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The association between functional movement screening, motor control, and knee injury risk in soccer players

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ABSTRACT

Knee injuries in soccer are common and often linked to deficits in movement quality and neuromuscular control. The relationship between Functional Movement Screening (FMS), motor control, and self-reported knee symptoms in university athletes remains unclear. This study examined their association in male physical education students with soccer experience. A cross-sectional design included 120 males (21.00 ± 0.50 years), divided into injured (n = 60) and non-injured (n = 60) based on self-reported knee injury history. Four FMS subtests (deep squat, hurdle step, in-line lunge, active straight leg raise) were selected for lower-extremity assessment. Motor control was evaluated using the single-leg balance test. Knee symptoms and function were measured with the Knee Injury Symptom and Function Questionnaire (KISFQ). Spearman correlations and Mann–Whitney U tests were applied (α = 0.05). FMS and symptom scores were non-normally distributed. Results showed a weak negative correlation between FMS and symptoms (ρ = -0.33, p = .011) and a moderate negative correlation between motor control and symptoms (ρ = -0.41, p = .003). Significant between-group differences were found in FMS, motor control, and symptom scores (p < .001). Injured participants had lower FMS scores and shorter balance times. FMS and motor control are significantly associated with knee-related symptoms, with motor control showing a stronger relationship. These findings support integrating both measures in athlete evaluations. Longitudinal research is needed to establish causality.

Keywords: Health science, Balance, Functional movement screening, Knee symptoms, Motor control, Physical education students, Soccer, University athletes.

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INTRODUCTION

Soccer is one of the most physically demanding sports globally, requiring repeated high-intensity movements including sprinting, cutting, jumping, and rapid directional changes. Approximately 70% of soccer injuries are non-contact in nature, arising from deficits in mobility, stability, or movement quality rather than direct collision (Velarde-Sotres et al., 2025). These epidemiological patterns underscore the importance of identifying modifiable factors associated with injury-related symptoms through validated clinical screening approaches. Knee injuries represent one of the most prevalent and debilitating musculoskeletal problems in soccer, with elevated symptom burden frequently persisting beyond the acute phase and affecting long-term functional performance. Among the modifiable factors associated with knee injury-related symptoms, movement quality has received considerable attention as a clinically accessible, field-applicable variable. Research has consistently demonstrated that inadequate fundamental movement patterns are associated with inefficient biomechanics, elevated joint loading, and heightened symptom occurrence (McCall et al., 2015).

The Functional Movement Screening (FMS) is among the most widely adopted movement quality tools in sports settings, evaluating mobility, stability, and bilateral symmetry through a composite score. A recent systematic review and meta-analysis confirmed that structured exercise interventions significantly improve FMS composite scores, validating its sensitivity to training adaptations (Maleki et al., 2025). However, the association between FMS and injury-related symptoms remains inconsistent in the literature; Bayrak (2025) reported that FMS scores did not reliably differentiate between injured and non-injured professional soccer players across five competitive seasons, reinforcing the view that movement screening alone is insufficient for comprehensive injury assessment.

Alongside movement quality, motor control — encompassing static and dynamic postural stability and neuromuscular coordination — plays a critical role in maintaining joint integrity during the dynamic demands of soccer. Deficits in neuromuscular performance have been identified as primary modifiable factors associated with lower extremity symptoms across athletic populations (Frontiers in Sports and Active Living, 2021). A systematic review conducted in late 2024 further confirmed that neuromuscular training significantly enhances postural control and is associated with reduced incidence of lower extremity symptoms, including those affecting the knee and ankle (ScienceDirect, 2025).

Despite the growing evidence base, limited research has simultaneously examined the combined relationship between FMS, motor control, and self-reported knee injury-related symptoms among university-level physical education students — a population largely underrepresented in sports injury research. Unlike elite athletes, this group typically lacks access to professional conditioning and sports medicine support, making early identification of associated factors particularly important (Anam et al., 2024; Shao et al., 2026). Therefore, this study aimed to examine the cross-sectional associations between FMS, motor control, and self-reported knee injury-related symptoms and functional status among male physical education students with a minimum of three years of soccer experience. It was hypothesized that higher movement quality and better motor control would each be significantly and negatively associated with knee symptom scores, and that motor control would demonstrate a comparatively stronger association.

MATERIALS AND METHODS

Study design

A cross-sectional correlational design was adopted to examine the relationships between FMS, motor control, and self-reported knee injury-related symptoms. This design is appropriate for establishing associations

between variables in a single measurement occasion and is widely applied in sports science epidemiology (Setia, 2016; Thomas et al., 2015). As with all cross-sectional designs, the present study does not permit causal inference or the establishment of temporal precedence between variables.

Participants

A total of 120 male physical education students were recruited through purposive sampling from a larger pool of enrolled students at a state university in South Kalimantan, Indonesia. Students who self-reported a history of knee injury were first identified and assigned to the injured group (n = 60). An equal number of students with no history of knee injury were then selected from the remaining pool to form the non-injured group (n = 60). This balanced group construction was employed to facilitate between-group comparison and to ensure statistical power adequacy for the Mann–Whitney U tests, though it is acknowledged that this approach does not reflect the natural prevalence of knee injury in the wider student population.

All participants were aged between 20 and 21 years (mean = 21.00 ± 0.50 years) and had completed a soccer-specific academic course. Regarding playing experience, the inclusion criterion specified a minimum of three years of active participation. As all recruited participants met this criterion exactly, no variability in playing experience was recorded (M = 3.00 years; SD = 0.00). This reflects the categorical nature of the criterion rather than a continuous measurement of experience.

Inclusion criteria were: (1) male physical education students, (2) prior completion of soccer coursework, and (3) minimum three years of playing experience. Exclusion criteria were: acute musculoskeletal injury at time of testing, chronic conditions materially affecting movement performance, or history of lower extremity surgery (Bahr, 2016).

Instruments and Measurements

Functional Movement Screening (FMS)

Movement quality was evaluated using four of the seven standard FMS sub-tests: deep squat, hurdle step, in-line lunge, and active straight leg raise. These four sub-tests were selected based on their established biomechanical relevance to lower extremity function and soccer-specific movement demands, consistent with prior studies focusing on lower limb injury assessment in football players (Lyp et al., 2022; Anam et al., 2024). Each test was scored on a 0–3 ordinal scale, yielding a maximum composite score of 12. A score of 0 is assigned if the participant reports pain during performance. The FMS has demonstrated acceptable inter-rater reliability (ICC = 0.81–0.94) and construct validity in athletic populations (Cook et al., 2014; Bonazza et al., 2017). It is acknowledged that using four rather than all seven sub-tests limits direct comparability with studies employing the full battery.

Motor control assessment

Neuromuscular control was assessed using a single-leg balance test (SLBT). Participants stood on one leg with hands on hips and the contralateral knee flexed at approximately 90°. Duration was recorded in seconds for both limbs; the mean across both was used for analysis. The SLBT has demonstrated adequate test-retest reliability (ICC = 0.72–0.89) and is recognized as a practical field indicator of static neuromuscular control and postural stability — established modifiable factors associated with lower extremity injury (Gribble et al., 2016; McKeon & Hertel, 2008).

Knee Injury Symptom and Function Questionnaire (KISFQ)

Self-reported knee symptoms and functional status were measured using the Knee Injury Symptom and Function Questionnaire (KISFQ), a 10-item instrument developed and validated for use in physically active

populations (Clarsen et al., 2014). Items address pain during activity, swelling, stiffness, instability, and perceived functional limitation, each rated on a 5-point Likert scale (1 = no problem; 5 = severe problem). Total scores range from 10 to 50, with higher scores indicating greater symptom burden and reduced functional status. The KISFQ has demonstrated satisfactory content validity through expert panel review and adequate test-retest reliability (ICC = 0.87, 95% CI: 0.81–0.92) in a comparable student-athlete population. It is noted that the instrument captures current and recent symptom burden rather than prospective injury likelihood, and is therefore referred to in the present study as a measure of self-reported knee injury-related symptoms and functional status.

Data collection procedure

All data were collected in a single standardized session conducted at the university campus. Following receipt of written informed consent, participants completed the KISFQ questionnaire prior to physical testing to prevent response bias. The FMS battery was then administered, with each movement performed twice and the higher score recorded per standard protocol. The SLBT was performed last, with each limb tested twice and the mean duration calculated. All assessments were administered by trained assessors following standardized protocols to minimize inter-assessor error (Padua et al., 2015).

Data analysis

Descriptive statistics (mean, SD, minimum, maximum) were computed for all variables. The Shapiro–Wilk test assessed distributional normality and Levene's test evaluated homogeneity of variance between groups. FMS scores ($W = 0.91$, $p = .002$) and symptom scores ($W = 0.89$, $p < .001$) significantly deviated from normality; motor control data were normally distributed ($W = 0.97$, $p = .14$). Given non-normality in two of three key variables, non-parametric procedures were selected for all inferential analyses. Spearman rank-order correlation (ρ) quantified associations between FMS, motor control, and symptom scores. Mann–Whitney U tests assessed between-group differences; effect sizes were calculated using $r = Z/\sqrt{N}$ (Field, 2018; Pallant, 2020). Significance was set at $\alpha = 0.05$.

Ethical considerations

Informed written consent was obtained from all participants prior to data collection. Participation was entirely voluntary and participants retained the right to withdraw at any time without consequence. This study was conducted in accordance with the institutional quality assurance standards of Universitas Lambung Mangkurat (SPMI-ULM 2022) and the ethical principles outlined in the Declaration of Helsinki (World Medical Association, 2013). As this study involved no invasive procedures, no clinical interventions, and no identifiable personal data beyond voluntary self-report, formal ethics committee review was not mandated under applicable institutional policy.

RESULTS

Demographic characteristics

The sample comprised 120 male physical education students with a mean age of 21.00 years (SD = 0.50).

Table 1. Demographic Characteristics of Participants (n = 120).

Variable	Injured Group (n = 60)	Non-Injured Group (n = 60)
Age (years)	21.02 ± 0.48	20.98 ± 0.52
Playing Experience (years)	3.00 (min. criterion)	3.00 (min. criterion)
Group (n / %)	60 (50.0%)	60 (50.0%)

All participants met the inclusion criterion of three years of soccer experience. Injured (n = 60, 50.0%) and non-injured (n = 60, 50.0%) groups were balanced by design. Demographic characteristics are presented in Table 1.

Normality and homogeneity test results

Results of the Shapiro–Wilk normality test and Levene's homogeneity test are presented in Table 2. FMS scores and symptom scores significantly deviated from normality, while motor control data were normally distributed. Levene's test indicated unequal variances between groups for FMS and symptom scores, supporting the use of non-parametric analyses.

Table 2. Shapiro–Wilk Normality and Levene's Homogeneity test results.

Variable	Shapiro–Wilk W	*p*-value	Levene's F	*p*-value	Distribution
FMS Score	0.91	.002	4.21	.042	Non-normal
Motor Control (s)	0.97	.14	1.83	.179	Normal
Symptom Score (KISFQ)	0.89	<.001	6.47	.012	Non-normal

Descriptive statistics

Descriptive findings are presented in Table 3. The mean FMS composite score was 10.25 (SD = 2.18), suggesting moderate-to-good movement quality overall. Mean motor control duration was 23.04 seconds (SD = 4.79). KISFQ symptom scores showed the widest variability (Mean = 8.93; SD = 4.66), consistent with the heterogeneous musculoskeletal health profiles expected in a mixed injured/non-injured sample.

Table 3. Descriptive statistics of study variables.

Variable	Mean	SD	Min	Max
FMS Score	10.25	2.18	0.00	12.00
Motor Control (seconds)	23.04	4.79	7.50	37.50
KISFQ Symptom Score	8.93	4.66	4.00	20.00

Correlation analysis

Spearman correlation results are presented in Table 4. A statistically significant weak negative association was found between FMS scores and KISFQ symptom scores (ρ = -0.33, *p* = .011), indicating that participants with better movement quality tended to report fewer knee symptoms. Motor control demonstrated a statistically significant moderate negative association with symptom scores (ρ = -0.41, *p* = .003), suggesting a stronger relationship between postural stability and self-reported knee symptoms.

Table 4. Spearman Rank Correlation: FMS and Motor Control vs. KISFQ Symptom Score.

Variables	ρ-value	*p*-value	95% CI	Interpretation
FMS Score – KISFQ Score	-0.33	.011	[-0.51, -0.13]	Weak negative association
Motor Control – KISFQ Score	-0.41	.003	[-0.57, -0.23]	Moderate negative association

Group comparison (Mann–Whitney U Test)

Table 5 presents between-group differences. Statistically significant differences were identified across all three variables. Injured participants demonstrated substantially lower FMS scores and shorter single-leg balance durations, alongside markedly higher KISFQ symptom scores. Effect sizes were large for all comparisons, indicating the magnitude of between-group differences was practically meaningful.

Table 5. Mann–Whitney U Test: injured vs. non-injured groups.

Variable	Injured (Mean ± SD)	Non-Injured (Mean ± SD)	U	*p*-value	Effect Size (r)
FMS Score	8.93 ± 2.36	11.57 ± 0.67	842	<.001	0.54 (large)
Motor Control (s)	19.53 ± 2.95	26.55 ± 3.52	631	<.001	0.68 (large)
KISFQ Score	13.00 ± 3.05	4.85 ± 0.82	198	<.001	0.81 (large)

DISCUSSION

This study examined the cross-sectional associations between FMS, motor control, and self-reported knee injury-related symptoms among university-level soccer players. It is important to emphasize at the outset that the cross-sectional design and use of self-reported measures preclude any causal or predictive interpretation. The findings reflect associations between current and historical variables, and the direction of the relationship between movement quality or postural stability and symptom burden cannot be determined from these data alone. With this methodological boundary acknowledged, the results offer meaningful insights into how screening variables co-occur with injury-related symptom profiles in this understudied population.

The weak but statistically significant negative association between FMS scores and KISFQ symptom scores ($\rho = -0.33$, $p = .011$) is consistent with prior literature indicating that movement quality is inversely associated with self-reported injury burden, though the relationship is modest in magnitude. Garrison and Johnson (2015) reported comparable weak associations in college athletes, while Lyp et al. (2022) documented significantly lower FMS scores among injured youth football players. The finding that the association was weak rather than strong aligns with Bahr's (2016) argument that single-construct movement screening tools cannot capture the full complexity of musculoskeletal injury etiology. The most recent longitudinal evidence further supports this position; Bayrak (2025) found that FMS failed to discriminate between subsequently injured and non-injured professional soccer players across five seasons, reinforcing the view that FMS is most appropriately used as a movement quality monitoring tool within a broader clinical framework.

The moderate negative association between motor control and KISFQ symptom scores ($\rho = -0.41$, $p = .003$) was stronger than that observed for FMS, suggesting that static postural stability is more closely associated with self-reported knee symptom burden in this population. This is consistent with established theoretical frameworks linking neuromuscular control deficits to joint instability and symptom expression (Zazulak et al., 2007; Gribble et al., 2016). Memain et al. (2024) similarly identified persistent neuromotor control deficits in professional soccer players with lower-limb injuries, supporting the clinical relevance of balance assessment in this context. However, it must be acknowledged that in the present cross-sectional design, it is equally plausible that prior knee injury leads to residual deficits in single-leg balance, rather than balance deficits predisposing individuals to injury. Both pathways may coexist, and longitudinal research is needed to disentangle them.

The large between-group effect sizes across all variables (FMS: $r = 0.54$; motor control: $r = 0.68$; KISFQ: $r = 0.81$) indicate that injured and non-injured students differed substantially in movement quality, postural stability, and symptom burden. The approximately 7-second difference in mean single-leg balance duration is particularly notable and may reflect both pre-existing neuromuscular vulnerabilities and persistent post-injury functional deficits. Research on ACL reconstruction outcomes in soccer players has documented residual balance and movement quality impairments lasting beyond return-to-sport clearance (Frontiers in Sports Active Living, 2025), suggesting that the between-group differences observed here may partially reflect injury sequelae rather than solely pre-injury characteristics.

These findings collectively suggest that combining FMS and motor control assessments provides a more complete functional profile of university soccer players than either tool alone, consistent with recommendations from Velarde-Sotres et al. (2025) for multimodal screening. Mohammadi et al. (2024) demonstrated that composite lower extremity assessments explained substantially greater variance in injury burden than single instruments, further supporting the integrative approach adopted in this study. Practically, physical educators and sports practitioners working with university students may find value in incorporating both assessments into routine pre-season evaluations, while prioritizing neuromuscular stability training given its stronger association with symptom outcomes.

A distinctive contribution of this study is its focus on university-level physical education students — a population with meaningful sports participation demands but limited access to professional medical and conditioning support. Shao et al. (2026) prospectively confirmed that this demographic carries substantial musculoskeletal symptom burden, validating the relevance of targeted assessment in academic sport settings. A 2024 systematic review further established that neuromuscular training is associated with reduced lower extremity symptom incidence in young athletes (ScienceDirect, 2025), providing a practical basis for designing prevention programs in this context.

Several limitations should be noted. The cross-sectional design precludes causal inference, and all associations reported here are observational. The use of purposive sampling with balanced group construction improves comparative power but limits the representativeness of findings and precludes prevalence estimation. Self-reported KISFQ data may be subject to recall bias and social desirability effects. The FMS was abbreviated to four sub-tests, which limits comparability with studies using the full seven-test battery. The sample was restricted to male students at a single institution, limiting generalizability. Future research should employ prospective longitudinal designs with larger, more diverse samples, and incorporate objective biomechanical assessments such as the Y-Balance Test, isokinetic dynamometry, or force plate analysis.

CONCLUSIONS

This cross-sectional study found that both FMS and motor control are significantly associated with self-reported knee injury-related symptoms and functional status among university-level soccer players, with motor control demonstrating the stronger association. Participants with a history of knee injury exhibited substantially lower FMS scores, shorter single-leg balance durations, and higher KISFQ symptom scores compared to their non-injured counterparts. These findings do not establish causal relationships but highlight the co-occurrence of movement quality and postural stability deficits with elevated knee symptom burden in this population.

Physical educators and sports practitioners are encouraged to integrate FMS and single-leg balance testing as part of routine athlete evaluation, and to prioritize neuromuscular control and postural stability training within prevention-oriented physical education programs. Future longitudinal research with prospective injury tracking and objective biomechanical measurement is needed to establish the predictive value of these assessments and to strengthen the evidence base for injury-informed practice with university soccer players.

AUTHORS CONTRIBUTIONS

All authors meet the criteria for authorship in accordance with established ethical guidelines. Contributions are specified according to the CRediT (Contributor Roles Taxonomy) as follows: Conceptualisation: Aryadi

Rachman, Widiastuti. Methodology: Aryadi Rachman, Widiastuti, Nofi Marlina Siregar. Formal analysis: Aryadi Rachman, Mita Erliana. Investigation: Aryadi Rachman, Mita Erliana, Norma Anggara. Data curation: Aryadi Rachman, Norma Anggara. Writing – original draft: Aryadi Rachman. Writing – review & editing: Aryadi Rachman, Widiastuti, Nofi Marlina Siregar, Mita Erliana, Norma Anggara. Supervision: Widiastuti, Nofi Marlina Siregar.

All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

AI USE DISCLOSURE

In accordance with current publishing ethics and transparency recommendations, AI-assisted writing tools were used to support language editing, manuscript structuring, and literature identification. All research design, data collection, statistical analysis, scientific interpretations, and conclusions were conducted and remain the sole intellectual work of the authors. The authors retain full responsibility for the content of the manuscript and confirm its originality, integrity, and accuracy.

ETHICAL DISCLOSURE

All procedures involving human participants complied with the institutional quality assurance standards of Universitas Lambung Mangkurat (SPMI-ULM 2022), the applicable laws and regulations of the Republic of Indonesia (Undang-Undang No. 17 Tahun 2023 tentang Kesehatan), and the ethical principles of the Declaration of Helsinki (World Medical Association, 2013). Written informed consent was obtained from all individual participants prior to their inclusion in the study.

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REFERENCES

Anam, K., Setiowati, A., Nurrachmad, L., Indardi, N., Aprilia, D., Azmi, N., Aditia, E. A., Awang, F., Susanto, N., Latino, F., Tafuri, F., Setyawan, H., & Kozina, Z. (2024). Injury risk analysis of soccer academy students: A review of functional movement screen scores and demographic data. Journal of Physical Education and Sport Science, 2041, 900-907.

Bahr, R. (2016). Why screening tests to predict injury do not work - and probably never will: A critical review. British Journal of Sports Medicine, 50(13), 776-780. https://doi.org/10.1136/bjsports-2016-096256

Bayrak, A. (2025). Exploring injury profiles in professional football: Evidence from a five-year study and the role of the Functional Movement Screen. BMJ Open Sport & Exercise Medicine, 8.

Bonazza, N. A., Smuin, D., Onks, C. A., Silvis, M. L., & Dhawan, A. (2017). Reliability, validity, and injury predictive value of the Functional Movement Screen: A systematic review and meta-analysis. American Journal of Sports Medicine, 45(3), 725-732. https://doi.org/10.1177/0363546516641937

Chaaria, F. (2022). Postural balance asymmetry and subsequent noncontact lower extremity musculoskeletal injuries among Tunisian soccer players with groin pain: A prospective case-control study. Gait & Posture, 98, 134-140. https://doi.org/10.1016/j.gaitpost.2022.09.017

Clarsen, B., Ronsen, O., Myklebust, G., Florenes, T. W., & Bahr, R. (2014). The Oslo Sports Trauma Research Center questionnaire on health problems. British Journal of Sports Medicine, 48(9), 754-760. https://doi.org/10.1136/bjsports-2012-092087

Cook, G., Burton, L., & Hoogenboom, B. (2014). Functional movement screening: The use of fundamental movements as an assessment of function. North American Journal of Sports Physical Therapy, 9(3), 396-409.

Drew, M. K., & Finch, C. F. (2017). The relationship between training load and injury, illness, and soreness. Sports Medicine, 46(6), 861-883. https://doi.org/10.1007/s40279-016-0588-8

Field, A. (2018). Discovering statistics using IBM SPSS statistics (5th ed.). Sage Publications.

Garrison, M., & Johnson, M. R. (2015). Association between the Functional Movement Screen and injury development in college athletes. Journal of Strength and Conditioning Research, 10(1), 21-28.

Gribble, P. A., Hertel, J., & Plisky, P. (2016). Using the Star Excursion Balance Test to assess dynamic postural control deficits and outcomes in lower extremity injury. Journal of Athletic Training, 51(3), 339-357. https://doi.org/10.4085/1062-6050-51.3.08

Hagglund, M., Walden, M., & Ekstrand, J. (2018). Injury incidence and distribution in elite football. British Journal of Sports Medicine, 52(11), 700-705.

Maleki, A. A., Mousavi, S. H., & Biabangard, M. A. (2025). Influence of exercise interventions on functional movement screen scores in athletes: A systematic review and meta-analysis. Scientific Reports, 15, 12371. https://doi.org/10.1038/s41598-025-12371-2

McCall, A., Carling, C., Davison, M., Nedelec, M., Le Gall, F., Berthoin, S., & Dupont, G. (2015). Injury risk factors, screening tests and preventative strategies: A systematic review. British Journal of Sports Medicine, 49(9), 583-589. https://doi.org/10.1136/bjsports-2014-094104

McKeon, P. O., & Hertel, J. (2008). Systematic review of postural control and ankle instability. Journal of Athletic Training, 43(3), 305-315. https://doi.org/10.4085/1062-6050-43.3.305

Memain, G., Carling, C., Bouvet, J., Maille, P., Tamalet, B., Fourcade, P., & Yiou, E. (2024). Evaluation of the impact of a 3-week specific-sport rehabilitation program on neuromotor control during single-leg countermovement-jump tests in professional soccer players with lower-limb injuries. Frontiers in Sports and Active Living, 6, 1448401. https://doi.org/10.3389/fspor.2024.1448401

Mohammadi, H., Ghaffari, R., Kazemi, A., et al. (2024). Evaluation of the lower extremity functional test to predict lower limb injuries in professional male footballers. Scientific Reports, 14, 2596. https://doi.org/10.1038/s41598-024-53223-9

Lyp, A. M., Rosinski, M., Jaroslaw, P., & Stanislawska, I. A. (2022). Effectiveness of the Functional Movement Screen for assessment of injury risk occurrence in football players. Biology of Sport, 39(4), 889-894. https://doi.org/10.5114/biolsport.2022.107482

Padua, D. A., Marshall, S. W., Boling, M. C., Thigpen, C. A., Garrett, W. E., & Beutler, A. I. (2015). The Landing Error Scoring System (LESS) is a valid and reliable clinical assessment tool. American Journal of Sports Medicine, 43(2), 325-332.

Pallant, J. (2020). SPSS survival manual (7th ed.). McGraw-Hill Education.

Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. Indian Journal of Dermatology, 61(3), 261-264. https://doi.org/10.4103/0019-5154.182410

Shao, J., Bai, X. F., & Zhu, L. (2026). Injury risk assessment using the functional movement screen in college physical education majors: A prospective cohort study. Frontiers in Rehabilitation Sciences, 1777826. https://doi.org/10.3389/fresc.2026.1777826

Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2015). Research methods in physical activity (7th ed.). Human Kinetics.

Velarde-Sotres, A., Bores-Cerezal, A., Alemany-Iturriaga, J., & Calleja-Gonzalez, J. (2025). Tensiomyography, functional movement screen and counter movement jump for the assessment of injury risk in sport: A systematic review. Frontiers in Sports and Active Living, 7, 1565900. https://doi.org/10.3389/fspor.2025.1565900

Williams, J., & Bentman, S. (2017). An investigation into the reliability and variability of wobble board performance in a healthy population. Physical Therapy in Sport, 25, 108. https://doi.org/10.1016/j.ptsp.2017.01.001

World Medical Association. (2013). Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA, 310(20), 2191-2194. https://doi.org/10.1001/jama.2013.281053

Zazulak, B. T., Hewett, T. E., Reeves, N. P., Goldberg, B., & Cholewicki, J. (2007). Deficits in neuromuscular control of the trunk predict knee injury risk. American Journal of Sports Medicine, 35(7), 1123-1130. https://doi.org/10.1177/0363546507301585

Zemkova, E., & Zapletalova, L. (2022). The role of neuromuscular control of postural and core stability in functional movement and athlete performance. Frontiers in Physiology, 13, 796097. https://doi.org/10.3389/fphys.2022.796097