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Ankle Sprains in Nonprofessional Athletes: Influence of Sport Type, History, and Leg Dominance

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Abstract

Background: Ankle sprains are common injuries in sports involving jumping and rapid directional changes. This study aimed to assess the incidence of ankle sprains among nonprofessional athletes in futsal, volleyball, and basketball and to identify associated risk factors—including sport type, previous ankle injuries, and leg dominance.

Methods: This cross-sectional study included 72 nonprofessional university athletes, with 24 participants each from futsal, volleyball, and basketball teams. Participants were selected using simple random sampling. Data collected included demographic information, ankle sprain incidence, history of previous injuries, and leg dominance. Logistic regression and odds ratios (OR) were utilized to analyze relationships between variables.

Results: The overall incidence of ankle sprains was 43%, with lateral sprains being the most common type. A previous history of ankle injuries was reported by 54% of participants. Basketball players had the highest incidence (58%), followed by volleyball (37.5%) and futsal (33.3%). No significant association was found between sport type and ankle sprain occurrence in either crude or adjusted analyses (crude $P = 0.171$; adjusted $P = 0.181$–0.201). However, a history of previous ankle injuries was a strong predictor of future sprains (crude OR = 33; $P < 0.001$; adjusted OR = 25; $P = 0.002$). Leg dominance showed a limited effect, with only 23% of injuries occurring on the dominant side (crude $P = 0.462$; adjusted $P = 0.601$).

Conclusion: The findings indicate that sport type does not significantly influence ankle sprain occurrence; however, a previous history of ankle sprains is a strong predictor of future injuries.

Keywords: Ankle Sprains, Nonprofessional Athletes, Injury History, Leg Dominance

Conflicts of Interest: *None declared*
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Introduction

Ankle sprains are common in athletes, impacting performance and long-term health (1-3). Most sprains (85%) affect the lateral ligaments, while 10% to 15% are syndesmotic or medial sprains, requiring more prolonged recovery and posing a higher disability risk (4, 5). Nearly half of sprains occur during sports, with the highest rates in basketball (41.1%), American football (9.3%), and soccer (7.9%) (1). Symptoms include pain, swelling, muscle weakness, and chronic ankle instability (CAI), which can lead to osteoarthritis and functional limitations (2-7).

Previous research has identified various intrinsic and extrinsic risk factors for ankle sprains, including anatomical characteristics, neuromuscular control deficits, and external factors such as playing surface and footwear (1, 8, 9).

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↑What is "already known" in this topic:
• Ankle sprains are prevalent injuries in sports, particularly in activities involving jumping or rapid directional changes.
• Numerous intrinsic and extrinsic factors, such as prior injury history, have been assessed; however, inconsistencies persist in understanding their precise roles in predicting and preventing future injuries.

→What this article adds:
• This study demonstrates that sport type does not significantly affect ankle sprain incidence, while prior injury history is a strong predictor.
• Furthermore, the findings indicate that leg dominance plays a limited role in injury occurrence, with the majority of sprains affecting the nondominant side.

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Among these, a history of prior ankle sprains is widely recognized as a key predictor of future injury (10-13). However, the influence of sport type on the likelihood of sustaining an ankle sprain remains unclear, with some studies reporting higher risks in certain sports due to frequent jumping, rapid directional changes, and player contact, while others suggest no significant association (14, 15). Additionally, the role of leg dominance in ankle sprain occurrence is debated, with conflicting evidence regarding whether the dominant or nondominant limb is more susceptible to injury. Some studies suggest the dominant leg may be more vulnerable to ankle sprains due to its frequent use in athletic maneuvers (16). Conversely, other research indicates that the nondominant leg might be at higher risk, as it experiences greater landing forces during jumps. Additionally, some studies have found no significant association between leg dominance and ankle sprains, emphasizing the need for further research to clarify its role (17).

Despite the extensive research on ankle sprains, there is still a lack of consensus on how sport type and leg dominance interact to influence injury risk, particularly among nonprofessional athletes.

To address this gap, the present study aims to evaluate the incidence of ankle sprains among nonprofessional athletes in futsal, volleyball, and basketball and to assess the impact of sport type, previous ankle injuries, and leg dominance on injury occurrence. In addition, by investigating the incidence of ankle sprains across futsal, volleyball, and basketball, this study provides valuable insights into which sports pose a higher risk and how previous injury history and leg dominance may contribute to future injuries. These findings can help coaches implement targeted training programs, such as proprioceptive exercises and ankle stability drills, to reduce injury rates in at-risk athletes.

Methods

Participants and Sample Size

This cross-sectional study involved 72 nonprofessional athletes, including 24 from futsal, 24 from basketball, and 24 from volleyball. Nonprofessional athletes were defined as individuals who regularly participate in their respective sports without competing at a professional level. This cross-sectional study was conducted between March and July 2024, over 5 months, in Shiraz, Iran.

These sports were chosen based on their distinct movement patterns, which provide a meaningful comparison of ankle sprain risk. Basketball and volleyball involve frequent jumping, landing, and rapid changes in direction, all of which are known risk factors for ankle sprains. Futsal, on the other hand, differs from traditional soccer in its playing environment and movement demands—it is played on a smaller, hard court. It requires quick footwork, rapid deceleration, and frequent pivoting, which may contribute to ankle injuries differently than soccer played on grass. Although soccer has a high incidence of ankle sprains, Futsal was chosen as one of the sports examined in this study because it is more relevant to nonprofessional university athletes, who often participate in futsal rather than soccer because of space limitations, accessibility, and university sports culture.

In this study, only 3 university teams—futsal, basketball, and volleyball—were assessed, selected based on our study aim. After identifying these teams, we contacted the team management and coaches to obtain permission for recruitment and a list of athletes. Once approval was granted, eligible players were informed about the study's objectives, and participants were randomly selected from the available team members using a random number generator.

After obtaining approval from team management and coaches, a list of athletes from each team was provided. Each athlete was assigned a unique identification number, and a random number generator was used to select participants from this list. If an athlete did not meet the inclusion criteria, they were replaced with another randomly chosen participant to ensure a complete and eligible sample.

The inclusion criteria for this study encompassed athletes aged 18 to 35 years who had participated in futsal, basketball, or volleyball at a nonprofessional level for a minimum of 1 year. Participants were required to have no history of surgical interventions on the lower extremities and to provide accurate information regarding their injury history, specifically related to ankle sprains (18).

Conversely, individuals were excluded from the study if they had any other musculoskeletal injuries, such as anterior cruciate ligament (ACL) reconstruction, neurological disorders, or systemic diseases. The Ethics Committee of Shiraz University of Medical Sciences approved this study. Before their involvement, all participants provided informed consent, ensuring they understood the study's purpose and procedures.

With a type I error rate of 0.05, an assumed prevalence of 30% for ankle sprains (19), and a precision level of 0.1, the required sample size for this cross-sectional study was calculated using a standard formula (20), resulting in an estimated 24 participants. To enhance representativeness, we included participants from 3 distinct sports—volleyball, basketball, and futsal—recruiting 24 individuals from each group.

Variables and Data Collection

A structured review process was employed to systematically collect demographic, background, and injury-related information from all participants. This included recording key characteristics such as age, weight, height, body mass index (BMI), sport type, years of experience in their respective sport, and weekly training frequency. To assess injury history, participants were asked about the number of ankle sprains sustained both during the past year and throughout their athletic careers. Additional details—such as the type of sprain (inversion or eversion) and the affected side (dominant or non-dominant leg)—were also documented. A standardized checklist was used during structured interviews to ensure consistency and alignment with the study variables. Leg dominance was determined through a functional test, in which participants were asked to kick a ball using their preferred leg, allowing for consistent classification of dominance across the sample (21).

In this study, primary data collection was based on self-reported injury history from participants. Additionally, external input from coaches or physicians was considered

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only when participants expressed uncertainty about past injuries (eg, exact occurrence, number, or type). If no reliable confirmation was available, the participant was excluded to maintain data accuracy and prevent inconsistencies.

Statistical Analyses

Statistical analyses were performed using Stata software, Version 17. For continuous demographic variables, data were presented as mean ± standard deviation (SD). The incidence of ankle sprain frequency was assessed, with a 95% confidence interval (CI). To evaluate the relationship between ankle sprain history, type of sport, and limb dominance with ankle sprain occurrence, logistic regression analysis was used, with effect sizes reported as odds ratios (OR). An OR >1 indicated a higher likelihood of ankle sprain in participants with specific characteristics (eg, dominant limb involvement or specific sports type). In comparison, an OR <1 indicated a lower likelihood (22). The significance level was set at 0.05.

Results

A total of 72 nonprofessional athletes participated in the study, with a mean age of 22.55 years. On average, participants had 5 years of experience in their sport and trained approximately 9 hours per week. Right-side dominance was observed in 83% of participants. Table 1 presents a complete overview of demographic characteristics. There were no missing data for any of the key study variables, as participants who could not recall their injury history accurately were excluded during recruitment.

Ankle sprains were reported by 43% of participants, with basketball players showing the highest incidence, followed by volleyball and futsal players. The majority of these injuries were lateral ankle sprains, and more than half of the participants reported a history of previous ankle sprains. Only a small portion (23%) of the sprains occurred on the dominant side, while most affected the nondominant leg. Detailed incidence rates by sport and injury type are provided in Table 2.

The strongest finding of the study was the significant association between prior ankle sprains and future sprain occurrence, with participants who had a history of ankle sprains being 33 times more likely to sustain a new sprain (OR = 33.18, 95% CI: 8.17–134.79; $P < 0.001$). This highlights the critical role of injury history as a predictor of recurrent sprains. In contrast, no statistically significant association was found between sport type and ankle sprain incidence ($P = 0.171$), although basketball players showed the highest incidence numerically. Similarly, limb dominance did not show a significant relationship with either the history or occurrence of ankle sprains ($P = 0.462$). Full results of the logistic regression analysis are presented in Table 3.

To account for potential confounding factors, multivariable logistic regression analyses were performed, adjusting for age, BMI, years of sports experience, and weekly training frequency. After adjustment, the associations between sport type and ankle sprain occurrence remained statistically nonsignificant. Specifically, the adjusted OR for ankle sprains in futsal compared to basketball was 0.4 ($P = 0.201$), and for volleyball compared to basketball, it was 0.5 ($P = 0.182$). Additionally, the association between ankle sprain occurrence was examined, and a history of previous ankle sprain in sports, which remained statistically significant after adjustment (adjusted OR = 25.0, P =

Table 1. Demographic Overview of Study Participants, Presented Separately for Each Group

Variable		Basketball group (n=24) Mean (SD)/ n (%)	Volleyball group (n=24) Mean (SD)/ n (%)	Futsal (n=24) Mean (SD)/ n (%)	Total (n=72) Mean (SD)/ n (%)
Age(year)		22.08 (1.9)	22.79 (1.71)	22.85 (1.66)	22.55 (1.78)
Weight(kg)		78.91 (5.11)	74.66 (7.68)	68 (4.06)	74.20 (7.31)
Height(cm)		185.54 (4.79)	184.5 (6.14)	173.9 (3.71)	181.75 (7.14)
Body Mass Index(kg/m^2)		23.07 (1.1)	21.96 (0.9)	22.52 (1.2)	22.48 (0.88)
Sport experience(year)		5.46 (1.59)	5.08 (1.61)	4.79 (2.22)	5.11 (1.83)
Weekly training(hours)		9.41 (3.16)	9.29 (2.59)	9.33 (2.79)	9.35 (2.82)
Dominant side	Right side	20 (83.3%)	22 (91.7%)	18 (75%)	60 (83.3%)
	Left side	4 (16.7%)	2 (8.3%)	6 (25%)	12 (16.7%)

Abbreviations: cm = centimeters, kg = kilograms, kg/m² = kilograms per square meter, SD = standard deviation.

Table 2. Distribution of Ankle Sprain incidence, Type, and Affected Side by Sport Group (n=72)

Variable		Basketball group (n=24) N (%) (95%CI)	Volleyball group (n=24) N (%) (95%CI)	Futsal (n=24) N (%) (95%CI)	Total (n=72) N (%) (95%CI)
Ankle sprains during the past year		14 (58.3%) (37% to 78%)	9 (37.5%) (19% to 59%)	8(33.3%) (16% to 55%)	31 (43.1%) (31% to 55%)
Previous ankle sprain history in sports		14 (58.3%) (37% to 78%)	12 (50%) (29% to 71%)	13 (54.2%) (33% to 74%)	39 (54.2%) (42% to 66%)
Direction of ankle sprain	Lateral	10 (71%) (42% to 92%)	11 (92%) (61% to 99%)	12 (92%) (64% to 99%)	33 (85%) (69% to 94%)
	Medial	4 (29%) (8% to 58%)	1 (8%) (0.2% to 38%)	-	5 (13%) (4% to 27%)
	both	-	-	1 (8%) (0.2% to 36%)	1 (3%) (0.06% to 13%)
Affected side	Right side	3 (21%) (5% to 51%)	4 (33%) (1% to 65%)	3 (23%) (5% to 54%)	10 (26%) (13% to 42%)
	Left side	8 (57%) (29% to 82%)	7 (58%) (28% to 84%)	8(61.5%) (31% to 86%)	23 (59%) (42% to 74%)
	Both	3 (21%) (5% to 51%)	1 (8%) (0.2% to 38%)	2 (15.4%) (2% to 54%)	6 (15%) (6% to 30%)
Affected side	Dominant side	1 (7%) (0.2% to 36%)	5 (42%) (15% to 72%)	3 (23%) (5% to 54%)	9 (23%) (11% to 39%)
	Non-dominant side	10 (71%) (42% to 92%)	6 (50%) (21% to 79%)	8 (61.5%) (31% to 86%)	24 (61.5%)(45% to 77%)
	Both	3 (21%) (5% to 51%)	1 (8%) (0.2% to 38%)	2 (15.4%) (2% to 45%)	6 (15%)(6% to 30%)

Abbreviations: CI=Confidence Interval

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Table 3. Results of Logistic Regression Analysis with Effect Sizes of Odds Ratio with 95% CI

Correlation ankle sprain		*P*-value	Odds ratio(95%CI)
Ankle sprain and Type of sport	Futsal vs.basketball	0.091	0.36 (0.11 to 1.15)
	volleyball vs. basketball	0.151	0.43 (0.13 to 1.46)
Ankle sprain and Previous ankle sprain history in sports		<0.001	33.18 (8.17 to 134.79)
Ankle sprain and Limb dominance		0.462	1.64 (0.44 to 6.02)
History of Ankle sprain and Limb dominance		0.462	1.6 (0.46 to 5.61)
History of Ankle sprain and Type of sport	Futsal vs. basketball	0.561	0.71 (0.23 to 2.32)
	volleyball vs. basketball	0.390	0.6 (0.19 to 1.89)

Abbreviations: CI = Confidence Interval

0.002), indicating a strong association between prior injury and future risk. The association between ankle sprain and limb dominance was not statistically significant (adjusted OR = 1.7, $P = 0.601$), nor was the association between a history of ankle sprain and limb dominance (adjusted OR = 1.5, $P = 0.602$). Additionally, there was no significant association between a history of ankle sprain and the type of sport. The adjusted OR was 0.8 for both futsal versus basketball ($P = 0.921$) and volleyball versus basketball ($P = 0.714$).

Discussion

This cross-sectional study aimed to assess the incidence of ankle sprains among nonprofessional athletes, focusing on the influence of sport type and previous injury history. The results indicated that lateral sprains were the most frequently reported type of injury, which is consistent with established patterns linked to the biomechanical stresses imposed by sports involving cutting, jumping, and rapid directional changes. Nearly all participants who reported an ankle sprain within the past year, except for 1 individual, also had a previous history of ankle sprains.

In our study, basketball players experienced the highest rate of ankle sprains compared to futsal and volleyball players, consistent with prior research (11, 23-27). However, direct comparisons should be interpreted cautiously due to differences in study design, sample characteristics, and definitions of injury. For instance, previous studies have differed in their definitions of ankle sprain—some included only time-loss injuries or physician-diagnosed cases, while others relied on self-reported symptoms. Furthermore, differences in study design (eg, prospective vs cross-sectional), sample characteristics (elite vs recreational athletes), and injury exposure measurement (eg, per 1000 athlete exposures vs lifetime prevalence) may explain variability in findings. Our use of a cross-sectional design and reliance on retrospective self-reports may have led to recall bias. In contrast, prospective studies with continuous monitoring may capture more accurate incidence data.

The high prevalence of ankle sprains in basketball can be attributed to the sport's physical demands, which involve continuous jumping, sharp cutting movements, abrupt stops, and swift directional shifts (28-30). In addition, this vulnerability can also be explained by the sensorimotor control theory, which suggests that adequate joint stability depends on rapid neuromuscular responses to sudden movements and external forces. When these responses are delayed or impaired—especially after a previous injury—the risk of inversion and ligament strain increases. In a sport like basketball, where unpredictable landings and player contact are frequent, any disruption in this control system can significantly elevate injury risk (28-30).

In addition, consistent with existing evidence (31), our study found that lateral ankle sprains were the most common injuries among basketball, volleyball, and futsal players, with 85% of participants reporting this type of injury. The higher prevalence of lateral ankle sprains observed in this study is likely due to the relative vulnerability of the lateral ligaments during everyday athletic movements such as jumping and sudden directional changes. These mechanisms frequently lead to inversion injuries, a well-documented pattern in sports biomechanics (32, 33).

In our study, although the prevalence of ankle sprains was higher in basketball players than in volleyball and futsal players, no significant association was found between the incidence of ankle sprains and the type of sport. The absence of a statistically significant association between sport type and ankle sprain occurrence may suggest that, despite some numerical differences in incidence rates, the core biomechanical demands shared across these sports—such as frequent jumping, cutting, and rapid changes in direction—pose similar levels of risk. This finding implies that injury prevention strategies may need to be applied more universally across high-impact sports, rather than being strictly sport-specific. However, it is essential to consider the potential for limited statistical power. With only 24 participants per sport group, the study may have been underpowered to detect small to moderate differences between groups. Therefore, the lack of statistical significance should not be interpreted as definitive evidence of no association. Also, extrinsic factors such as footwear, playing surface, or variations in training and warm-up routines across teams may have obscured actual sport-specific risk differences. Individual differences in conditioning, preventive strategies (such as ankle taping or bracing), and injury history could have introduced variability within each sport group, potentially masking sport-specific effects.

In our study, a strong relationship was observed between a history of ankle sprains and the occurrence of subsequent sprains. Athletes with a previous history of ankle sprains had odds of sustaining a new sprain that were 31 times greater than those without such a history. Analysis by sport type revealed that the likelihood of ankle sprains was great-

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est among basketball players (OR = 117), followed by volleyball players (OR = 32), and futsal players, who had odds of 15.4.

While the calculated ORs indicate strong associations, particularly the OR of 117 for basketball players with previous ankle sprains, such extreme values should be interpreted with caution. These inflated ORs may be statistical artifacts resulting from the small sample size and low event counts within subgroups. Wide confidence intervals further highlight the uncertainty around these estimates, suggesting a high degree of variability rather than precise measurement. These findings align with previous studies (10-13) that have identified a history of ankle sprains as a significant risk factor for future injuries.

Several factors contribute to this relationship. Previous sprains can result in ligamentous laxity, which reduces joint stability and increases the ankle's susceptibility to future injuries (34). Proprioceptive deficits and altered neuromuscular control after an injury can impair balance and coordination, thereby raising the risk of reinjury during dynamic movements (35). Chronic ankle instability, characterized by recurrent episodes of the ankle giving way, further elevates the likelihood of subsequent sprains (3, 36). Psychological factors, such as fear of reinjury, can negatively impact an athlete's confidence and biomechanics (37-39). Although this study did not assess injury prevention programs directly, the strong association found between previous ankle sprains and future injury risk suggests that such individuals may benefit from targeted preventive measures. These may include proprioceptive, balance, and neuromuscular training programs.

In our study, only 23% of participants sustained ankle sprains on their dominant side. In comparison, 61.5% reported injuries on their nondominant side, suggesting that limb dominance may not be a determining factor in injury occurrence. Furthermore, no significant association was found between left or right limb dominance and either the history or occurrence of ankle sprains. Although the relationship between limb dominance and ankle sprain occurrence did not reach statistical significance in our study (P = 0.46), the observed OR of 1.64 suggests a possible trend toward a higher risk of injury on the dominant side. This observation, while not conclusive, deserves further attention. From a biomechanical standpoint, the dominant leg is typically used for dynamic actions such as kicking, cutting, and landing, which may result in higher cumulative load, joint stress, and muscle fatigue over time. These repetitive demands could make the dominant limb more vulnerable to acute injury under certain conditions. In contrast, several studies have reported a higher prevalence of ankle sprains on the nondominant side, possibly due to its role as a stabilizing limb during sport-specific maneuvers, where inadequate proprioception or strength may increase the risk of poor landings or unexpected perturbations. These inconsistencies in the literature underscore the multifactorial nature of ankle sprains and suggest that limb dominance likely interacts with other risk factors, such as sport-specific movement patterns, neuromuscular control, fatigue, and training history. The nonsignificant yet elevated OR observed in our analysis may reflect an actual but underpowered effect due to the limited sample size. The higher rate of ankle sprains on the nondominant side may reflect the stabilizing role this limb often plays during sport-specific movements. In many athletic tasks—such as kicking, cutting, or pivoting—the dominant leg acts, while the nondominant leg provides balance and support. This supporting role exposes the nondominant ankle to greater ground reaction forces during landing or directional changes, potentially increasing the risk of sprains. Moreover, athletes may unconsciously place more load on their dominant side, causing fatigue or coordination deficits on the non-dominant side.

The study has several limitations that should be acknowledged. The cross-sectional design limits the ability to draw causal inferences regarding the relationships between sport type, injury history, and ankle sprain occurrence. Future research should consider using prospective cohort or longitudinal designs to determine better the temporal relationships between variables such as prior injury, sport type, and injury risk.

Another significant limitation is the reliance on self-reported injury history, which introduces the possibility of recall bias. Participants may have forgotten past ankle sprains, especially if they were minor or occurred several years ago, leading to underreporting. Conversely, some may have misclassified the type or timing of injuries, resulting in misestimation of incidence. This recall bias could affect the accuracy of the associations observed—particularly those related to prior injury history, which was a central variable in our analysis. While we attempted to reduce this risk by excluding participants with unclear or unreliable responses, we were not able to formally assess or quantify the extent of recall bias.

Third, the relatively small sample size—particularly 24 participants per sport—may have reduced the statistical power of subgroup analyses. Furthermore, the exceptionally high ORs observed in specific subgroups, such as the OR of 117 for basketball players with prior injury history, should be interpreted with caution. These extreme values, accompanied by wide confidence intervals, may reflect slight sample bias, sparse data, or potential overfitting in the logistic regression model. Future studies with larger and more diverse samples are needed to validate these findings and improve the precision of effect estimates.

Another limitation is that this study did not collect information on individual factors such as ankle bracing, taping, training intensity, or warm-up routines, which could influence ankle sprain risk. These variables likely differed across participants and may have affected the outcomes. Future studies should include these factors as covariates to better control for individual variability in injury risk.

Additionally, the potential for selection bias must be considered due to the exclusion of participants who were unable to recall their injury history accurately. While this criterion was applied to enhance data reliability, it may have led to a nonrepresentative sample by favoring individuals with more precise recollection or greater health awareness, thereby limiting the generalizability of the findings.

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Conclusion

This cross-sectional study demonstrated a high incidence of ankle sprains among nonprofessional athletes, with lateral sprains being the most prevalent. Although basketball players exhibited the highest observed rate of ankle injuries, no statistically significant association was found between sport type and ankle sprain occurrence, potentially due to the limited sample size. A previous history of ankle sprains emerged as a strong predictor of future injury, emphasizing the importance of early identification and targeted management of at-risk individuals.

From a practical standpoint, these findings support the implementation of injury prevention programs—such as proprioceptive training, balance exercises, and neuromuscular control interventions—for athletes with a history of ankle sprains, regardless of sport. Given the shared biomechanical demands across high-risk sports, such preventive strategies may be broadly applicable rather than sport-specific.

Future research should employ longitudinal designs with larger and more diverse samples to confirm these findings and further investigate the role of sport type, playing position, and individual factors such as ankle bracing, training load, and warm-up routines. Exploring these variables may offer more detailed insights into modifiable risk factors and inform the development of sport- and athlete-specific prevention protocols.

Authors' Contributions

Ali Tajik contributed to the study design, data collection, and drafting of the initial manuscript. Katayoon Rezaei supervised the project, conducted data analysis, and critically reviewed the final manuscript. Amin HaghParast was responsible for statistical analysis and interpretation of the results. Mahsa Mazaheri performed the literature review and contributed to manuscript editing. All authors read and approved the final version of the manuscript.

Ethical Considerations

The Ethics Committee of Shiraz University of Medical Sciences approved this study. Informed consent was obtained from all participants before data collection.

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Conflict of Interests

The authors declare that they have no competing interests.

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