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Comparison of Jump Performance and Lower-Limb Strength by Playing Position in Soccer Players

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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.

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Abstract

This study aimed to determine differences in jumping ability and lower extremity strength according to playing positions in soccer players. A total of 27 healthy male soccer players from Denizlispor Soccer Club participated in the study (age: 20.0 ± 3.74 years; height: 181.22 ± 11.12 cm; body mass: 67.78 ± 13.97 kg). Players were classified into four positions: goalkeepers (n = 4), defenders (n = 9), midfielders (n = 12), and forwards (n = 2). Lower extremity strength was assessed using the 6-repetition Maximum (6RM) leg press and 6RM squat tests, while jump performance was evaluated using the squat jump (SJ), countermovement jump (CMJ), and horizontal jump (HJ) tests. Data were analyzed using one-way analysis of variance (ANOVA) with Tukey post hoc tests. The results revealed significant positional differences in lower-body strength and jump performance ($p < 0.05$). Midfielders and forwards demonstrated significantly higher 6RM squat and leg press values compared with goalkeepers. Significant differences were also observed in SJ, CMJ, and HJ performances across positions ($p < 0.05$), with forwards achieving the greatest horizontal jump distances. Goalkeepers exhibited the lowest values across all strength and jump measures. These findings indicate that lower-limb strength and jump performance vary according to playing position, reflecting the distinct physical demands associated with each role in soccer.

Keywords: Soccer, lower-body strength, jumping ability, positional differences, performance analysis

Özet

Futbolcularda Mevkilere Göre Sıçrama ve Alt Ekstremite Kuvvetinin Karşılaştırılması

Bu çalışma, futbolcularda oyun pozisyonlarına göre alt ekstremite kuvveti ve sıçrama performansındaki farklılıkları belirlemeyi amaçlamaktadır. Denizlispor Futbol Kulübü'nden 27 sağlıklı erkek futbolcu araştırmaya dahil edilmiştir (yaş: 20.0 ± 3.74 yıl, boy: 181.22 ± 11.12 cm, kilo: 67.78 ± 13.97 kg). Oyuncular dört farklı pozisyona göre sınıflandırılmıştır: kaleci (n = 4), defans (n = 9), orta saha (n = 12) ve forvet (n = 2). Alt ekstremite kuvveti 6 Tekrar Maksimum (6TM) Leg Press ve 6TM Squat testleriyle değerlendirilmiş, sıçrama performansı ise Squat Jump (SJ), Countermovement Jump (CMJ) ve Horizontal Jump (HJ) testleriyle ölçülmüştür. Veriler tek yönlü varyans analizi (ANOVA) ve Tukey post-hoc testleri ile analiz edilmiştir. Elde edilen bulgular, alt ekstremite kuvveti ve sıçrama performansının oyun pozisyonuna göre anlamlı farklılıklar gösterdiğini ortaya koymuştur ($p < 0.05$). Orta saha ve forvet oyuncularının 6TM squat ve leg press değerleri kalecilere kıyasla anlamlı düzeyde daha yüksek bulunmuştur. Ayrıca SJ, CMJ ve HJ performanslarında pozisyonlar arasında anlamlı farklılıklar saptanmış ($p < 0.05$), özellikle horizontal sıçrama mesafesinde forvet oyuncularının en yüksek değerlere ulaştığı belirlenmiştir. Kalecilerin ise kuvvet ve sıçrama testlerinin tamamında en düşük performans değerlerini sergilediği görülmüştür.

Bu sonuçlar, futbolcularda alt ekstremite kuvveti ve sıçrama performansının oyun pozisyonuna bağlı olarak değiştiğini ve her pozisyonun kendine özgü fiziksel gereksinimlere sahip olduğunu göstermektedir.

Anahtar Kelimeler: Futbol, alt ekstremite kuvveti, sıçrama, mevkisel farklılıklar, performans analizi

INTRODUCTION

Soccer is a sport that demands high-level athletic performance. Throughout a match, players are exposed to various physical demands such as sprinting, changing direction, sudden stops and starts, and aerial duels. These physical requirements may vary by on-field playing position (16). As one of the most widely played sports worldwide, soccer requires athletes to possess advanced technical and tactical skills (14). Achieving success additionally necessitates the optimal development of aerobic and anaerobic capacity, alongside the effective integration of fundamental performance components such as endurance, strength, speed, coordination, and flexibility (1). Soccer is also characterized as a high-intensity intermittent activity, compelling players to display versatile physical and physiological qualities to adapt to the constantly changing dynamics of play (2). In particular, jump ability and lower-body power play a crucial role both in aerial dominance and in movements requiring explosive power (11).

Recent research indicates increasingly distinct, position-specific physical and physiological demands (15). With the widespread adoption of a high-tempo style in modern soccer, high-intensity running and explosive actions have grown in importance (13). Forwards and wingers are expected to exhibit greater speed and agility, whereas defenders are generally expected to be stronger and more robust (3). Consequently, jump abilities and strength levels may differ among players in different positions according to the physical demands of those roles. For example, center-backs may possess strong squat jump capabilities to gain superiority in aerial duels, while wide players and forwards may develop superior horizontal jump capacity (6). Midfielders are expected to maintain a more balanced jumping profile (8).

Assessing lower-limb strength in soccer players can help tailor training programs to individual needs. Determining whether jump performance is associated with strength measures such as 6RM leg press and squat is important for understanding which types of strength should be prioritized in training (17). A strong lower body supports not only jump performance but also acceleration, change of direction, and balance—core competencies in soccer (9).

Although numerous studies have profiled physical and motor characteristics across different sports within Sport Sciences, comprehensive investigations specifically targeting soccer players remain relatively limited. The number of studies analyzing soccer players' physical capacities and motor skills in detail appears lower than in other sports, suggesting a need for further research in this domain. The present study aimed to examine differences in jump ability and strength among soccer players by playing position. In addition, it sought to analyze the relationship between jump performance and strength to identify position-specific physical requirements. Findings are intended to provide sport scientists with evidence to guide position-focused training program design.

METHOD

Participants

Twenty-seven healthy male players from Denizlispor Football Club participated (age: 20.0 ± 3.74 years; height: 181.22 ± 11.12 cm; body mass: 67.78 ± 13.97 kg). The study initially began with 29 players; two were excluded due to non–study-related injuries. Positional distribution was: goalkeepers (n = 4), defenders (n = 9), midfielders (n = 12), and forwards (n = 2). All participants trained regularly and were free of injury at the time of testing. Prior to data collection, written informed consent was obtained from all players.

Data Collection

Players' jump and strength performances were assessed.

Jump Tests

Countermovement Jump (CMJ), Squat Jump (SJ), and Horizontal Jump (HJ) protocols were administered. Measurements were obtained using a digital jump mat with 0.01-s resolution (Fusion Sport Smart Speed, Brisbane, Australia).

Squat Jump (SJ) Protocol

Players performed a maximal vertical jump with both feet while keeping their hands on the hips. After standing still on the contact mat, they moved to approximately 90° knee flexion, held that position for at least 3 s, and executed a maximal jump without any countermovement (13).

Countermovement Jump (CMJ) Protocol

Procedures were similar to SJ, except players performed a rapid downward movement (countermovement) before the maximal jump. In both SJ and CMJ, hands remained on the hips and both feet were used simultaneously. Each test was performed twice; the best value was recorded in centimeters (cm) (23).

Horizontal Jump (HJ) Protocol

From a standing start, players performed a maximal bilateral horizontal jump with arm swing permitted. Each player completed three maximal attempts with 30-s rests. Distance (cm) was measured from the take-off line to the heel landing point using a measuring tape; the longest distance was used for analysis (8).

Strength Tests

Lower-limb strength was assessed using the 6RM method. The 6RM leg press and 6RM squat were tested on a leg press machine and a Smith machine, respectively. All tests were conducted with appropriate warm-up and safety procedures aligned with players' training routines.

6RM Squat

Following a general warm-up and squat-specific dynamic warm-up, players completed one set of six reps at ~50–70% of the estimated 6RM, rested 3 min, then load was increased by ~5–10% for subsequent attempts. Testing stopped when six reps could not be completed with proper technique. The highest load with six technically correct reps was recorded as 6RM (7).

6RM Leg Press

Procedures mirrored the squat test: warm-up, one set of six reps at ~50–70% estimated 6RM, 3-min rest, then ~5–10% load increments until the heaviest technically correct set of six was achieved (7).

Ethical approval and institutional permission

The necessary permissions for this study were obtained from the ethics committee with the decision of Pamukkale University Non-Interventional Clinical Research Ethics Committee (02/08/2025 - 020-660432).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics 26.0. Normality was evaluated via the Shapiro–Wilk test alongside skewness and kurtosis. For normally distributed variables, one-way ANOVA was used to examine positional differences in jump and strength parameters; Tukey post hoc tests were applied where appropriate. Statistical significance was set at $p < 0.05$. Results are reported as mean (X) ± standard deviation (SD).

FINDINGS

Table 1. Descriptive characteristics by playing position

Variable	Goalkeepers (n=4)	Defenders (n=9)	Midfielders (n=12)	Forwards (n=2)	p
Age (years)	21.011±3.554	20.552±3.804	19.880±3.732	20.044±3.212	0.655
Height (cm)	188.004±9.071	184.048±10.099	178.011±9.041	176.190±8.098	**0.021**
Body mass (kg)	75.015±12.034	72.103±11.037	65.105±10.014	63.378±9.273	**0.031**
p<0.05					

The descriptive data indicate that goalkeepers and defenders were generally taller and heavier compared to midfielders and forwards. Statistically significant differences were observed for both height (p = 0.021) and body mass (p = 0.031), with midfielders and forwards presenting lower values.

No significant positional difference was found for age (p = 0.655). These findings suggest that anthropometric characteristics vary by playing position, with defensive roles tending to be associated with greater height and body mass, whereas midfield and forward players exhibit comparatively smaller body dimensions.

Table 2. One-Way ANOVA of Motor Characteristics by Position

Test	Position	Mean ± SD	95% CI of Mean	F	p	Post hoc differences	ηp^2
6RM Leg Press (kg)	GK	127.510±12.581	107.494-147.526	4.321	**0.010***	GK–MID **p=0.022***	0.371
	DEF	138.699±30.851	115.176-162.604				
	MID	148.145±19.487	135.763-160.527				
	FWD	160.015±0.021	159.826-160.204				
6RM Squat (kg)	GK	89.254±9.977	73.381-105.127	5.128	**0.006***	GK–DEF **p=0.019***	0.412
	DEF	97.251±20.381	81.585-112.917				
	MID	104.299±12.444	96.392-112.206				
	FWD	112.007±0.127	110.866-113.148				
CMJ (cm)	GK	38.710±3.598	32.986-44.434	3.412	**0.025***	GK–MID **p=0.034***	0.318
	DEF	39.801±3.527	37.090-42.512				
	MID	42.327±2.904	40.482-44.172				
	FWD	41.991±3.120	13.959-70.023				
SJ (cm)	GK	39.237±3.341	33.921-44.553	4.876	**0.009***	DEF–FWD **p=0.022***	0.399
	DEF	38.316±4.127	35.144-41.488				
	MID	40.522±3.516	38.288-42.756				
	FWD	41.300±3.205	12.505-70.095				
HJ (m)	GK	2.051±0.111	1.874-2.228	6.092	**0.003***	DEF–FWD **p=0.010***	0.454
	DEF	2.077±0.128	1.979-2.175				
	MID	2.149±0.137	2.062-2.236				
	FWD	2.223±0.153	0.848-3.598				

P<0.05

GK=Goalkeepers; DEF=Defenders; MID=Midfielders; FWD=Forwards; F=ANOVA test statistic. η^2p=partial eta squared (effect size). Significant post hoc differences are indicated.

6RM Leg Press Results

Analysis of the 6RM leg press test revealed significant positional differences (F(3.22) = 4.321, p = 0.010). Post-hoc comparisons indicated that goalkeepers (127.51 ± 12.58 kg) demonstrated significantly lower strength levels compared to midfielders (148.15 ± 19.49 kg; p = 0.022). Although defenders (138.89 ± 30.85 kg) performed lower than midfielders, the difference was not statistically significant (p > 0.05). Forwards achieved the highest mean values (160.02 ± 0.02 kg), yet these differences did not reach statistical significance due to variability across individuals. Overall, goalkeepers showed the lowest, and forwards the highest, strength values.

6RM Squat Results

The 6RM squat test also revealed significant positional differences (F(3.22) = 5.128, p = 0.006). Post-hoc analysis showed that goalkeepers (89.25 ± 9.98 kg) had significantly lower squat strength compared to defenders (97.25 ± 20.38 kg; p = 0.019). Midfielders (104.30 ± 12.44 kg) and forwards (112.01 ± 0.13 kg) recorded the highest scores, but the difference between these two positions was not statistically significant. These findings highlight goalkeepers as the weakest group in terms of squat strength, while defensive players, likely due to the physical demands of aerial duels, demonstrated superior performance compared to goalkeepers.

Countermovement Jump (CMJ) Results

The CMJ test, used to assess explosive power, indicated significant positional differences (F(3.22) = 3.412, p = 0.025). Post-hoc analysis revealed that goalkeepers (38.71 ± 3.60 cm) performed significantly lower than midfielders (42.33 ± 2.90 cm; p = 0.034). No significant differences were observed between defenders (39.80 ± 3.53 cm) and forwards (41.99 ± 3.12 cm). Nevertheless, midfielders achieved the highest CMJ values, suggesting greater efficiency in dynamic and explosive movements.

Squat Jump (SJ) Results

The SJ test, evaluating lower-limb strength and vertical jump capacity, showed significant differences among positions ($F(3.22) = 4.876$, $p = 0.009$). Defenders (38.32 ± 4.13 cm) recorded significantly lower squat jump performance compared to forwards (41.30 ± 3.21 cm; $p = 0.022$). These results suggest that forwards possess superior explosive strength, which may be advantageous in aerial duels and offensive actions that require frequent vertical jumps.

Horizontal Jump (HJ) Results

The HJ test, reflecting horizontal explosive force, also demonstrated significant positional differences ($F(3.22) = 6.092$, $p = 0.003$). Defenders (2.08 ± 0.13 m) exhibited significantly lower performance compared to forwards (2.22 ± 0.15 m; $p = 0.010$). This finding suggests that forwards have stronger propulsive capacity, which may provide an advantage in sprint initiation and rapid directional changes. Conversely, the relatively lower HJ values in defenders may indicate a greater focus on vertical power, while their horizontal explosiveness is less developed.

DISCUSSION

This study demonstrated clear positional differences in lower-limb strength and jump performance among soccer players, reinforcing the concept that on-field playing roles substantially shape physical capacities. In the present sample, forwards and midfielders exhibited significantly greater leg strength (6RM squat and leg press) and superior jump performances (SJ, CMJ, and HJ) compared with goalkeepers and defenders. These findings are consistent with previous research conducted in both elite and sub-elite soccer populations, indicating that attacking-oriented positions are generally characterized by higher explosive power outputs (12).

Supporting this interpretation, Ileri et al. (12) reported that midfielders and forwards achieved greater vertical jump heights (≈39–41 cm) than defenders and goalkeepers (~34 cm), with a similar pattern observed in horizontal jump performance. Such differences likely reflect the greater frequency of explosive actions, accelerations, and aerial challenges experienced by attacking players during match play. Conversely, defensive roles may prioritize positional play and physical robustness over repeated maximal explosive actions, potentially explaining their comparatively lower jump outputs.

In terms of maximal strength, the higher 6RM squat and leg press values observed in forwards and midfielders suggest superior lower-limb force production capacity. This aligns with earlier findings indicating that attacking players frequently demonstrate higher strength and power levels due to their involvement in sprinting, tackling, and rapid changes of direction (7). However, the literature also presents contrasting evidence. For example, Arslan and Bekir (14) reported higher anaerobic leg power in defenders compared with forwards in amateur players, highlighting that positional differences may vary depending on competition level, training background, and tactical demands. These discrepancies suggest that positional physical profiles are not fixed but can be modified by training emphasis and contextual factors.

Jump performance differences across positions were further evident in the present study, particularly in horizontal jump outcomes, where forwards showed the greatest distances. Horizontal jumping ability is closely linked to sprint initiation and horizontal force production, qualities that are critical for offensive actions such as breaking defensive lines and initiating counterattacks. Similar trends have been reported in youth and adult soccer players, with attackers typically outperforming defenders and goalkeepers in horizontal jump tasks (12, 18). Nevertheless, some studies involving youth or developing players have reported minimal or no positional differences in vertical jump performance (19, 20), suggesting that role-specific specialization may become more pronounced with age, training experience, and competitive exposure. However, these findings—particularly those related to the forward position—should be interpreted with caution due to the relatively small sample size in this group.

Goalkeepers emerged as a distinct group, demonstrating the lowest values across strength and jump measures. This finding is consistent with previous studies identifying goalkeepers as physical outliers due to their unique movement patterns, training demands, and match activities (7, 19). While goalkeepers generally perform fewer high-intensity runs and jumps than outfield players, evidence indicates that targeted training interventions can substantially improve their explosive power. For instance, AlTaweel et al. (21) reported superior single-leg jump and hop performances in elite goalkeepers compared with midfielders, emphasizing

the potential impact of role-specific strength and plyometric training. These mixed findings underscore that physical characteristics in goalkeepers are highly sensitive to training focus and program design.

Collectively, the present results support the growing consensus that soccer playing positions are associated with distinct physical performance profiles encompassing strength, power, and jump ability (20, 22). Such differences are not merely descriptive but provide meaningful insight into the physiological demands imposed by different roles on the field. Recent evidence increasingly emphasizes the need for position-aware physical profiling and assessment to guide training strategies and performance monitoring (23).

Practical Applications

The findings of this study highlight the importance of considering position-specific physical demands in soccer training programs. Coaches and strength and conditioning professionals are encouraged to design tailored training interventions rather than applying uniform routines across all playing positions. Forwards may benefit from greater emphasis on explosive power, sprint speed, and horizontal force production, while defenders and goalkeepers may require increased focus on dynamic stability, maximal strength, and vertical power. Midfielders, who are exposed to both offensive and defensive demands, should follow balanced programs integrating strength, power, and endurance components. For example, explosive power training emphasizing horizontal force production may be particularly relevant for forwards, given their superior HJ performance observed in the present study.

Incorporating position-specific testing and recent normative data as benchmarks may help refine individualized training prescriptions and improve on-field performance. Moreover, position-tailored conditioning strategies may contribute to injury risk reduction by better preparing players for the unique mechanical and physiological stresses associated with their roles.

Future research should prioritize longitudinal and interventional designs to examine how position-specific training adaptations develop over time and how early specialization versus broad physical development influences these differences across playing positions.

Limitations

This study has several limitations that should be acknowledged. First, the relatively small sample size—particularly within the forward group—limits the statistical power and generalizability of the findings. Second, the study included only male athletes from a single age group and competitive level, which restricts the applicability of the results to other populations such as female players, younger athletes, or professionals competing in different leagues. Third, the cross-sectional design precludes any causal inferences regarding the observed positional differences. Fourth, although standardized, the laboratory-based strength and jump assessments may not fully reflect the complex and dynamic demands of competitive match play. Additionally, the absence of longitudinal monitoring and match-related performance indicators (e.g., GPS-based running metrics, technical actions) further reduces the ecological validity of the findings. Future research should therefore incorporate larger and more diverse cohorts, include both sexes across different age categories, and employ longitudinal designs integrating laboratory and field-based measures to provide a more comprehensive understanding of positional differences in soccer.

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