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Original Article

Association of Foot Posture and Dynamic Balance in University Football Players

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ABSTRACT

Background: Foot posture may influence lower-limb biomechanics, proprioceptive control, and postural stability during sport-specific movements. In football players, dynamic balance is essential for sprinting, cutting, landing, kicking, and rapid directional changes; however, evidence regarding the relationship between foot posture and dynamic balance among university football players remains limited. Objective: To determine the association between foot posture and dynamic balance among university football players. Methods: This observational cross-sectional study included 152 university football players recruited through convenience sampling. Participants with recent lower-limb injury or surgery, neuromuscular disease, vestibular or balance disorders, neurological illness, recent concussion, or any condition affecting balance were excluded. Foot posture was assessed using the Foot Posture Index, and dynamic balance was assessed using the Y-Balance Test composite score. Data were analyzed using IBM SPSS Statistics version 27, and Spearman rank correlation was used to examine the association between Foot Posture Index and Y-Balance Test performance. Results: The mean age was 25.97 ± 4.97 years. Normal foot posture was observed in 87 participants (57.2%), supinated posture in 55 (36.2%), and pronated posture in 10 (6.6%). The mean Y-Balance Test composite score was 97.12 ± 7.36. Foot Posture Index showed a strong negative correlation with Y-Balance Test score (r_s = -0.715, $p < 0.001$). Conclusion: Foot posture was significantly associated with dynamic balance among university football players. These findings support the inclusion of foot posture assessment in sports screening and preventive rehabilitation, although causal interpretation is limited by the cross-sectional design. Keywords: Foot Posture Index; Y-Balance Test; Dynamic Balance; Football; Postural Balance; Sports Physiotherapy; University Athletes

INTRODUCTION

Football is a high-intensity multidirectional sport that requires repeated acceleration, deceleration, sprinting, cutting, jumping, landing, kicking, and rapid changes in body orientation under variable external demands. These sport-specific movements place substantial mechanical load on the lower extremities and require coordinated interaction between strength, neuromuscular control, proprioception, agility, and postural stability. In university-level football players, these demands are further intensified by regular training exposure, competitive participation, and the need to maintain functional performance while balancing academic schedules. Previous evidence has shown that lower-limb injury history and altered movement control can influence gait variability and functional performance, highlighting the importance of identifying modifiable biomechanical factors that may affect balance and injury risk in athletic populations (1).

Dynamic balance is particularly important in football because players frequently perform single-limb support tasks while responding to unpredictable game situations. Functional movement screening and

dynamic balance assessments have been used in athletic populations to identify deficits that may contribute to altered movement efficiency or increased injury susceptibility (2). Among the biomechanical factors that may influence balance, foot posture is clinically relevant because the foot represents the primary interface between the body and the ground. Through its arches, joints, ligaments, intrinsic and extrinsic muscles, and sensory receptors, the foot contributes to shock absorption, load transmission, proprioceptive feedback, and control of the body's center of mass during static and dynamic activities. Alterations in foot posture, including excessive pronation or supination, may therefore influence lower-limb alignment, plantar loading, joint mechanics, and the efficiency of postural control strategies during sport-specific movements.

The relationship between altered foot posture and balance has been explored in different physically active populations, but findings remain variable across age groups, sports, measurement tools, and foot-type classifications. Research involving physically active females with pronated feet has suggested that dynamic balance may be more sensitive than static balance to changes in foot structure, particularly during reach tasks that challenge lower-limb control (3). In contrast, studies involving adolescent volleyball players have reported weaker or non-significant relationships between foot biomechanics and balance, suggesting that the strength of this association may depend on sport-specific movement demands, participant characteristics, and the biomechanical variables assessed (4). Evidence from neuromuscular training research also indicates that balance, strength, and movement control are adaptable performance domains, which reinforces the clinical importance of identifying structural or functional factors that may limit dynamic stability in athletes (5).

Football-specific evidence has shown that lower-extremity strength and neuromuscular training can improve components of performance such as dynamic balance, shooting speed, dribbling skill, and jumping ability, indicating that postural control is not an isolated construct but an integrated element of athletic function (6). In individuals with flexible pes planus, interventions targeting joint or soft-tissue impairments have been examined for their effects on lower-limb function, supporting the view that foot posture-related impairments may be clinically modifiable when properly identified (7). Similarly, evidence from dancers has shown that pronated and supinated foot postures may influence static and dynamic balance, suggesting that deviations away from neutral alignment may affect functional stability even in populations exposed to high balance demands (8). Taping studies evaluating balance and navicular mechanics further support the relevance of foot alignment and midfoot control in postural performance (9).

The Y-Balance Test is commonly used to assess dynamic balance through anterior, posteromedial, and posterolateral reach tasks, and has been applied in athletic screening because it reflects the integrated contribution of mobility, stability, strength, proprioception, and neuromuscular control. Studies in volleyball and basketball players have used Y-Balance Test performance and related functional measures to identify athletes who may be more prone to injury, supporting its clinical utility in sports rehabilitation and performance monitoring (10). Because football involves rapid multidirectional transitions, single-limb stance, kicking, landing, and defensive maneuvers, deficits in Y-Balance Test performance may reflect impairments that are directly relevant to football-specific movement. Resistance and isoinertial training studies have further emphasized that lower-limb strength, balance, and explosive functional tasks are closely linked in athletes, particularly in football players who require repeated control of body mass over a changing base of support (11,12).

Foot morphology and plantar structure may influence how forces are distributed across the lower limb during weight-bearing tasks. Evidence from young athletes with different foot types has shown that foot morphology can affect plantar pressure distribution, while studies on flat-footed individuals and athletes have reported reductions in dynamic balance performance compared with those with normal arches (13,14). Although not all available studies are directly comparable because of differences in population, assessment procedures, and outcome measures, the overall body of literature suggests that abnormal

foot posture may compromise proprioceptive input, alter joint loading, and reduce the efficiency of dynamic postural control. However, some published sources remain incomplete or only indirectly relevant to this specific question, which highlights the need for carefully designed studies that directly examine foot posture and dynamic balance in clearly defined football populations (15).

Despite the clinical and performance relevance of foot posture, there remains limited evidence on its association with dynamic balance among university football players, particularly in local university settings. This gap is important because university football players may represent a population with high training exposure but variable access to biomechanical screening, preventive physiotherapy, footwear assessment, or individualized balance training. Previous studies involving runners, athletes with flat feet, and adults with altered foot posture have reported inconsistent strengths of association between foot alignment and balance, suggesting that sport-specific analysis is necessary before applying findings from one athletic group to another (16–19). Understanding whether foot posture is associated with dynamic balance in university football players may assist physiotherapists, coaches, and sports scientists in identifying athletes who could benefit from targeted proprioceptive training, lower-limb strengthening, footwear modification, or corrective exercise strategies.

Therefore, the present study was conducted to determine the association between foot posture and dynamic balance among university football players. It was hypothesized that altered foot posture, measured using the Foot Posture Index, would be significantly associated with reduced dynamic balance performance measured using the Y-Balance Test.

MATERIAL AND METHODS

This observational cross-sectional study was conducted to evaluate the association between foot posture and dynamic balance among university football players. The cross-sectional design was selected because the objective was to determine the relationship between naturally occurring foot posture characteristics and dynamic balance performance at a single point in time rather than to test the effect of an intervention. Active university football players of both sexes, aged 18–35 years, were recruited using a convenience sampling technique. Players were considered eligible if they were actively participating in football training or competition and were able to perform the required balance assessment safely. Individuals were excluded if they had a recent lower-limb injury or surgery, known neuromuscular disease, vestibular or balance disorder, neurological illness, concussion within the preceding three months, or any other condition that could independently affect postural control or safe performance of the Y-Balance Test.

Participants were approached through university football settings and were screened according to the predefined eligibility criteria. Demographic, anthropometric, and training-related information was collected using a standardized data collection form. The recorded variables included age, sex, height, weight, body mass index, football training experience, and relevant injury or medical history. Body mass index was calculated in kg/m^2 from measured or recorded height and weight. Foot posture was treated as the primary biomechanical exposure variable, while dynamic balance performance was treated as the primary functional outcome variable. Potentially relevant participant characteristics, including age, sex, body mass index, and training experience, were recorded to describe the sample and to identify factors that could influence balance performance.

Foot posture was assessed using the Foot Posture Index-6, a clinical observational tool used to classify foot posture on the basis of six components reflecting rearfoot, midfoot, and forefoot alignment. Each participant was assessed in relaxed standing, with weight distributed naturally through both feet. The Foot Posture Index score was used to classify participants into neutral, pronated, or supinated foot posture categories according to the scoring criteria applied in the study. To reduce measurement variability, assessments were performed using a consistent procedure and by the same assessor.

Participants were instructed to stand comfortably without intentionally correcting their foot position during assessment.

Dynamic balance was assessed using the Y-Balance Test, which evaluates reach performance in the anterior, posteromedial, and posterolateral directions while the participant maintains single-limb stance. Before testing, participants were given standardized instructions and demonstration of the procedure. Reach performance was recorded according to the Y-Balance Test protocol, and the final balance score was expressed as a normalized score to allow comparison across participants with different limb lengths (20). Trials were considered invalid if the participant failed to maintain balance, lifted or displaced the stance foot, placed weight through the reaching foot, or failed to return to the starting position under control. The Y-Balance Test score was used as the primary dynamic balance outcome.

Data were entered and analyzed using IBM SPSS Statistics version 27. Continuous variables were summarized using mean and standard deviation when reported as approximately normally distributed or when distributional information was not available, while categorical variables were summarized using frequency and percentage. The distribution of foot posture categories was described using counts and percentages. The association between Foot Posture Index score and Y-Balance Test performance was examined using Spearman's rank correlation because foot posture scoring is ordinal in clinical interpretation and the analysis aimed to assess a monotonic association between foot posture and dynamic balance. A two-tailed p-value of less than 0.05 was considered statistically significant. Missing or incomplete data were checked during data entry and verification, and analyses were conducted using available valid observations for the reported variables.

To improve internal consistency and reduce assessment bias, the same operational definitions, testing instructions, and scoring procedures were applied across all participants. Data were reviewed for completeness, range errors, and inconsistencies before analysis. Because the study used a non-probability sampling approach and an observational cross-sectional design, the analysis was interpreted as an association rather than evidence of causality.

RESULTS

A total of 152 university football players were included in the analysis. The demographic, anthropometric, training-related, foot posture, and dynamic balance characteristics of the participants are presented in Table 1.

Table 1. Demographic, Anthropometric, Training, Foot Posture, and Dynamic Balance Characteristics of Participants

Variable	Category / Measure	Value
Age (years)	Mean ± SD	25.97 ± 4.97
	Range	18–35
Sex	Male, n (%)	52 (34.2)
	Female, n (%)	100 (65.8)
Height (cm)	Mean ± SD	176.55 ± 7.72
Weight (kg)	Mean ± SD	72.93 ± 7.76
Body mass index (kg/m²)	Mean ± SD	23.53 ± 3.26
	Range	16.80–31.20
Training experience (years)	Mean ± SD	6.70 ± 3.22
	Range	2–12
Foot posture	Normal, n (%)	87 (57.2)
	Pronated, n (%)	10 (6.6)
	Supinated, n (%)	55 (36.2)
Y-Balance Test composite score	Mean ± SD	97.12 ± 7.36
	Range	85.20–109.80

The mean age of the participants was 25.97 ± 4.97 years, with an age range of 18–35 years. The sample included 52 male participants (34.2%) and 100 female participants (65.8%). The mean height and weight

were 176.55 ± 7.72 cm and 72.93 ± 7.76 kg, respectively, while the mean body mass index was 23.53 ± 3.26 kg/m². Participants had a mean football training experience of 6.70 ± 3.22 years. Normal foot posture was the most frequent category, observed in 87 participants (57.2%), followed by supinated foot posture in 55 participants (36.2%) and pronated foot posture in 10 participants (6.6%). The mean Y-Balance Test composite score was 97.12 ± 7.36, with values ranging from 85.20 to 109.80. The association between Foot Posture Index and dynamic balance performance is presented in Table 2.

Table 2. Association Between Foot Posture Index and Y-Balance Test Performance

Variable 1	Variable 2	Statistical Test	r_s	p-value	N
Foot Posture Index	Y-Balance Test composite score	Spearman rank correlation	-0.715	<0.001	152

Abbreviation: r_s, Spearman's rank correlation coefficient.

Spearman rank correlation analysis demonstrated a strong negative association between Foot Posture Index score and Y-Balance Test composite score (r_s = -0.715, $p < 0.001$). This finding indicates that higher Foot Posture Index scores were associated with lower dynamic balance performance among the included university football players. Because the study used a cross-sectional design, this association should be interpreted as a relationship between foot posture and dynamic balance rather than evidence of a causal effect.

The available aggregate data did not include direction-specific Y-Balance Test values, group-wise Y-Balance Test scores according to foot posture category, individual Foot Posture Index scores, or adjusted regression outputs. Therefore, additional subgroup comparisons, confidence intervals, adjusted estimates, and effect-size calculations were not reported in the present Results section.

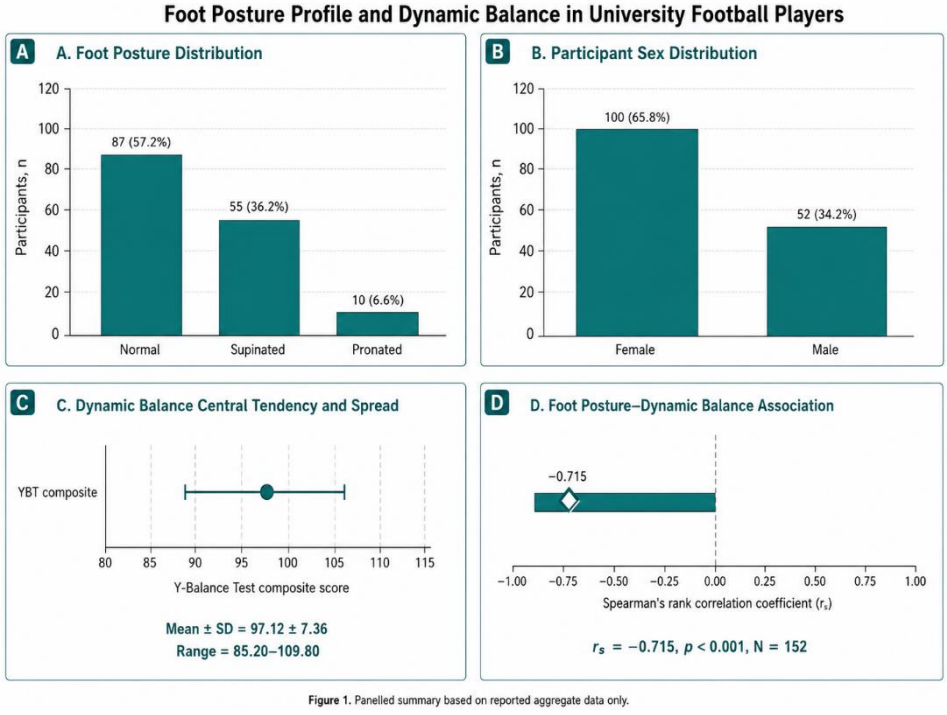

Figure 1 Foot Posture Profile and Dynamic Balance in University Football Players.

The panelled visualization summarizes the biomechanical and functional profile of 152 university football players using the available aggregate data. Normal foot posture was the most frequent category, observed in 87 participants (57.2%), while supinated posture was present in 55 participants (36.2%) and pronated posture in 10 participants (6.6%). The sample included 100 female participants (65.8%) and 52 male participants (34.2%). Dynamic balance performance showed a mean Y-Balance Test composite score of 97.12 ± 7.36, with values ranging from 85.20 to 109.80. The association panel demonstrates a strong negative correlation between Foot Posture Index and Y-Balance Test composite score (r_s = -0.715,

$p < 0.001$), indicating that increasing Foot Posture Index scores were associated with lower dynamic balance performance. Because the data are cross-sectional and based on aggregate reporting, this pattern should be interpreted as an association rather than evidence of causality.

DISCUSSION

The present study examined the association between foot posture and dynamic balance among university football players using the Foot Posture Index and Y-Balance Test. The findings demonstrated a strong negative and statistically significant association between Foot Posture Index score and Y-Balance Test composite score, indicating that increasing FPI scores were associated with lower dynamic balance performance in this sample. Normal foot posture was the most frequent category, followed by supinated and pronated foot postures, while the overall Y-Balance Test composite score suggested generally preserved but variable dynamic balance performance. These findings support the clinical relevance of foot posture assessment in football players, particularly because football requires repeated single-limb control, rapid directional changes, landing, kicking, and postural adjustments during unpredictable match situations.

The observed association is biomechanically plausible because foot posture influences the alignment and function of the lower-limb kinetic chain. The foot acts as the primary contact point between the athlete and the playing surface, contributing to load distribution, proprioceptive feedback, shock absorption, and control of the body's center of mass. Excessive pronation may alter medial arch mechanics, tibial rotation, and lower-limb loading, while excessive supination may reduce adaptive mobility and shock attenuation. Either deviation from optimal alignment may compromise efficient neuromuscular control during dynamic reaching tasks. This is clinically important in football because multidirectional running, cutting, and landing require rapid integration of sensory input from the foot and ankle with proximal hip, knee, and trunk control.

The findings are consistent with Chemperek et al., who reported that physically active females with pronated feet demonstrated altered dynamic balance performance, particularly in Y-Balance Test components, although static balance differences were less evident (3). This supports the interpretation that dynamic balance tests may be more sensitive than static assessments for detecting functional consequences of altered foot posture. The present study extends this evidence to university football players and suggests that foot posture may remain functionally relevant even in trained athletic populations. However, the current study used a composite Y-Balance Test score rather than direction-specific values, limiting the ability to determine whether anterior, posteromedial, or posterolateral reach was most affected.

The current findings also align with studies reporting reduced dynamic balance in individuals with flat or pronated feet. Muhsin and Ghazwan observed that young adults with flat feet demonstrated lower dynamic balance performance across multiple Star Excursion Balance Test directions compared with individuals with normal foot posture (14). Similarly, Rauf et al. reported differences in dynamic balance between flat-footed and normal-arched athletes, suggesting that altered arch mechanics may affect postural efficiency during functional reach tasks (17). Soni et al. also reported impairments in static and dynamic balance among adults with flat feet, supporting the view that abnormal medial longitudinal arch structure can influence proprioceptive and neuromuscular control (19). Collectively, these studies reinforce the clinical interpretation that altered foot posture may be associated with measurable functional balance deficits.

Some contrasting evidence should also be considered. Demirdel and Aksu found no clear relationship between foot biomechanics and balance measures in adolescent volleyball players, although plantar pressure variables showed some associations with balance-related parameters (4). This discrepancy may reflect differences in sport type, age group, training exposure, outcome measures, and biomechanical assessment methods. Volleyball involves repeated jumping and landing within a relatively constrained

court environment, whereas football requires more frequent multidirectional running, cutting, kicking, and reactive postural control. Therefore, the influence of foot posture on balance may vary according to the mechanical and neuromotor demands of each sport.

Evidence from dancers and runners further suggests that the strength of the association between foot posture and dynamic balance may vary by population and assessment method. Ladha and Jain reported that pronated and supinated foot postures can influence static and dynamic balance in dancers, supporting the possibility that deviations from neutral alignment affect functional stability even in highly trained individuals (8). In contrast, Pradhan et al. reported only a weak correlation between foot posture and balance in recreational runners, indicating that linear running activities may not expose balance limitations to the same degree as multidirectional sports (16). This difference is important because football requires frequent control of body mass outside the base of support, making dynamic balance more sensitive to biomechanical variations in the foot and ankle.

The strong negative correlation observed in the present study should be interpreted carefully. Although higher FPI scores generally indicate a shift toward pronated posture, the sample included a substantial proportion of participants with supinated posture and a relatively small proportion with pronated posture. Therefore, the relationship between foot posture and dynamic balance may not be fully explained by pronation alone. If both excessive pronation and excessive supination impair functional stability, a category-wise comparison or nonlinear analysis would be more informative than a single monotonic correlation. Future analyses should report Y-Balance Test performance separately for normal, pronated, and supinated foot posture groups and should include direction-specific Y-Balance Test scores to clarify whether balance impairment is generalized or direction-specific.

The clinical implications of these findings are relevant for sports physiotherapy, athletic screening, and injury-prevention programming. Routine assessment of foot posture may help identify football players who require further evaluation of balance, proprioception, lower-limb strength, footwear, or orthotic needs. Interventions such as proprioceptive training, balance exercises, intrinsic foot muscle strengthening, eccentric or isoinertial lower-limb strengthening, and sport-specific neuromuscular control drills may be considered for players with altered foot posture and reduced balance performance. However, because the present study was observational and cross-sectional, these interventions should be viewed as clinically reasonable implications rather than direct consequences proven by the current findings.

This study has several limitations. The use of convenience sampling may limit generalizability beyond the included university football players. The cross-sectional design prevents causal inference, so it cannot be determined whether altered foot posture contributed to reduced dynamic balance or whether other factors influenced both variables. Potential confounders such as playing position, limb dominance, fatigue level, footwear type, training load, previous subclinical injury, and lower-limb strength were not controlled in the reported analysis. The analysis relied on an unadjusted Spearman correlation and did not include regression modelling or stratified analysis by sex, BMI, training experience, or foot posture category. The absence of direction-specific Y-Balance Test values also limits clinical interpretation. Future studies should use larger and more representative samples, report detailed FPI and Y-Balance Test component scores, include adjusted statistical models, and consider prospective designs to determine whether altered foot posture predicts balance deficits or injury occurrence in football players.

CONCLUSION

This study demonstrated a significant negative association between Foot Posture Index score and Y-Balance Test composite score among university football players, indicating that variations in foot posture were associated with differences in dynamic balance performance. Normal foot posture was the most common category, while supinated and pronated postures were also observed within the sample. These findings suggest that foot posture assessment may be a useful component of clinical screening,

performance monitoring, and preventive rehabilitation planning in football players. However, because the study used a cross-sectional design, the findings should be interpreted as associative rather than causal, and future research should include direction-specific balance outcomes, group-wise foot posture comparisons, and adjusted analyses to clarify the functional impact of pronated and supinated foot postures.

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