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Association between Sports-Related Injuries and Functional Tests in Physically Active College Students: A Cross-Sectional Study

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ABSTRACT

Aims: Increasing university students' athletic participation has corresponded with an increase in musculoskeletal injuries. Functional screening presents a practical, non-invasive method for identifying individuals at risk. This study aimed to explore the association between performance in several functional tests—the Functional Movement Screen (FMS™), Y-Balance Test (YBT), Weight-Bearing Lunge Test (WBLT), and Davies test—and the history of sports-related injuries among active college students.

Method and Materials: A cross-sectional design was employed, involving 120 student-athletes (55 female, 65 male; mean age 26.7 ± 4.67 years) at the season's onset. Assessments included the FMS™, YBT, WBLT, and Davies tests. A structured questionnaire documented sports injuries sustained in the prior six months. Statistical analyses, including independent t-tests, chi-square tests, and binary logistic regression, were utilized to investigate the relationships.

Findings: A significant proportion of participants (26%; 31 individuals) reported at least one injury, predominantly affecting the ankle and knee. Individuals with a history of injury exhibited lower FMS™ scores and demonstrated reduced ankle dorsiflexion during the WBLT ($p < 0.05$). The logistic regression model was significant overall ($\chi^2(4) = 11.867$, $p = 0.018$). The FMS™ ($B = -0.173$, $p = 0.05$) and WBLT ($B = -0.223$, $p = 0.01$) were significantly associated with injury status, whereas the YBT and Davies test were not.

Conclusion: Both movement quality and ankle dorsiflexion demonstrated a significant association with injury history in university athletes. This suggests that these specific functional aspects may offer more clinical insight than balance or upper-limb stability for this population when assessing injury risk.

Keywords: Functional Tests, Sports Injuries, Functional Movement Screen (FMS), Y-Balance, Davies test, Weight-Bearing Lunge Test (WBLT)

Introduction

Sports in academic environments not only promote physical and mental health among students but also provide an essential platform for developing social and professional skills in young athletes. However, widespread participation in university-level competitions, especially high-intensity sports such as handball, football, and basketball, is associated with an increased risk of musculoskeletal injuries [1]. Existing data suggest that the population of male and female athletes has grown [2]. Naturally, this trend has been accompanied by a rise in injury incidence, with injury rates among university athletes reported between 15% and 20% over 16 years [2,3]. As the results show, knee and foot injuries are common among athletes [4,5]. Many injured players are forced to take extended breaks from training or even end their athletic careers. Therefore, early identification of at-risk athletes through accurate, field-based screening tools has become a key strategy for professional and collegiate teams [6]. One of the significant challenges in prevention is the risk of re-injury among athletes with a prior history of injury. Studies show that up to 63% of these individuals are at risk of secondary injuries, which are often more severe and costly [7]. Hence, using functional tests for initial screening to detect movement impairments or muscle imbalances is crucial. However, research on the accuracy of these tests in predicting injuries has produced varied and sometimes contradictory findings [6,8], such as inconsistent test protocols, non-standardized injury definitions, and reliance on self-reported data susceptible to recall bias [9,10], which reduces the accuracy and generalizability of findings and emphasizes the need for standardized research designs [9].

Regarding their combined ability to discriminate injury risk remains inconsistent, particularly in university-level athletes. Most previous studies have examined these tools in isolation, with limited attention to their relative contribution when assessed simultaneously. Among the most widely used tools for injury risk screening are the Functional Movement Screen (FMS™), Y-Balance Test (YBT), Weight-Bearing Lunge Test (WBLT), and Davies test. The FMS™ is specifically designed to identify faulty movement patterns and core control deficits, and weak trunk muscles have been associated with injury risk in several studies [11–14]. The YBT, a modified version of the Star Excursion Balance Test (SEBT), assesses dynamic balance and neuromuscular control of the lower limb in three directions (anterior, posteromedial, posterolateral). The test can identify functional asymmetries, core instability, and deficiencies in balance strategies, and has been extensively used to associate injuries to the ankle, knee, and hamstring [15]. The WBLT is recognized as a simple, accurate, and reliable method for assessing ankle dorsiflexion Range of Motion (ROM), which plays a crucial role in shock absorption and preventing knee and ankle injuries [16,17]. The athlete places their foot perpendicular to a wall and moves their knee forward to touch the wall without lifting the heel. Studies have linked limited ROM to increased risk of recurrent injuries and proximal joint problems. For example, players with dorsiflexion <36.5° are more prone to patellar tendinopathy and valgus-related injuries during landing [18]. The Davies test is a simple, practical method for assessing scapular stability and upper-limb neuromuscular performance. The individual assumes a push-up position and must rapidly touch alternating hands across a 36-inch distance within 15 or 30 seconds. The test assesses muscular endurance of the shoulders, arms, and core and can help identify asymmetries and movement control deficits. It is particularly relevant to overhead sports such as handball, volleyball, basketball, and swimming [19].

While previous studies have examined each of these tests individually, few have analyzed them in combination within university athlete populations. Therefore, this study addresses this gap by investigating the combined associations of the FMS™, YBT, WBLT, and Davies tests with musculoskeletal injury occurrence among university athletes, aiming to provide a more comprehensive understanding of multidimensional risk factors and to inform the development of effective injury prevention strategies.

Method and Materials

This study was designed as a cross-sectional observational study in accordance with the Declaration of Helsinki.

The sample size was determined using G*Power software (version 3.1). With a 95% confidence level, an effect size of 0.65 [7], and a statistical power of 0.85, the minimum required sample size was calculated to be 104 participants. Ultimately, 120 participants were recruited. This study was conducted on 120 male and female athletes from the University of Tehran, who were randomly selected from volunteers and invited to the university laboratory. Participants were engaged in various sports disciplines. Inclusion criteria were: age between 18 and 30 years, regular sports participation over the past six months (at least three sessions per week), and medical clearance for full sports activity. Exclusion criteria included a history of surgery, severe injuries within the past year, or chronic/neurological disorders. All participants were asked to provide informed consent and complete a medical history form before participating in the study. Tests were performed in random order with rest intervals to minimize fatigue and training load effects as confounding variables. A sports-related injury was defined as any musculoskeletal complaint resulting from sports participation that led to modified training, medical consultation, or time loss from activity.

FMS™ was utilized as a comprehensive screening tool to evaluate fundamental movement patterns and identify potential limitations or asymmetries that may predispose individuals to musculoskeletal injury. Following the standardized protocols established by the authors, subjects performed seven specific movement tasks. These included the Deep Squat to assess bilateral, symmetrical mobility of the hips, knees, and ankles; the Hurdle Step to evaluate stride mechanics, stability, and hip mobility; and the Inline Lunge to examine torso stability alongside quadriceps and hip flexibility. Furthermore, Shoulder Mobility was assessed for bilateral range of motion, scapular mobility, and thoracic extension, while the Active Straight Leg Raise (ASLR) measured hamstring and calf flexibility in relation to core stability. Finally, trunk stability was evaluated through the Trunk Stability Push-up, assessing sagittal plane control during upper-body closed-chain movement, and the Rotary Stability test, which measures multi-planar trunk stability during integrated upper- and lower-body movements (Figure 1). Each task is scored on a scale from 0 to 3 (0 = pain during the movement, 1 = inability to perform, 2 = completion with compensation, 3 = perfect execution) with a maximum total score of 21 points. Previous literature has consistently shown that a composite score of ≤14 is associated with a significantly higher risk of sports-related injuries among physically active populations [11].

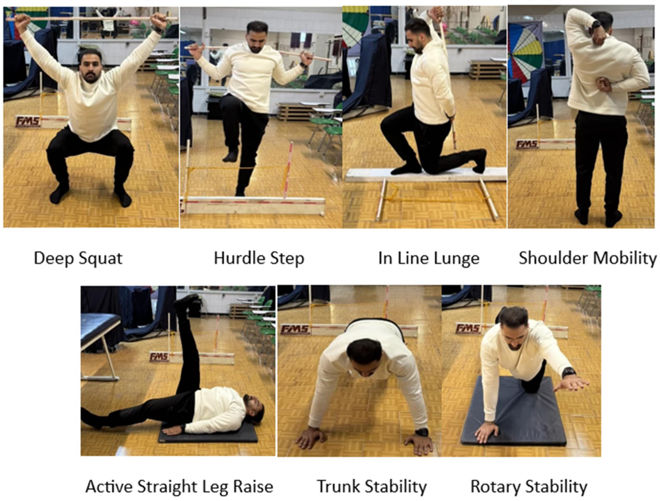


Figure 1) Seven test positions/activities of the Functional Movement System (FMS™).

YBT is a quantitative measure of dynamic postural control. It requires subjects to maintain a stable stance while reaching maximally in three distinct directions with the free limb: Anterior, Posteromedial, and posterolateral (Figure 2). The distances reached in each direction are normalized to leg length (measured from the anterior superior iliac spine to the distal tip of the medial malleolus) to account for anthropometric differences [20,21]. Furthermore, lower composite reach scores (sum of three normalized directions divided by three times leg length × 100) have been linked to reduced neuromuscular control and heightened injury susceptibility [20].

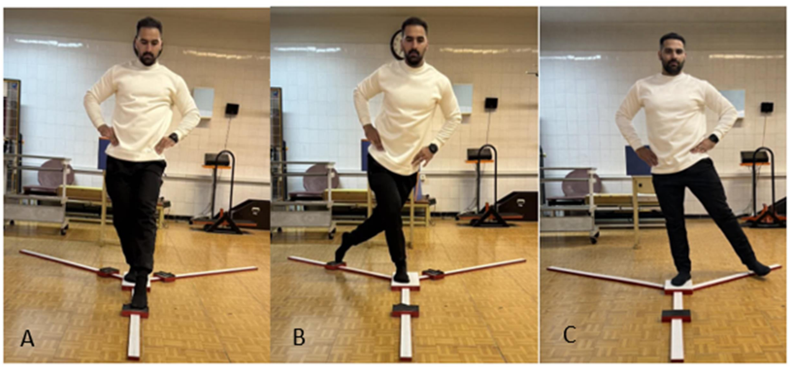


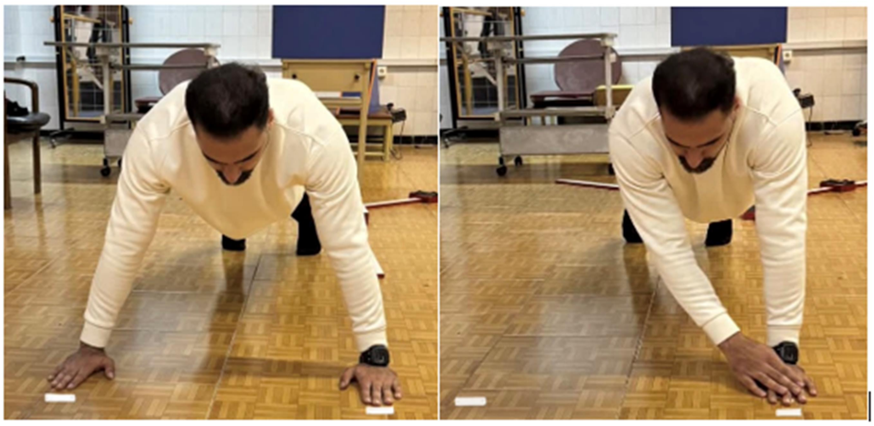
Figure 2) Y-balance test reaches (A: anterior, B: posteromedial, C: posterolateral).

The WBLT is a reliable clinical measure for assessing ankle dorsiflexion ROM in a closed kinetic chain. During the assessment, the participant stands facing a wall and lunges forward until the knee touches the wall without the heel lifting off the ground. The maximum distance from the tip of the great toe to the wall is recorded in centimeters (Figure 3). In an attempt to establish the most reliable method for measuring ankle dorsiflexion ROM during the WBLT, five commonly used techniques were considered: heel-wall distance, toe-wall distance, tibia angle, Achilles tendon angle, and a trigonometric angle derived from the heel-wall distance and the ground-knee distance. So, he reached a reliable formula with the ground-knee distance and heel-wall distance [17,22]:

Dorsiflexion ROM (angle) = 90 – Arc tan° [ground-knee distance (GK) / heel-wall distance (HW)]

Figure 3) The weight-bearing lunge test. GK: Ground-Knee distance; HW: Heel-Wall distance.

The Davies Test is used to assess scapular stability, upper-extremity strength, and endurance in a weight-bearing, closed-chain position. The participant adopts a high plank position with hands placed 90 cm apart and alternately touches the opposite hand with each repetition. The total number of touches completed in 15 seconds is recorded (Figure 4). Lower performance scores indicate deficits in scapular stabilizer endurance, shoulder girdle strength, and overall upper-body neuromuscular control, which may contribute to shoulder or upper-limb injuries in athletes [19].



A B

Figure 4) Davies Test: A) The patient assumes the push-up position with the hands placed 36 inches apart on strips of athletic tape. B) The patient reaches with alternating hands across the body to touch the opposing piece of tape as many times as possible in 15 seconds.

Injury history over the past six months was used to examine the association between functional test scores and injury status. Data were analyzed using SPSS v26. The normality of the data was assessed using the Shapiro-Wilk test. Effect sizes were calculated for each comparison, with 0.2 considered small, 0.5 moderate, and 0.8 or greater large. Independent t-tests were used to compare scores between injured and non-injured groups. Chi-square tests and binary logistic regression were employed to assess associations between functional tests and injury occurrence. Statistical significance was set at $p < 0.05$.

Findings

A total of 120 physically active university students (55 females and 65 males) participated in the study, with a mean age of 26.7 ± 4.67 years. The mean Body Mass Index (BMI) was 22.58 ± 2.19 kg/m^2.

In this study, 31 participants (25.8%) sustained sports-related injuries. Injury locations were: upper limb (16.0%), lower back (7.0%), and lower limb (77.0%). The most frequent injury sites were the knee (57.9% of injuries) and ankle (36.8%), while neck and thigh injuries were the least frequent (~1% each). The sum of the percentages exceeds 100% because some participants had multiple injuries. Chi-square analysis indicated significant differences in injury distribution across body segments (χ^2 = 395.14, df = 7, p = 0.001).

Initial analyses indicated associations between FMS™, Y-Balance Test, Davies Test, and WBLT scores and the occurrence of sports injuries. Logistic regression showed that, when considered together, FMS™ and WBLT scores were significantly associated with injury status, while YBT and Davies tests were not significant in the multivariate model. The Shapiro-Wilk test confirmed that all variables were normally distributed (p > 0.05).

As Table 1 shows, independent t-tests indicated that injured participants had significantly lower FMS™ scores than non-injured participants. WBLT scores were slightly lower in injured participants than in non-injured participants. This apparent decrease suggests that WBLT values, which reflect ankle dorsiflexion, may behave differently in isolated analysis compared to multivariate models. No significant group differences were found for YBT or Davies Test scores, indicating that these tests may have limited discriminative ability for injury risk in this population.

Table 1) Comparison of Functional Test Scores Between Injured and Non-Injured Participants

Test	Injured (n=31) (Mean ± SD)	Non-Injured (n=89) (Mean ± SD)	t	p-value
FMS™ Total	16.12 ± 1.99	17.00 ± 2.41	1.94	0.05*
WBLT Total (°)	44.62 ± 2.66	45.01 ± 2.69	2.92	0.04*
YBT Total	89.36 ± 10.23	91.40 ± 12.17	0.82	0.41
Davies Test	11.87 ± 2.65	12.03 ± 3.95	-0.24	0.81

Functional Movement Screen (FMS™), Y-Balance Test (YBT), Weight-Bearing Lunge Test (WBLT), and Davies Test ; P < 0.05

Effect size calculations (Cohen's d) indicated a moderate difference for FMS™ (d = 0.36) and small differences for WBLT (d = -0.14) and YBT (d = 0.16), and the Davies test (d = 0.04) demonstrated negligible effect sizes.

Given the higher prevalence of lower-limb injuries in this study, lower-limb-specific tests were analyzed separately by side (Table 2). Injured participants demonstrated lower scores on all tests for the affected side, except for the right-side WBLT, where injured participants showed slightly higher values; however, none of these differences reached statistical significance.

Table 2) Comparison of Functional Test Scores Between the Injured Sides of the Lower Limbs.

Test / Limb	Injured Left side (Mean ± SD)	Injured Right side (Mean ± SD)	t	p-value
WBLT Left (°)	41.45 ± 1.87	43.71 ± 3.22	1.85	0.08
WBLT Right (°)	42.46 ± 2.61	43.78 ± 2.75	1.09	0.28
YBT Left	86.75 ± 12.26	90.11 ± 10.47	0.66	0.51
YBT Right	91.40 ± 10.08	88.38 ± 13.22	-0.56	0.58

Weight-Bearing Lunge Test (WBLT): Y-Balance Test (YBT)

A binary logistic regression was conducted to examine the associations between FMS™, WBLT, YBT, and Davies Test scores and the occurrence of sports injuries (Table 3). The Omnibus Test of Model Coefficients was significant ($\chi^2(4) = 11.867$, $p = 0.018$), indicating that at least one variable was significantly associated with injury status. Pseudo R^2 values (Cox & Snell $R^2 = 0.101$, Nagelkerke $R^2 = 0.145$) suggested the model explained a modest portion of the variance. The Hosmer–Lemeshow test indicated a good fit ($\chi^2(8) = 3.714$, $p = 0.882$).

The model correctly classified 75.9% of cases, with high specificity (96.3%) but low sensitivity (22.6%). FMS™ and WBLT scores were significantly associated with injury status, with higher scores associated with a lower likelihood of injury after controlling for other variables. YBT and Davies Test scores were not significantly associated with injury status. The odds ratios (OR) were 0.841 for FMS™ and 0.800 for WBLT, indicating their potential protective role. YBT and Davies tests were not statistically significant in the multivariate model.

Table 3) Logistic Regression Coefficients Examining Associations Between Functional Tests and Injury Status.

Test	B	SE	p-value	OR	95%CI Lower	95%CI Upper
FMS™	-0.173	0.080	0.05*	0.841	0.719	0.984
WBLT	-0.223	0.102	0.01*	0.800	0.655	0.977
YBT	-0.140	0.189	0.46	0.869	0.600	2.259
Davies Test	0.022	0.079	0.77	1.022	0.876	1.193

Functional Movement Screen (FMS™), Weight-Bearing Lunge Test (WBLT), Y-Balance Test (YBT), and Davies test ; $p < 0.05$

Discussion

The purpose of this study was to examine the associations between functional test results and the occurrence of sports injuries in physically active college students. One of the strengths of this study is the simultaneous assessment of multiple functional tests, which provides a comprehensive view of participants' movement quality and functional capacity. Although the model showed high specificity (96.3%), its sensitivity was low (22.6%), which limits its ability to identify injured individuals correctly. This should be considered when applying the model in practice.

The findings indicated that FMS™ and WBLT scores were significantly associated with injury occurrence, whereas YBT and Davies test scores were not significantly associated in the multivariate model. These results are consistent with previous studies highlighting the relevance of functional movement and performance assessments in evaluating injury risk. Two studies have shown that a total FMS™ score below 14 is associated with a higher risk of musculoskeletal injury in athletes [11,20,23]. In our study, the injured group had a mean FMS™ score of 16.12, which supports the use of this threshold. Although injured participants demonstrated slightly lower WBLT values in univariate analysis, multivariate modeling revealed an inverse association, suggesting that isolated comparisons may be confounded by dominance or compensatory adaptations.

Conversely, although the injured group scored lower on the YBT composite, this test did not retain significance in the multivariate model. Meanwhile, scores on the injured side were lower (non-significantly) than the contralateral side, possibly due to fear of weight-bearing and balance. This aligns with research showing that athletes with ankle instability performed significantly worse on balance tasks than healthy individuals [24]. One plausible explanation is the relatively homogeneous, high baseline balance performance in our cohort, which likely limited variance and diminished discriminatory power. Moreover, given that most injuries were localized to the knee and ankle, tests directly assessing joint mobility (WBLT) and overall movement quality (FMS™) may have overshadowed general dynamic balance measures. This aligns with recent systematic reviews suggesting the YBT's independent predictive utility weakens when included alongside other mobility and movement quality assessments [25,26].

WBLT findings also reinforce mechanistic evidence: restricted dorsiflexion alters landing biomechanics, increasing knee and ankle stress [27]. In our study, injured participants had significantly lower dorsiflexion, indicating this mobility limitation may substantially affect injury risk, even if numerically small. Additionally, the injured dominant foot exhibited greater dorsiflexion ROM on the WBLT than the non-dominant foot. This finding may be related to right-foot dominance and associated repetitive loading or overuse adaptations [28]. Alternatively, increased ROM may reflect post-injury adaptations, such as ligamentous laxity; however, these potential mechanisms remain speculative and require further investigation. Consistent with our results, a prospective cohort study (2014) found that reduced dorsiflexion range of motion significantly increased the risk of mid-portion Achilles tendinopathy in military recruits [29]. An experimental study further supports these findings, showing that artificial restriction of dorsiflexion through wedge inserts resulted in increased patellofemoral joint forces and altered knee kinematics during stop-jumping tasks [30]. These mechanistic insights reinforce the potential role of dorsiflexion limitation as a modifiable risk factor for lower extremity injuries.

Additionally, the Davies test, which assesses shoulder-girdle stability and upper-limb coordination, was not significantly associated with injury. The upper-limb injury rate in our samples is lower, with active individuals having minimal upper-extremity injury rates[31]. Together, these results suggest that, although the Davies Test is useful for assessing upper limb function, its association with injury risk in athletic populations remains uncertain and requires further investigation in larger studies with higher injury incidence.

Given the cross-sectional design of this study, the associations observed between functional test scores and injury history cannot be interpreted as causal. These findings indicate correlations rather than cause-and-effect relationships and should therefore be interpreted with caution. Several limitations should also be acknowledged. First, the reliance on participants' recall of injuries may have introduced recall bias. Second, important confounding factors such as training load, sport type, and psychological readiness were not controlled for, which could have influenced both functional performance and injury occurrence. Third, although the logistic regression model demonstrated acceptable specificity, its low sensitivity limits its ability to accurately identify athletes at risk of injury.

Future studies are encouraged to adopt prospective longitudinal designs, control for potential confounders, and examine the combined utility of different functional tests. Moreover, it would be valuable to investigate whether targeted interventions based on identified deficits (e.g., low FMS™ or WBLT scores) can effectively reduce sports-related injury rates. The low sensitivity observed in the regression model indicates that functional tests alone may be insufficient for injury risk identification and should be interpreted as complementary rather than predictive tools.

Conclusion

Among the functional tests assessed, lower FMS™ and WBLT scores were significantly associated with a higher likelihood of sports injury in physically active university students. In contrast, YBT and Davies test scores showed no significant association. Incorporating FMS™ and WBLT into routine screening may help sports professionals identify athletes at a higher likelihood of injury and implement targeted preventive interventions. Future prospective studies are recommended to validate these associations and to explore the added value of combining functional assessments with biomechanical and neuromuscular evaluations to enhance injury risk management. Future research should evaluate whether targeted interventions based on FMS™ and WBLT deficits can prospectively reduce injury incidence.

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Authors' Contributions

S.A: conceptualization, validation, methodology, investigation, data curation, writing the original draft, software, review and editing. D.Z: conceptualization, methodology, validation, investigation, data curation. N.T: conceptualization, methodology, and formal analysis. S.M: data curation, conceptualization, methodology. R.GH: data curation, conceptualization, methodology. S.H.M: conceptualization, validation, investigation, review & editing, supervision, and project administration.

Conflict of interest

The authors declared no conflict of interest.

Ethical Permission

Ethical approval was obtained from the Tehran University Ethics Committee (IR.UT.SPORT.REC.1403.007). The article adhered to ethical guidelines, including obtaining participants' consent, maintaining the confidentiality of information, and allowing participants to withdraw at any time.

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