatory stability dysfunction was seen more frequently in FIG and SEG than in SUG (p<0.05). Participants' FMS tests scores are given in Table 2.

**Table 2.** Individual FMS test scores of participants

Test	Score	All	SUG	FIG	SEG	p <sup>a</sup>
Deep squat	1	25 (39.1)	10 (43.5)	09 (39.1)	06 (33.3)	0.807
	2	39 (60.9)	13 (56.5)	14 (60.9)	12 (66.7)	
	3	-	-	-	-	
Hurdle step	1	10 (15.6)	06 (26.1)	04 (17.4)	-	0.085
	2	52 (81.3)	16 (69.6)	19 (82.6)	17 (94.4)	
	3	02 (03.1)	01 (04.3)	-	01 (05.6)	
Inline lunge	1	19 (29.7)	10 (43.5)	05 (21.7)	04 (22.7)	0.332
	2	44 (68.7)	12 (52.2)	18 (78.3)	14 (77.8)	
	3	01 (01.6)	01 (04.3)	-	-	
Shoulder mobility	1	26 (40.6)	09 (39.1)	08 (34.8)	09 (50.0)	0.399
	2	26 (40.6)	06 (26.1)	13 (56.5)	07 (38.9)	
	3	12 (18.8)	08 (34.8)	02 (08.7)	02 (11.1)	
Active straight leg raise	1	11 (17.2)	06 (26.1)	03 (13.0)	02 (11.1)	0.761
	2	41 (64.1)	12 (52.2)	15 (65.2)	14 (77.8)	
	3	12 (18.7)	05 (21.7)	05 (21.7)	02 (11.1)	
Trunk stability pushup	1	16 (25.0)	07 (30.4)	02 (08.7)	07 (38.9)	0.194
	2	34 (53.1)	08 (34.8)	17 (73.9)	09 (50.0)	
	3	14 (21.9)	08 (34.8)	04 (17.4)	02 (11.1)	
Rotatory stability	1	41 (64.1)	10 (43.5)	17 (73.9)	14 (77.8)	0.037*
	2	23 (35.9)	13 (56.5)	06 (26.1)	04 (22.2)	
	3	-	-	-	-	

Figures as n (%); FMS: Functional movement screen, SUG: Super League soccer players, FIG: First League soccer players, SEG: Second League soccer players; p<sup>a</sup>: Chi-square test; \*: p<0.05

The total FMS score was found to be 12.3 ± 2.3 when data of all players were evaluated together. Movement, mobility and reflex core stabilization scores were respectively 5.20 ± 0.97, 3.79 ± 1.11 and 3.32 ± 0.99. The total FMS, motor control, mobility and reflex core stabilization scores of groups were not different (p>0.05). When tests were compared indi-

vidually, only the rotatory stability test score was found to be different (p<0.05) (Table 3).

Among all participants, the rate of those who were below the mobility score threshold was 45.0%, the rate of those who were below the reflex core stability score was 61.0%,

re threshold was 51.6%. Proportion of players with mobility and reflex core stability score below the threshold was higher in the FIG (61.1%, 72.2%), the ratio of soccer players under the motor control score threshold score was higher in SUG (65.2%). The distribution of the total scores and the sub-scores of the groups were not different (Table 4).

The rate of players with at least one asymmetry was 76.6%, with at least one asymmetric pattern or more than a score of 95.3%. Shoulder mobility was the most common asymmetric test in all players. In the SUG, hurdle step (26.1%), inline lunge (26.1%) and shoulder mobility (26.0%) were observed to be the most frequent asymmetric tests. The most common asymmetrical test was the shoulder mobility test in the FIG and SEG (34.8%, 37.5%). The distribution of

the asymmetric tests of the groups were not different ( $p > 0.05$ , Figure 1).

**Table 3.** Comparison of FMS test scores of groups

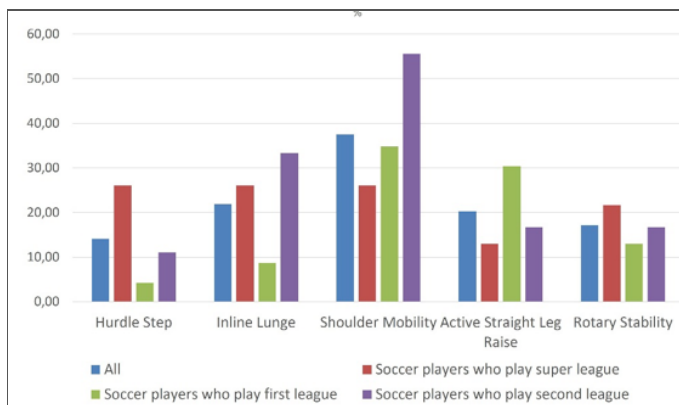
Test	SUG	FIG	SEG	p <sup>a</sup>
Deep squat	2 (1-2)	2 (1-2)	2 (1-2)	0.80
Hurdle step	2 (1-3)	2 (1-2)	2 (2-3)	0.08
Inline lunge	2 (1-3)	2 (1-2)	2 (1-2)	0.33
Motor control	5 (3-7)	6 (3-6)	6 (4-7)	0.21
Shoulder mobility	2 (1-3)	2 (1-3)	2 (1-3)	0.39
Active straight leg raise	2 (1-3)	2 (1-3)	2 (1-3)	0.76
Mobility	4 (2-6)	4 (2-6)	3 (3-6)	0.61
Trunk stability pushup	2 (1-3)	2 (1-3)	2 (1-3)	0.19
Rotatory stability	2 (1-2)	1 (1-2)	1 (1-2)	0.03*
Reflex core stabilization	4 (2-5)	3 (2-5)	3 (2-5)	0.12
Total score	12 (7-17)	13 (8-16)	12 (9-15)	0.70

Figures as median (min-max); FMS: Functional movement screen, SUG: Super League soccer players, FIG: First League soccer players, SEG: Second League soccer players; p<sup>a</sup>: Kruskal-Wallis test, \*:  $p < 0.05$

**Table 4.** Total and subgroup FMS scores of participants

Test	Test score	All	SUG	FIG	SEG	p <sup>a</sup>
Motor control	3	03 (04.7)	02 (08.7)	01 (04.3)	-	0.217
	4	14 (21.9)	06 (26.1)	05 (21.7)	03 (16.7)	
	5	16 (25.0)	07 (30.4)	05 (21.7)	04 (22.2)	
	6	29 (45.3)	07 (30.4)	12 (52.2)	10 (55.6)	
	7	02 (03.1)	01 (04.3)	-	01 (05.6)	
Mobility	2	06 (09.4)	03 (13.0)	03 (13.0)	-	0.618
	3	23 (35.9)	08 (34.8)	04 (17.4)	11 (61.1)	
	4	19 (29.7)	04 (17.4)	11 (47.8)	04 (22.2)	
	5	10 (15.6)	04 (17.4)	04 (17.4)	02 (11.1)	
Reflex core stabilization	6	06 (09.4)	04 (17.4)	01 (04.3)	01 (05.6)	0.124
	2	14 (21.9)	05 (21.7)	02 (08.7)	07 (38.9)	
	3	25 (39.1)	06 (26.1)	13 (56.5)	06 (33.3)	
	4	15 (23.4)	05 (21.7)	06 (26.1)	04 (22.2)	
Total score	5	10 (15.6)	07 (30.4)	02 (08.7)	01 (05.6)	0.709
	≤14	52 (81.5)	16 (69.5)	21 (91.1)	15 (83.3)	
	>14	12 (18.5)	07 (30.5)	03 (08.9)	03 (16.7)	

Figure as n (%); FMS: Functional movement screen, SUG: Soccer players who play super league, FG: Soccer players who play first league, SEG: Soccer players who play second league, p<sup>a</sup>: Chi-square test



**Figure 1.** Distribution (%) of the asymmetric tests of the groups

## DISCUSSION

Total FMS scores, and sub-group and individual test scores, except for the rotatory stability score, were not affected by the professional league level in professional soccer players. Rotatory stability dysfunction was seen more frequently and variably in the lower professional leagues. FMS total

score and subgroup score averages were below the threshold score in all professional leagues. Therefore, it can be said that there are many dysfunctional movement patterns in soccer players. Shoulder mobility was the most common asymmetric test in all professional leagues.

While the total FMS score of 81.5% of all participants was  $\leq 14.0$ , the mean FMS total score was  $12.3 \pm 2.3$ . The total FMS score is reported to be between 15-16 among the adult elite soccer players and between 11-14 among young soccer players (10,25). Compared with data in the literature, the total FMS score was found to be low in this study, with senior male professional soccer players as subjects. The difference is important in terms of indicating the approach of athletes and professionals in countries where the study is conducted. More efforts must be done in Turkey for the prevention and correction of dysfunction or asymmetry in professional leagues. It is important to evaluate the athletes from this point of view until they reach the elite category and to perform the necessary intervention. Previous studies revealed a relationship between maturation and the FMS score (10).

It was found that the rate of at least one asymmetric pattern was 76.6%. Asymmetry rates obtained by FMS in soccer players vary. Zalai et al. specified the asymmetric pattern ratio in professional elite soccer players as 40.0% (26). In the study conducted by Marques et al. with young soccer players as participants, the asymmetric pattern ratio was reported to be 65.0% (13). Considering that the participants of this study are elite professional soccer players, the asymmetry rate is quite high. In other words, volunteers are more likely to experience musculoskeletal injuries because it has been shown that athletes with asymmetrical patterns or who score  $\geq 1$  in any FMS test are more susceptible to musculoskeletal injuries than others (9). The high asymmetrical pattern rate can be explained by the fact that asymmetries are not determined and the programs required for the correction of the determined asymmetries are not adequately covered in team or individual training. However, Sprague et al. stated that asymmetries in soccer players can be corrected through corrective exercises (27).

It has been stated that features such as physical characteristics, muscle strength, endurance, injury rate, technical and tactical skills in soccer vary according to the competition category (14). There are studies stating that even specific measurements are affected by the level of competition. Butler et al. reported that the results of dynamic balance were affected by the level of competition and that the findings improved as they reached the professional level (15). All this knowledge suggests that the level of competition can also affect FMS scores. Grygorowicz et al. (16) compared the FMS scores of female soccer players who pursue their careers at two different levels. They reported that those who were at the top level had higher scores from the rotatory stability tests, while those who were at the lower level had better scores from the deep squat, inline lunge and active straight leg raise tests. Researchers stated that scores obtained from FMS tests may have different functional reasons and that muscle flexibility is one of them (16).

To the best of our knowledge, this is the first study to investigate how competition level affects FMS scores in male professional soccer players. According to the results of this study, it was observed that no FMS data except the rotatory stability test of the soccer players playing in three different professional leagues were different. It can be thought that many factors affected the similarity between other tests except the rotatory stability test. However, the main reason may be that asymmetries and dysfunctions are equally important in all three professional league levels. Therefore, it was concluded that similar efforts were made to reveal the asymmetries in soccer players, and to make the necessary intervention in the evaluated leagues. However, the high

rate of asymmetry and dysfunction compared with the literature suggests that more efforts should be made in this regard.

The rotatory stability test was the only test that was differentiated between all tests in this study. The scores of the players in the Super League were better than others and the dysfunction rate was lower. The rotatory stability test is indicative of postural stability or reflex core stabilization. Previous studies have shown that there is relationship between competition level and postural stability in soccer players. Paillard et al. reported that national team players had better postural stability and were more successful in developing postural strategies than local players (28). Grygorowicz et al. reported that female soccer players playing in the upper league scored better in the rotatory stability test than those in the lower league (16). In other words, the results of the literature and the results of the rotatory stability test in this study revealed that postural stability was affected by the level of competition.

It has been reported that technical skills and training experience may affect the results of the rotatory stability test in a way that more skills and experience will increase the test scores (16). It can be said that the difference found in this study may originate from these reasons. In addition, one of the factors that create the difference between professional leagues may be the importance given to the works carried out to improve the postural stability of soccer players in the Super League. There are some findings in the literature that support this idea. It has been previously reported that health professionals working in elite soccer clubs believe that one of the most important tools to protect soccer players from injuries is to increase body stabilization and to concentrate their exercises on these areas (29).

It was another remarkable point that the shoulder mobility test results were the determining factor in the rate of asymmetry and dysfunction. It seems that the participants of this study and the professionals who serve them do not give enough importance to upper extremity mobility in their works. However, it has been shown that upper extremity injuries are common in male elite soccer players and the upper extremity plays an important role in biomechanical maneuvers in soccer (30,31). For this reason, paying attention to upper extremity exercises in soccer players will reduce injury rates and make a positive contribution to their performance.

This study has some limitations. The fact that descriptive data such as participants' training load, training experience, and past lower or upper league experiences were not questioned, made it difficult to interpret the results of the

study. The strength of the study is that it presented the data of elite professional soccer players.

## CONCLUSION

The results of the study revealed that the rate of asymmetry and dysfunction was high among professional soccer players. At the same time, the results indicated the need to focus on more specific exercise programs for the correction of asymmetry and dysfunction. On the other hand, the results revealed that reflex core stabilization was affected by the difference in the professional leagues. Therefore, particular attention needs to be paid to improve reflex core stabilization, especially in lower professional leagues.

### Ethics Committee Approval / Etik Komite Onayı

The approval for this study was obtained from Clinical Research Ethics Board of Necmettin Erbakan University (Approval number: 2019/2065, Date: 13.09.2019).

### Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

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### Author Contributions / Yazar Katkıları

Concept: ED,SA; Design: ED,SA; Supervision: ED,SA; Materials: ED,SA; Data Collections and Processing: ED,SA; Analysis and Interpretation: ED,SA; Literature Review: ED,SA; Writing Manuscript: ED,SA; Critical Reviews:ED,SA.

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