Research Article

Comparing Functional Movement Screen Scores and Performance between Male and Female Soccer Players

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ABSTRACT

Introduction: Soccer is the most popular sport globally for both men and women. The functional movement screen (FMS) is a 7-part standardized tool created by experts to evaluate movement quality. This research compares FMS scores and performance between male and female soccer players.

Materials and Methods: A total of 60 semi-professional soccer players (30 males and 30 females) participated in this study. All participants completed the FMS test, Y-balance test, Davies test, single hop for distance, and cross-over hop test. Between-group comparisons were performed using an independent t test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables.

Results: There were no significant differences between male and female players in deep squat, hurdle step, in-line lunge, or overall FMS score (P>0.05). However, significant differences were found in shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability (P<0.05). Men performed better in trunk stability, while women excelled in shoulder mobility and active straight leg raise. Men outperformed women in the single-hop distance and the cross-over hop. In upper extremity performance, males performed better in the Davies test and dynamic balance in the superolateral direction, with no significant differences in other upper extremity dynamic balance directions.

Conclusion: The study's findings demonstrate the necessity of gender-specific training programs to enhance performance and reduce injury risk. According to the findings, it is recommended that flexibility and mobility exercises be implemented for male soccer players and that core stability and strength training be implemented for female soccer players.

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Introduction

Soccer is widely regarded as one of the most prominent sports worldwide, attracting the largest global audience. It promotes both physical and psychosocial development and demands high levels of strength, endurance, agility, speed, flexibility, and balance [1, 2]. In addition, soccer is classified as a sport with a high incidence of injury, primarily due to the unpredictable nature of complex field situations, the intensity of play, and the inherent physical contact between players [3].

As a result, at the professional level, injury prevention and minimizing player absence during training and matches are critical. Given the significant financial investment in players' contracts and tournament participation, preventing and managing sports injuries is imperative [4]. Previous studies have emphasized the role of proper movement patterns in ensuring safe and efficient long-term physical performance in soccer players [5-7].

Optimal movement patterns and strong neuromuscular control are essential for improving performance and reducing injury risk, particularly during high-intensity actions such as landing, cutting, and rapid directional changes common in soccer [8]. Since 2004, the number of athletes engaged in competitive sports has increased significantly, with a greater focus on athlete safety. These concerns have led to extensive research in injury prevention through effective screening and rehabilitation strategies.

One widely recognized tool in this context is the functional movement screen (FMS), which aims to detect and correct dysfunctional or high-risk movement patterns that may predispose athletes to injury [9]. Introduced by Cook et al. [10], the FMS is a practical assessment tool designed to identify asymmetries and limitations in mobility and stability. Its primary goal is to detect movement dysfunctions that may elevate the risk of injury.

The screen evaluates 7 fundamental movement patterns that assess balance, mobility, and stability, reflecting key principles of proprioception and kinesthetic awareness [10]. A composite score from all seven tasks helps identify limitations in flexibility, bilateral strength asymmetries, and core stability deficiencies, factors closely related to athletic performance potential and injury risk [11]. Moreover, core muscle weakness is widely recognized as a contributor to injury, as core stability is essential for efficient force transfer between the upper and lower body. Weakness in the hip and thigh muscles can lead to instability during lower limb movements, which may result in poor movement patterns and increased injury risk. The FMS helps prevent such issues by detecting them early [12].

Several recent studies have examined the relationships among FMS scores, physical performance, and gender in soccer players. In the study by Amjad et al. (2023), the researchers examined the differences and relationships between FMS scores and physical fitness tests in semi-professional male and female soccer players. The findings revealed that male players performed significantly better than female players in the 505 change-of-direction test. However, no significant gender differences were found in total FMS scores [13]. In contrast, Martín-Moya et al. (2023) found that female footballers scored lower on the composite FMS score compared to male footballers [14].

Evaluating physical performance provides valuable insights into an athlete's physical capabilities [15] and is a fundamental component of elite soccer player development programs [16]. In this regard, Mascherini et al. demonstrated that male athletes excelled in all physical performance tests, including the horizontal jump, triple jump, and 5-m and 10-m sprints. This superior performance, especially in tests requiring higher power and speed, is likely attributed to greater muscle mass and lower body fat percentage in males [17]. Moreover, Barin et al. conducted a comparative study on the performance of male and female soccer players. The findings revealed that male athletes outperformed their female counterparts in several individual technical skills, including vertical jump height, sprint speed, agility, and dribbling power. These performance disparities were partially attributed to inherent differences in anthropometric characteristics between the sexes [18]. The data can guide coaches in talent identification, player selection, and long-term athlete development strategies [19].

Although tools such as the FMS are widely utilized, few studies have thoroughly examined individual FMS components and functional performance assessments involving both upper and lower limbs. These assessments are essential for identifying muscular imbalances, postural misalignments, and joint mobility restrictions that can influence performance and injury risk. This gap is particularly relevant given the physiological and biomechanical differences between sexes. As such, comparing FMS scores and functional performance outcomes across genders may offer valuable insights for optimizing training strategies and minimizing injury risk. Accordingly, the present study aimed to compare FMS scores and physical performance between male and female soccer players and to determine whether sex-related differences exist in specific functional performance tasks.

Materials and Methods

Study participants

This research was descriptive-comparative and employed a field-based data collection approach. The study population comprised young male and female athletes participating in the Tehran Football League, Tehran City, Iran. A total of 60 semi-professional soccer players were recruited for this study: 30 men (Mean±SD age: 19.83±1.48 years; Mean±SD weight: 72.40±3.69 kg; Mean±SD height: 176.66±5.24 cm; Mean±SD body mass index [BMI]: 20.30±1.70 kg/m²) and 30 women (Mean±SD age: 19.73±1.48 years; Mean±SD weight: 58.96±5.64 kg; Mean±SD height: 164.36±4.93 cm; Mean±SD BMI: 19.43±1.79 kg/m²). Participants were selected according to predefined inclusion and exclusion criteria. The inclusion criteria were as follows: Participants aged 18-24 years with at least 3 years of membership in a Tehran League team, no significant skeletal or muscular injuries, and no history of surgery in the past 6 months. Participants were excluded if they sustained an injury during the study, withdrew from participation, or failed to complete the research process.

The sample size, calculated using G*Power software, version 3.1 (with an effect size of 0.85, α=0.05, and power=0.8), was 60 participants.

Study procedures

Participants were recruited through visits to men's and women's soccer clubs across Tehran. All participants provided written informed consent and completed a demographic questionnaire before data collection. Functional movement quality was assessed using the FMS with a standardized FMS kit. The upper quarter Y-Balance test (UQ-YBT) evaluated dynamic upper limb balance. Upper limb performance was assessed through the Davies test, while lower limb performance was measured using the single hop for distance test and the crossover hop for distance test.

Measurement

FMS assessment protocol

The FMS is an assessment tool to evaluate an individual's fundamental movement patterns. It provides a distinct approach for identifying dysfunctions, predicting performance, and reducing injury risk. Limitations in joint mobility and stability can increase the likelihood of injury among athletes and the general population, whereas optimal movement patterns help prevent and minimize such risks. The FMS consists of 7 fundamental movement tasks that require a balance between mobility and stability. These tasks are structured to provide observable performance indicators across basic movement functions, including locomotion, manipulation, and stabilization. By placing athletes in challenging positions where appropriate stability is essential for sufficient mobility, the FMS helps expose weaknesses, asymmetries, and compensatory movement patterns [10, 20].

The FMS comprises 7 distinct movement tests: Deep squat, hurdle step, in-line lunge, shoulder mobility, active straight-leg raise, trunk stability push-up, and rotary stability. Before the assessment, participants received detailed verbal instructions and demonstrations for each movement pattern. They were allowed one practice trial to familiarize themselves with the movements. In the evaluation, participants performed each movement three times. For unilateral tests, the highest score from the three trials was recorded for each side, and the lower of the two scores was used as the final score for that movement. For bilateral tests, the best score from the three trials was recorded (Figure 1) [20].

Evaluators positioned themselves at consistent distances from the participants in anterior, posterior, and lateral views to ensure accurate observation and scoring. Movements were scored on a standardized 4-point scale ranging from 0 to 3. A score of 3 indicates that the movement was performed correctly without any compensations. A score of 2 is given if the movement was completed but with some form of compensation or deviation from the standard movement pattern. A score of 1 is assigned when the individual cannot complete the movement or cannot assume the required position. Finally, A score of 0 is given if pain is reported during any part of the movement [20].

Furthermore, FMS is a reliable assessment tool for interrater reliability (ICC=0.81; 95% CI, 0.74%, 0.8%) and intrarater reliability (ICC=0.81; 95% CI, 0.70%, 0.92%) [21].

Measurement of functional performance

Jump tests were utilized to assess functional performance. A measuring tape was used to determine the distance covered by participants in the zigzag triple jump and single-leg forward hop tests. Additionally, the length of the upper limb was measured from the C7 vertebra to the tip of the middle finger.

Figure 1. The FMS test

The Davis push-up test

The Davis push-up test was used to assess upper extremity performance, specifically evaluating muscular strength, endurance, and upper-limb stability during closed kinetic chain movements. This modified push-up test was developed by Davies and Dickoff-Hoffman in 1993 and has demonstrated high test-retest reliability [22].

In this assessment, 2 tape strips were placed on the floor, positioned 90 cm (approximately 36 inches) apart. Participants assumed a push-up position between the strips. Over a 15-s interval, they rapidly alternated hand touches to the outer edges of the tape strips in a crisscross manner. The total number of touches completed within this period was recorded as the participant's score. The test was conducted 3 times, and the final score was calculated as the average of the 3 trials [22]. Moreover, a 30-40 s rest period was provided between trials (Figure 2).

Single hop for distance test

Single-legged hop tests assess the performance of the entire lower extremity and athletes' ability to perform components of sport-specific actions such as hopping [23]. The single-hop distance test requires a 3-m long, narrow measuring tape placed on the floor. The athlete stands on their dominant leg, with the toe tip precisely at the tape's starting point. The test involves performing a forward hop to cover the maximum possible distance, landing on the same leg, and maintaining balance for at least 2 s. Participants may use their arms for balance if necessary. The participant performed 3 consecutive single-leg hops using the dominant leg, with the maximum distance achieved recorded as the test result [24, 25]. A rest period of 30-40 s was provided between trials to minimize fatigue. The single-hop distance demonstrated excellent reliability, with an ICC of 0.92 (Figure 3) [26].

Figure 2. The Davis push-up test

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Cross-over hop for distance test

In this test, the participant stands on the test leg and performs a hopping sequence in a cross pattern, covering a 15-cm wide line 3 times. The maximum distance achieved across three trials is recorded as the test outcome. A rest interval of 30-40 s is provided between trials to mitigate fatigue and ensure optimal performance.

The total distance covered during the hopping sequence is then recorded. If the participant places the opposite foot on the ground or fails to hop across the entire width of the tape, the trial is considered invalid and must be repeated [24, 25]. The cross-over hop for distance showed good reliability, with an ICC of 0.84 (Figure 4) [26].

UQ-YBT

The UQ-YBT is a clinical assessment tool used to evaluate upper-limb performance in 3 directions: Medial, superolateral, and inferolateral, each at 135° to the others. This test assesses strength, stability, and mobility of the upper extremity and is considered a reliable and valid instrument, with reliability coefficients ranging from 80% to 99% [27]. During the test administration, participants shifted their body weight onto the testing arm while maintaining balance on one hand without compromising stability. Simultaneously, they reached as far as possible with the non-testing arm in the 3 designated directions. The feet were positioned 30 cm apart, and each direction was tested thrice. The average of the 3 trials in each di-

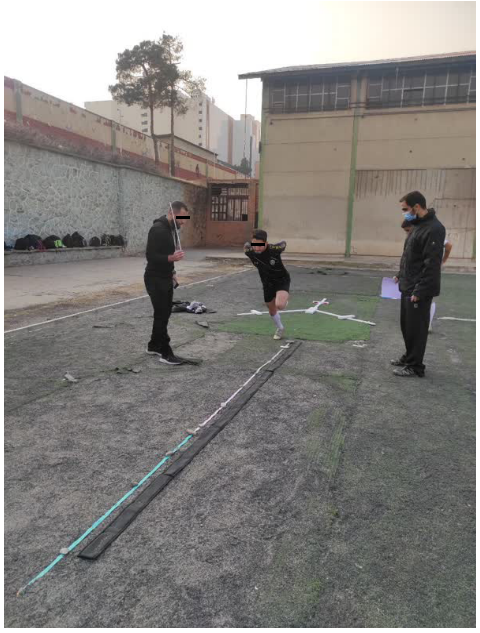

Figure 3. Single hop for distance test

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Figure 4. Cross-over hop for distance

rection was calculated for analysis, with a 2-minute rest interval provided between attempts to reduce fatigue. Given the significant correlation between reach distance and arm length, dynamic balance scores were normalized by dividing the average reach distance in each direction by the participant's arm length, then multiplying the result by 100 to express reach distance as a percentage of arm length. The composite score was calculated as the sum of the 3 normalized directional scores (Figure 5) [27, 28].

Ethical considerations

All participants were assured that their personal information would remain confidential and accessible only to the research team. They were informed of their right to withdraw from the study at any stage without any repercussions. All procedures were carried out in accordance with the ethical standards established by the Sport Sciences Research Institute of Iran. Before the study began and data collection commenced, participants were provided with detailed information about the study's objectives and procedures. Written informed consent was obtained from all participants, indicating their voluntary participation. Transparency in the research process, the confidentiality of personal data, and the absence of financial obligations for participants were emphasized as fundamental ethical principles maintained throughout the study.

Statistical analysis

Following data collection, the study participants' dataset was analyzed using descriptive and inferential statistics with SPSS software, version 22. The normality of the data distribution was assessed using the Shapiro-

Figure 5. Upper quarter Y-balance test

Wilk test. The independent samples t test was employed for normally distributed variables in between-group comparisons. At the same time, the Mann-Whitney U test was used for variables with non-normal distributions. A significance level of 0.05 (α≤0.05) was set for all statistical tests.

Results

Table 1 presents the demographic details of the participants in the study, including age, height, weight, body mass index, sports experience, weekly physical activity, and dominant upper limb, along with the mean and standard deviation for each variable and the results of an independent t-test. Since the data did not meet the assumption of normality, the Mann-Whitney U test was used to compare the two groups. The results indicated that all variables, except age and sports experience, showed statistically significant differences between the groups.

The Shapiro-Wilk test was used to assess the normality of the data distribution for both FMS scores and performance (Table 2).

According to the results, the FMS subtests and the single-hop for distance test data were not normally distributed (P<0.05). However, the distributions of the total FMS score, the Cross-over hop for distance test, the Davies test, and the UQ-YBT tests in different directions were normal (P>0.05). Accordingly, the Mann-Whitney U test was used to compare groups for non-normally distributed variables. At the same time, an independent t-test was applied to normally distributed variables at the 95% significance level.

The results of the between-group comparisons indicated no statistically significant differences between male and female football players in the deep squat (P=0.108), hurdle step (P=0.076), in-line lunge (P=0.688), and overall FMS score (P=0.089), as all P exceeded the 0.05 threshold. Conversely, significant sex-based differences were observed in Shoulder Mobility (P=0.001), active straight leg raise (P=0.013), trunk stability push-up (P=0.001), and rotary stability (P=0.048). In particular, male football players performed better in the trunk stability push-up and rotary stability test. In contrast, female football players outperformed their male counterparts in the shoulder mobility and straight leg raise tests. Comparing lower extremity performance between male and female soccer players revealed significant differences in the Single hop for distance (P=0.001) and the cross-over hop for distance (P=0.001).

Analysis of the mean scores indicated that male soccer players performed better than female soccer players in both the Single hop for distance test and the cross-over hop for distance test. Furthermore, comparing upper-extremity performance between male and female soccer players revealed significant differences in the Davies test (P=0.001) and UQ-YBT in the superolateral direction (P=0.026). However, no significant differences were observed between the two groups in the medial (P=0.384) and inferolateral (P=0.061) directions of upper extremity dynamic balance. Examination of the mean scores further revealed that male soccer players outperformed female soccer players in the Davies test and upper extremity dynamic balance in the superolateral direction (Tables 3 and 4).

Table 1. The demographic characteristics of the study participants

Variables	Mean±SD		P
	Men	Women	
Age (y)	19.83±1.48	19.73±1.48	0.791
Weight (kg)	72.40±3.69	58.96±5.64	0.001*
Height (cm)	176.66±5.24	164.36±4.93	0.001*
BMI	20.30±1.70	19.43±1.79	0.046*
Sports experience (y)	5.33±1.49	4.83±1.14	0.194
Weekly physical activity (h)	6.60±1.37	5.23±1.13	0.001*
Dominant upper limb length (cm)	90.36±4.07	80.56±3.38	0.001*

*Statistically significant difference, Statistical significance was considered at P<0.05.

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Table 2. Assessment of data normality in research variables

Variables	Men		Women	
	Mean±SD	P	Mean±SD	P
Deep squat	2.23±0.67	0.001	1.96±0.61	0.001
Hurdle step	2.13±0.57	0.001	1.86±0.57	0.001
In-line lunge	2.23±0.72	0.001	2.16±0.69	0.001
Shoulder mobility	2.00±0.45	0.001	2.53±0.50	0.001
Active straight leg raise	1.93±0.58	0.001	2.30±0.46	0.001
Trunk stability push-up	2.70±0.46	0.001	1.83±0.59	0.001
Rotary stability	2.16±0.46	0.001	1.90±0.54	0.001
Total FMS	15.40±1.90	0.073	14.56±1.83	0.052
Single hop for distance test (m)	1.72±0.18	0.030	1.25±0.15	0.826
Cross-over hop for distance (m)	4.46±0.65	0.224	3.05±0.63	0.115
Davis test	28.80±5.44	0.132	24.03±3.75	0.199
Dynamic balance–medial-lateral (cm)	97.50±13.19	0.078	94.96±8.82	0.474
Dynamic Balance–inferior-lateral (cm)	99.24±17.91	0.720	91.64±12.33	0.248
Dynamic balance–superior-lateral (cm)	92.49±13.97	0.768	84.87±11.76	0.475

Statistical significance was considered at P<0.05.

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Table 3. The Mann-Whitney U test results

Variables	Mean Rank		Z	P
	Men	Women		
Deep squat	33.73	27.27	-1.609	0.108
Hurdle step	33.83	27.17	-1.774	0.076
In-line lunge	31.33	29.67	-0.402	0.688
Shoulder mobility	23.30	37.70	-3.779	0.001*
Active straight leg raise	25.90	35.10	-2.493	0.013*
Trunk stability push-up	40.70	20.30	-4.959	0.001*
Rotary stability	33.95	27.05	-1.974	0.048*
Single hop for distance test (m)	1.72	1.25	10.814	0.001*

*Statistically significant difference.

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Table 4. The t-test results

Variables	t	Mean Difference	Effect Size	P
Total FMS score	1.727	0.84	0.049	0.089
Cross-over hop for distance (m)	8.526	1.44	0.556	0.001*
Davis test	3.946	4.77	0.212	0.001*
Dynamic balance- medial-lateral (cm)	0.876	2.54	0.013	0.384
Dynamic balance -inferior-lateral (cm)	1.914	7.60	0.059	0.061
Dynamic balance - superior-lateral (cm)	2.287	7.62	0.083	0.026*

*Statistically significant difference.

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Discussion

The present study aimed to compare FMS and performance between male and female soccer players. The FMS is recognized as a cost-effective, non-invasive, and reliable tool for evaluating fundamental movement patterns [29, 30]. The existing literature supports its high reliability [31, 32] and its specificity in identifying athletes at increased risk of sports-related injuries [5]. In this study, the FMS was utilized to evaluate fundamental movement patterns. Additionally, upper extremity dynamic balance was measured using the UQ-YBT, upper extremity performance was assessed via the Davies test, and lower extremity performance was evaluated using the single-hop for distance and crossover-hop for distance tests.

The findings of this study showed no statistically significant differences between male and female football players in several FMS components, specifically the deep squat, hurdle step, in-line lunge, and the total FMS score. This finding suggests that fundamental movement patterns may be similar between genders, particularly when skill level and training are comparable across groups. However, significant gender-related differences were observed in certain FMS components. Specifically, female players performed better on flexibility tests, such as shoulder mobility and the active straight leg raise, which may reflect greater flexibility and anatomical differences typically seen in women.

In contrast, male players demonstrated superior performance in the trunk stability push-up and rotary stability tests, likely due to more efficient activation and coordination of key stabilizing muscle groups, including the hip adductors, rotators, abdominal muscles, spinal stabilizers, and the quadratus lumborum [33-35].

Johnson et al. (2023) investigated sex differences in FMS scores among Reserve Officers' Training Corps cadets. The findings revealed that females outperformed males on both the in-line lunge and active straight leg raise tests. Conversely, males demonstrated significantly higher scores on the trunk stability push-up test. In a similar vein, these results align with our study. These differences may be attributed to increased mobility in the ankle and hamstrings, as well as reduced upper-body muscle mass in females compared to males. Consequently, these sex-related differences should be taken into account when designing tailored exercise programs for males and females [36].

In the present study, no significant differences were observed between females and males in the total FMS score. The literature on FMS presents conflicting evidence regarding sex differences in total scores; some studies [37-39] report that males exhibit higher-quality movement patterns than females. However, recent research suggests that females tend to perform better when composite FMS scores are used [40]. Although there may be general differences in physical performance between males and females due to biological factors such as muscle mass and hormonal variation [41], it is important to recognize that individuals of both sexes can exhibit a wide range of abilities and capabilities [39].

Additionally, several studies have compared FMS scores between male and female athletes across different populations. According to Hamil et al., female soccer players exhibited higher FMS scores and greater injury rates than male players. They suggest that this discrepancy may justify increasing the FMS cutoff score for females as a predictor of injury. However, further research is needed due to the small sample size of their study [42]. According to Ransdell and Murray, the higher incidence of injuries among females can be attributed to a range of contributing factors [43, 44]. These include reduced muscle fiber size and cross-sectional area [45], a narrower skeletal structure [46], decreased activation of the gluteus medius muscle [33], as well as the vastus medialis oblique and vastus lateralis [47], diminished neuromuscular coordination [49, 50], and less core stability [35, 48]. In contrast, Amjad et al. found that female footballers scored lower on the FMS tests than male footballers. They concluded that there was a significant association between FMS composite scores and injury occurrence, suggesting that FMS results for both genders may be associated with the likelihood of injury [13].

The results of the current study revealed significant differences in lower-extremity performance between male and female soccer players, specifically in the single-hop for distance (P=0.001) and the crossover-hop for distance (P=0.001). Analysis of the mean scores indicated that male players outperformed female players in both tests. These findings suggest that male athletes tend to exhibit superior lower-body explosive power and strength, likely due to greater muscle mass and differences in hormonal profiles, which are known to contribute to enhanced performance in power-related tasks such as hopping and distance-based tests [35, 50]. In contrast, when comparing upper extremity performance, significant differences were also observed between male and female soccer players. Specifically, male athletes performed better in the Davies test (P=0.001) and upper extremity dynamic balance in the superolateral direction (P=0.026). These results align with previous studies indicating that males generally demonstrate greater upper-body strength and neuromuscular control, often attributed to increased upper-body muscle mass and higher testosterone levels [35, 50].

Our findings show that males performed better than females across all physical ability tests. Reference data from youth to adulthood typically indicate that males possess greater musculoskeletal strength and power than females, which aligns with the observed results in the physical performance tests. In support of this, O'Brien-Smith et al. compared the performance of male and female football players aged 9 to 18. It was reported that male players outperformed female players in individual skills, vertical jump, sprinting, agility, and dribbling power. The study attributed these differences to gender-based anthropometric characteristics, which were considered among the reasons for the superiority of male players [17]. Similarly, Schons et al. compared the anthropometric profiles and physical performance of professional male and female soccer players. It confirmed that men generally perform better than women in physical tests [51].

In another study by Arundale et al. (2020), it was found that female athletes are at greater risk for lower extremity injuries, including anterior cruciate ligament injuries. Diagnostic test scores for lower-limb movement pattern deficits, such as increased knee valgus and decreased knee flexion, were more pronounced in females than in males. These findings were attributed to lower-limb muscular weakness in female athletes compared with their male counterparts [52]. Consequently, it could help justify the findings of specific studies suggesting that women perform worse than men.

Based on the findings of the present study, it is recommended that coaches, movement specialists, and sports medicine teams consider gender differences in physical performance when designing training programs and injury prevention strategies.

Focusing on core stability exercises for female athletes, given their higher prevalence of trunk instability, and incorporating flexibility-enhancing exercises for male athletes to reduce muscular tightness and improve range of motion can play a significant role in reducing injury risk and enhancing athletic performance. For example, exercises such as the Plank with leg lift can help women improve core stability and reduce lower-limb stress. In contrast, the World's Greatest Stretch can help men increase hip-joint and hamstring flexibility, thereby improving mobility and functional performance.

Furthermore, future research should carefully control for potential confounding variables such as training history, injury history, and anthropometric characteristics. For example, athletes with longer, more consistent training experience typically demonstrate greater strength, endurance, and movement efficiency, factors that can influence their test performance and susceptibility to injury. This finding suggests that functional assessment tools, such as the FMS, can better predict injury susceptibility and improve movement efficiency.

Conclusions

This study demonstrates the necessity of gender-specific training programs to enhance performance and reduce injury risk. According to the findings, it is recommended that flexibility and mobility exercises be implemented for male soccer players and that core stability and strength training be implemented for female soccer players. These suggestions stem from the observed FMS tests. Additionally, male athletes outperformed female athletes in performance tests, likely due to biomechanical and neuromuscular differences between the sexes.

In this regard, future research should investigate the underlying mechanisms driving these differences while accounting for individual factors such as playing experience and fitness level.

Study limitations

Despite the researchers' efforts to control various aspects of the study, several limitations remain. One major limitation is the small sample size, which reduces the generalizability of the findings. Increasing the number of participants in future research is essential to enhance statistical power and obtain more reliable results. Another limitation is that data collection occurred only once during the season, potentially overlooking variations in movement quality and performance across different training periods. Therefore, Future studies should assess FMS and physical performance before and after training phases to clarify how changes in movement patterns affect performance outcomes over time.

Consent for publication

All authors have given their consent for the publication of this manuscript.

Availability of data and materials

All relevant data and materials are included within the article. Additional data can be made available upon reasonable request.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Sport Sciences Research Institute, Tehran, Iran. (Code: SSRI.REC-2310-2493).

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Authors' contributions

Data collection and writing the original draft: Alireza Zare; Conceptualization and supervision: Hashem Piri; Review, and editing: All authors.

Conflict of interest

The authors declared no conflict of interest.

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