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Research Article / Araştırma Makalesi

Comparison of dynamic balance among football, futsal, and beach soccer players

Futbol, futsal ve plaj futbolu oyuncuları arasında dinamik dengenin karşılaştırılması

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ABSTRACT

Objective: Although football, futsal, and beach soccer have relatively different physiological requirements and playing on different surfaces is likely to impact dynamic balance at different levels, there is no study evaluating the dynamic balance of football, futsal, and beach soccer players. The objective of the present study is to evaluate the dynamic balance of football, futsal, and beach soccer players.

Material and Methods: A total of 114 amateur male players registered with the Turkish Football Federation participated in the study. They were divided into three sub-groups according to their sports disciplines: football (n=41), futsal (n=39), and beach football (n=34). The modified star excursion balance test with four outcomes for each extremity as anterior (A), posterior lateral (PL), posterior medial (PM), and composite (C) score was used to measure dynamic balance.

Results: Dominant side PL and C scores (p<0.01, ES=0.10; p<0.01, ES=0.11; respectively), and non-dominant side A, PL and C scores of beach soccer players were significantly higher comparing to futsal players (p=0.01, ES=0.07; p<0.01, ES=0.08; p<0.01, ES=0.08; respectively). Also, dominant side C scores of beach soccer players were significantly higher than football players (p<0.02, ES=0.11).

Conclusion: Findings demonstrate that the dynamic balance profile of beach soccer players was better compared with futsal players. In light of present study results, it may be beneficial for players from different sports disciplines to train on sand in order to improve dynamic balance.

Keywords: *Proprioception, equilibrium, sand, firm surface, athlete*

ÖZ

Amaç: Futbol, futsal ve plaj futbolunun göreli farklı fizyolojik gereksinimleri olmasına ve farklı yüzeylerde oynamanın dinamik dengeyi farklı seviyelerde etkileme olasılığına rağmen, futbol, futsal ve plaj futbolu oyuncularının dinamik dengelerini değerlendiren çalışma göze çarpmamaktadır. Bu çalışmanın amacı futbol, futsal ve plaj futbolu oyuncularının dinamik dengelerini değerlendirmektir.

Gereç ve Yöntemler: Çalışmaya Türkiye Futbol Federasyonu'na kayıtlı toplam 114 amatör erkek oyuncu katıldı. Oyuncular, spor dallarına göre futbol (n=41), futsal (n=39) ve plaj futbolu (n=34) olmak üzere üç alt gruba ayrıldılar. Dinamik dengeyi ölçmek için her bir ekstremite için ön (Ö), arka dış (AD), arka iç (Aİ) ve toplam (T) skor olmak üzere dört sonuç veren modifiye yıldız dağılım denge testi kullanıldı.

Bulgular: Plaj futbolcularının dominant taraf AD ve T skorları (sırasıyla p<0.01, ES=0.10; p<0.01, ES=0.11) ve dominant olmayan taraf Ö, AD ve T skorları futsal oyuncularına göre anlamlı olarak daha yüksekti (sırasıyla p =0.01, ES=0.07; p<0.01, ES=0.08; p<0.01, ES=0.08). Ayrıca, plaj futbolcularının dominant taraf T skorları futbolculardan anlamlı olarak daha yüksekti (p<0.02, ES=0.11).

Sonuç: Bulgular plaj futbolcularının dinamik denge profilinin futsal oyuncularına göre daha iyi olduğunu gösterdi. Çalışma sonuçları göz önüne alındığında, farklı spor disiplinlerinden oyuncuların dinamik dengelerini geliştirmek için kum üzerinde antrenman yapmaları önerilebilir.

Anahtar Sözcükler: *Propriosepsiyon, denge, kum, sert yüzey, sporcu*

INTRODUCTION

Although beach soccer and futsal are considered variants of football (soccer), it is noticeable that there are more differences than similarities between (1). For example, while a football match consists of two 45-min periods, a beach soccer match consists of three 12-min periods, and a futsal match of two 20-min periods (2-4). Also, in beach soccer and futsal matches, time is stopped when the ball goes out of the bounds. The pitch sizes of these sports disciplines are different, too. While the size of a football pitch is 90-120m by 45-90m, it is 35-37m by 26-28m for beach soccer, and 38-42m by 20-25m for futsal (2-4). In addition, each football team consists of 11 players, while this number is five for beach soccer and futsal. When pitch sizes and the number of players are evaluated together for each sport discipline, the area per player in beach soccer and futsal is almost one-third compared with football. Besides the high-intensity nature of beach soccer and futsal, playing in smaller areas makes matches more intense (5). Research indicates that a football match is played with an average of 80-90%

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of the maximum heart rate, and this rate is >90% for beach soccer and 85-90% for futsal (6-8).

The difference of surfaces on which football, futsal, and beach soccer are played may also cause some different adaptations among players. The fact that the ground is sand in beach soccer makes it difficult to move and reach high speed during the match (1,9). Since maintaining balance on unstable surfaces is more difficult comparing to hard surfaces, hip and knee movements become even more important in matches played on sand (10). Research reveals that the quadriceps isokinetic strength of beach soccer and football players is higher than in futsal players (11). Given that there is positive relationship between lower-extremity strength and dynamic balance performance, it may be argued that futsal players have poorer dynamic balance comparing to football and beach soccer players (12). Conversely, futsal involves more repetitive sprints compared with football and beach soccer, which may provide greater improvement in type 2 fibers in futsal players (13). Since it is known that type 2 fibers contribute to maintaining balance faster than type 1 fibers, in particular against sudden perturbations, the dynamic balance of futsal players may not be as poor as it thought (14). In addition, while football and futsal are played with shoes, playing beach soccer barefoot can also be considered a unique challenge in maintaining balance since it may cause differences in elastic energy distribution (15).

Besides the nature of the sports, playing on different surfaces may affect the occurrence of injuries. Research reveals that 13.0%, 12.1%, and 3.2% of ankle injuries comprise football, futsal, and beach soccer injuries, respectively. Moreover, 67.5% of football ankle injuries are sprains, these rates are 84.2% for futsal and <1% for beach soccer (9,16,17). In ankle injuries, while hard surfaces may cause the foot to lock onto the ground, making it easier to injure the ligament, sand may reduce the incidence of ligament injury by causing the foot to slide without the formation of injury mechanisms (torsion, inversion, etc.) (9,18). Bahr and Reeser also report that ankle sprains are less common in beach volleyball than in indoor volleyball, which supports this idea (19). Since poor dynamic balance is a risk factor for sports injuries, another possible reason for the lower rate of ankle sprain injuries in beach soccer players may be their higher balance profile (20). Considering the effect of dynamic balance profiles on sports injuries and athletic performance, it is useful to measure the dynamic balances of athletes in order to identify poor balance profiles and take necessary precautions (20,21).

Although football, futsal, and beach soccer have relatively different physiological requirements, and playing on different surfaces is likely to affect dynamic balance at different levels; to our best knowledge, there is no study evaluating the differences in dynamic balances of football, futsal, and beach soccer players. The main purpose of the present study is to evaluate the dynamic balance of football, futsal, and beach soccer players. Based on the studies mentioned above, it was hypothesized that the dynamic balance of beach soccer players would be better comparing to football and futsal players.

MATERIALS and METHODS

Participants

Amateur male football, futsal, and beach soccer players registered with the Turkish Football Federation were included in this study. The inclusion criteria were: 1) playing only one of the sports of football, futsal or beach soccer; 2) being aged between 18-40; 3) attending in 2-3 team training sessions per week; 4) having no history of surgery or severe injury in the lower extremity in the last year; 5) having no acute injuries in the lower extremity.

Study Design

This study was conducted in accordance with the Helsinki declaration and was approved by the Selçuk University Sport Science Faculty Ethical Committee. All participants were informed about the study, and their informed consent was obtained. Before the dynamic balance test, all players were evaluated by the same sports medicine physician. Twelve futsal and 14 beach soccer players were excluded from the study because they also play football. After physical examination, two futsal players (anterior cruciate ligament surgery history and patellofemoral pain syndrome), two football players (acute ankle sprain, Achilles tendon tenderness) and a beach soccer player (quadriceps femoris contusion) were excluded from the study. Then, a series of tests including measurements of height, weight, leg length, and dynamic balance were administered to three groups of participants (n=114). The flow diagram of the study is given in Figure 1.

Measurements

Height, Weight, and Leg Length

The weight, height, and leg lengths of the participants were measured before breakfast on the day of the balance test. The weights of the participants were measured with an electronic scale device (Omron HN-286). The height and leg length of the participants were measured with a tape measure. The length from the bottom of the feet to the highest point of the head was recorded as height when the participants were standing upright barefooted. Leg length was measured from the anterior superior iliac spine to the ipsi–

lateral medial malleolus while participants were lying on supine position. All measurements were undertaken by the same sports medicine physician.

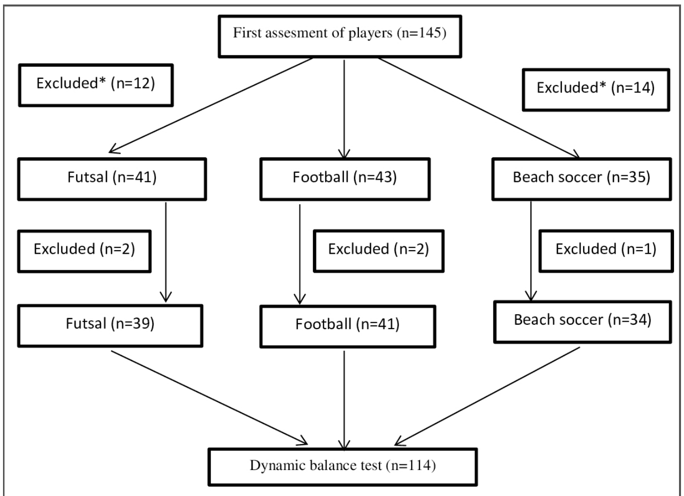

Figure 1. Flow diagram of the study.
** Exluded from the study for also playing football*

Dynamic Balance Test

The modified star excursion balance test (mSEBT) was used to measure dynamic balance. The mSEBT is a screening tool used to measure dynamic balance, and has good inter- and intrarater reliability (22,23). The mSEBT consists of three 2-meter lines taped on the floor (anterior (A), posterior-lateral (PL), and posterior-medial (PM)) joining at angles of 90, 135, and 135 degrees at the midpoint. After showing all participants how to perform mSEBT, participants had four practices for both legs in each direction for familiarization. Before main tests, participants warmed up for 10 minutes in sportswear (~7 min running at 50%-65% of maximum heart rate and then ~3 min dynamic stretching) (12). The test was performed barefoot on a hard surface. Following 30 minutes of rest after the familiarization sessions, measurements were performed, and all valid results were recorded.

The stance leg of participants was placed at the centre of the “Y” with the most distal end of the big toe placed on the mark zero. Participants were asked to reach as far as possible to slightly tap the floor with their other foot. For valid trials, the reached distance was noted for each participant by the distal part of the big toe in each direction, while hands remained on the hips. When the participants removed their hands from their hips, moved stance foot position, did not return to the starting position, and transferred their bodyweight to the reaching foot to increase distance, the trial was accepted as invalid, and the participant repeated the test. Three valid tests were performed for each participant on both dominant and non-dominant legs. The dominant leg was determined as the leg used to kick the ball. Visual cues, such as objects on the ground and people not involved in the study, were removed from the testing area to avoid visual and auditory influences. No encouragement or further instruction was given to the participants throughout the testing. All tests were performed by the same sports medicine physician. Since alcohol and fatigue may negatively affect dynamic balance performance, participants were warned to avoid activities that would cause excessive fatigue and not to drink alcohol in the last 24 hours (24,25).

Directional scores for each direction were calculated according to the formula DS=(RD1+RD2+RD3)/3/LLx100, where DS means direction score, RD reached distance (cm), LL leg length (cm) (23). The composite score for each leg was also calculated according to the formula CS=(Amax+PLmax+PMmax)/3/LLx100, where CS means composite score, A anterior (cm), PL posterior-lateral (cm), and PM posterior-medial (cm).

Data Analysis

The SPSS 25.0 statistical package program was used for data analysis. Data were summarized by giving means and standard deviations. Whether the data showed normal distribution or not was checked with Kurtosis-Skewness coefficient intervals. Since the data showed normal distribution (the range did not exceed the values of +2.0 and -2.0), ANOVA was used for comparisons of more than two sets (26). The differences between the groups were given by Tukey post-hoc test due to the equal distribution of the number of groups (27). The level of significance was taken as 0.05. G-power program was also used to calculate the effect size (ES) with partial eta squared (n^2). It measures the ratio of variance explained by a given variable of the total variance remaining after accounting for variance explained by other variables in the model (<0.01: small ES; 0.01-0.06: medium ES, >0.14: large ES) (28).

RESULTS

A total of 114 participants, including 34 beach football players, 39 futsal and 41 football players, participated in the study. While the height of futsal players was significantly lower than football players (p=0.03, ES=0.05), the weight of futsal players was significantly lower than beach soccer players (p=0.03, ES=0.05). The number of years spent by football players in sports was significantly higher than that of futsal players (p=0.05, ES=0.05). The characteristics of the participants are given in Table 1.

Table 1. Characteristics of participants (n=114)					
Variables	**Futsal (A)**	**Beach soccer (B)**	**Football (C)**	**p**	**ES**
Age (year)	23.4±4.6	25.1±6.1	24.8±5.0	0.29	0.02
Height (cm)	178.1±4.6	180.4±5.7	181.0±5.2	**0.03 (A-C)**	**0.05**
Weight (kg)	72.2±6.2	76.1±8.0	74.3±5.5	**0.03 (A-B)**	**0.05**
BMI (kg/m²)	22.7±1.5	23.3±1.7	22.7±1.1	0.08	0.04
Years in sport	2.6±2.2	3.7±2.9	4.0±2.9	**0.05 (A-C)**	**0.05**
Leg length (cm)	91.4±4.4	92.0±4.9	92.1±5.0	0.76	0.01

BMI: body mass index; figures as Mean±SD; ES: effect size

When the direction and composite scores were compared between groups, dominant side PL and C scores (p<0.01, ES=0.10; p<0.01, ES=0.11, respectively) and non-dominant side A, PL and C scores of beach soccer players were significantly higher comparing to futsal players (p=0.01, ES=0.07; p<0.01, ES=0.08; p<0.01, ES=0.08, respectively). In addition, dominant side C scores of beach soccer players were significantly higher than football players (p<0.02, ES=0.11). The comparison of balance performance according to sports disciplines is given in Table 2.

Table 2. Comparison of the dynamic balance scores according to sports disciplines (n=114)									
Direction	**Side**	**Discipline**	**Mean±SD**	**Lower**	**Upper**	**F**	**p**	**ES**	**Post-hoc**
Anterior score	**Dominant**	Futsal	87.2±5.0	85.6	88.8	1.66	0.19	0.02	-
		BS	89.9±7.4	87.3	92.5				
		Football	88.6±6.5	86.5	90.6				
Posteriolateral score		Futsal	100.4±7.4	97.9	102.8	6.16	**<0.01**	0.10	A<BS
		BS	106.1±7.8	103.4	108.9				
		Football	102.5±6.0	100.6	104.4				
Posteriomedial score		Futsal	94.1±6.5	92.0	96.3	2.69	0.07	0.04	-
		BS	98.6±9.2	95.4	101.8				
		Football	96.4±8.8	93.6	99.2				
Composite score		Futsal	96.0±5.5	94.2	97.8	7.09	**<0.01**	0.11	A<BS C<BS
		BS	101.4±7.2	98.9	103.9				
		Football	96.5±7.1	94.3	98.8				
Anterior score	**Non-dominant**	Futsal	87.5±5.4	85.7	89.2	4.52	**0.01**	0.07	A<BS
		BS	91.8±7.8	89.1	94.6				
		Football	89.0±5.7	87.2	90.8				
Posteriolateral score		Futsal	101.1±7.7	98.6	103.6	5.23	**<0.01**	0.08	A<BS
		BS	106.4±7.5	103.8	109.1				
		Football	103.0±6.0	101.1	104.9				
Posteriomedial score		Futsal	94.4±6.6	92.3	96.6	0.81	0.44	0.01	-
		BS	96.8±9.2	93.6	100.1				
		Football	95.9±8.6	93.2	98.6				
Composite score		Futsal	96.9±6.2	94.8	98.9	5.32	**<0.01**	0.08	A<BS
		BS	101.5±6.8	99.1	103.9				
		Football	98.3±5.3	96.6	100.0				

A: Futsal; BS: Beach soccer; C: Football

DISCUSSION

To our knowledge, this is the first study investigating the dynamic balance profiles among football, futsal, and beach soccer players. The main findings of the present study were that the dynamic balance profile of beach soccer players was better comparing to futsal players, and there were no significant difference between direction scores of beach soccer and football players (except for the dominant side composite score), although the scores of beach soccer players were slightly higher than football players.

Performing on different surfaces may affect athletic performance parameters such as dynamic balance to varying levels. For example, unstable surfaces such as sand may cause sudden and repetitive perturbations, resulting in greater improvement in dynamic balance, while hard surfaces may not cause as much perturbation as sand. Therefore, it was shown that running on the sand may cause significant deviations in the centre of pressure (10). Difficulty in maintaining balance on sand may lead to long-term adaptations, improving dynamic balance. The present study results support the literature by displaying that the dynamic balance performance of beach soccer players was better than futsal players. Conversely, displacement on sand is more difficult compared to a hard surface due to difficulties in maintaining dynamic balance in the knee or ankle joints, and may lead to an increase in strength in the lower extremity muscle (10). Prior research supports this by revealing that beach soccer players have higher lower extremity muscle strength than futsal players (11). Since improved muscle strength is associated with better dynamic balance performance, it may be argued that having higher muscle strength is a factor that enables beach soccer players to have better dynamic balance performance (12).

On the other hand, the nature of sports and the metabolic demands of the sports disciplines may also have an impact on dynamic balance. Paterno et al. reported that six weeks of neuromuscular training improves single-limb stability in athletes (29). Myer et al. supported these results by showing that plyometric training primarily affects sagittal plane kinematics during a drop vertical jump, and may reduce lower extremity valgus measures (30). Although sports-specific drills such as sudden change of direction, acceleration and deceleration are common in all three disciplines, jumping frequency may be significantly different. Beach soccer players often play from the air due to the unstable surfaces where beach soccer is played, and football players tend to play from the air by throwing long balls during the match, leading to repetitive jumps, while futsal players often play from the ground, and may jump much less during a match. The difference in jumping frequencies may also be a reason for the difference in dynamic balance between beach soccer and futsal players.

Furthermore, the metabolic demands of these sports disciplines are also different (1). While anaerobic processes provide a significant amount of energy during a beach soccer match, it is relatively less for futsal, whereas the majority of the energy in a football match is provided by aerobic processes (6-8). Considering that type 2 fibers (also called fast and glycolytic fibers), which make up a possibly larger amount in beach soccer players, contribute faster than type 1 fibers in maintaining balance, in particular, against sudden perturbations, it may be argued that the metabolic demands of each sport disciplines may have an impact on the dynamic balance profiles (14). Given that sand surfaces produce similar gains to those observed after hard-surface training, cause less muscle damage, and may provide a safer alternative to the hard ground, strength and conditioning coaches and sport scientists who work with team sports can use both sand and hard surface training programs as part of regular training practices to improve balance during distinct phases of the season (31,32). Future research is needed to inform how often and how to train on sand.

The difference in dynamic balance between beach soccer and futsal players seems to be reflected in injuries as well. In a meta-analysis, it was reported that the sports category with the highest incidence of ankle sprain was indoor/court sports (18). Studies on futsal and beach soccer injuries also support these results. Whilst ankle sprain is almost one tenth of injuries in futsal, this rate is less than 1% in beach soccer (9,17). Although playing on different surfaces has a facilitating or protective impact on ankle sprain formation, it may be argued that the difference in dynamic balance also has an effect on injuries. It is known that a poorer balance profile is a risk factor for sports injuries (20). In order to prevent lower extremity ligament injuries, it may be beneficial for futsal players to train on sand. Moreover, sand causes less loading during the eccentric phase of the drop jumps, so it can be considered as a surface that can offer injury prevention under demands for large energy expenditure (33). Since sand may provide a safer alternative to hard ground when performing, training on sand not only reduces injuries, but may also be used for injury rehabilitation (34).

A number of limitations must be considered for the present study. Firstly, factors that might affect dynamic balance performance could not be assessed. Also, general sports practices or football background of beach soccer and futsal players were not questioned, although they might have an impact on dynamic balance. Secondly, since the study was conducted on male athletes only, it does not provide information about gender differences in dynamic balance. Thirdly, further studies with larger sample sizes would be better in supporting findings of this study. Fourthly, the cross-sectional nature of the study design limits the information about changes in dynamic balance over the season. Lastly, although all participants performed a familiarization session before the main measurement, playing beach soccer barefoot and the dynamic balance measurement performed barefoot may have provided convenience to beach football players.

To conclude, findings demonstrated that the dynamic balance profile of beach soccer players is better comparing to futsal players. Considering the results of the present study, it may be useful for players from different sport disciplines to train on sand in order to improve their dynamic balance, although there are other factors affecting balance. More comprehensive research that also evaluates those factors affecting dynamic balance is needed.

Ethics Committee Approval / Etik Komite Onayı

Approval for this study was obtained from the Institutional Ethics Committee of Selçuk University Sport Science Faculty, Konya, Türkiye (Decision No: 46 Date: 25.03.2022).

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: YL; Design: YL; Supervision: YL; Materials: YL; Data Collection and Processing: YL; Analysis and Interprepation: YL; Literature Review:

YL; Writing Manuscript: YL; Critical Reviews: YL.

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