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Original Article

Association of Hamstring Strain Injury With Hip Flexor Tightness Among Male Football Players: A Cross-Sectional Study

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ABSTRACT

Background: Hamstring strain injury is a frequent and clinically important musculoskeletal problem among football players, often contributing to pain, functional limitation, recurrent injury, and time loss from sport. Restricted hip flexor flexibility may alter pelvic control and running mechanics, potentially increasing posterior-chain loading during sprinting and explosive football movements. Objective: To determine the frequency of hip flexor tightness and examine its association with hamstring strain injury indicators among male outfield football players. Methods: This cross-sectional observational study included 75 male football players aged 18–30 years from football clubs and academies in Lahore, Pakistan. Participants were selected through non-probability convenience sampling. Goalkeepers and players with current major hamstring or hip flexor injury, knee or hip osteoarthritis, patellofemoral pain syndrome, leg length discrepancy, or previous hip/knee surgery were excluded. Hip flexor tightness was assessed using the Thomas test, while hamstring-related clinical status was assessed using injury-history questioning, the Functional Assessment Scale for Acute Hamstring Injuries, and the Modified Bent-Knee Stretch Test. Data were analyzed using SPSS version 26, with chi-square testing used to examine associations. Results: The sample included 18 defenders, 31 midfielders, and 26 attackers. Thomas test positivity was observed in 61.3% of players, while Modified Bent-Knee Stretch Test positivity was observed in 70.7%. Hip flexor tightness was most frequent among defenders at 88.9%, followed by midfielders at 54.8% and attackers at 50.0%. Position-specific analysis showed a statistically significant association between hip flexor tightness and hamstring strain injury indicators among attackers ($p = 0.008$), while no significant association was observed among defenders ($p = 0.908$) or midfielders ($p = 0.496$). Conclusion: Hip flexor tightness and hamstring-related clinical positivity were common among male football players, but their association was significant only among attackers. Position-specific screening strategies may improve hamstring injury-prevention planning in football. Keywords: football players; hamstring strain injury; hip flexor tightness; Thomas test; Modified Bent-Knee Stretch Test; injury prevention; cross-sectional study.

INTRODUCTION

Football is a high-intensity intermittent sport that requires repeated acceleration, deceleration, sprinting, kicking, jumping, cutting, feinting, and rapid changes in direction, all of which impose substantial mechanical demands on the lower-limb musculotendinous system. Because these movements frequently occur under competitive pressure and in both contact and non-contact situations, football players remain vulnerable to a wide range of lower-extremity injuries, particularly muscle strains involving the thigh and hip regions (1, 2). The repetitive transition between eccentric braking and concentric propulsion during sprinting and directional change places high loads on the hamstring muscle group, making adequate flexibility, strength balance, neuromuscular control, and hip mobility essential for efficient performance and injury prevention (2, 3).

Muscle injuries account for a considerable proportion of football-related injuries, with the hamstrings consistently reported among the most frequently affected muscle groups. Previous literature has indicated that hamstring injuries may contribute substantially to time loss from training and competition, with reported involvement of the hamstrings, quadriceps, and adductors in a large proportion of muscle-related injuries among football and athletic populations (4). Hamstring strain injuries are particularly important because they can result in prolonged absence from sport, recurrent symptoms, reduced sprint performance, impaired team availability, and financial consequences for athletes and sports organizations (5). The hamstring muscle group, consisting primarily of the semitendinosus, semimembranosus, and biceps femoris, crosses the hip and knee joints and contributes to hip extension, knee flexion, pelvic control, and lower-limb deceleration during high-speed running. These bi-articular functions expose the hamstrings to substantial strain when the lower limb rapidly transitions from terminal swing to stance and propulsion, especially during sprinting and explosive sport-specific actions (6).

The burden of hamstring strain injury is amplified by its recurrent nature. Prior studies have reported that hamstring strain injuries constitute a major proportion of muscle injuries in football and related sports, with recurrence rates remaining clinically concerning in athletic populations (5, 7, 8). In football, hamstring injury risk is influenced by several intrinsic and extrinsic factors, including previous injury, strength deficits, hamstring-to-quadriceps imbalance, eccentric strength asymmetry, inadequate flexibility, high-speed running exposure, fatigue, training load, and position-specific movement demands (5, 9, 10). Restricted range of motion at the hip and ankle has also been described as a potentially modifiable factor associated with hamstring injury susceptibility, suggesting that local flexibility deficits may alter lower-limb mechanics and increase compensatory loading across the posterior chain during sprinting and cutting tasks (10, 11, 12).

Hip flexor tightness is clinically relevant in this context because the hip flexor complex contributes to hip motion, pelvic positioning, stride mechanics, and trunk–pelvis coordination during running and kicking. Tightness of the iliopsoas, rectus femoris, sartorius, and related anterior hip structures may contribute to anterior pelvic tilt, reduced hip extension, altered stride length, and compensatory posterior-chain loading during high-speed activity (13, 14). In football players, these biomechanical changes may be especially important because sprinting, kicking, rapid acceleration, landing, and changes of direction require coordinated interaction between the hip flexors, quadriceps, gluteal muscles, and hamstrings. Although hip and groin injuries are common in football, and restricted hip range of motion has been discussed as a risk-related factor in lower-limb injury patterns, the specific association between hip flexor tightness and hamstring strain injury indicators remains insufficiently described in club-level male football players (9, 15).

Existing literature has more frequently emphasized hamstring strength deficits, hamstring-to-quadriceps ratios, previous injury, and general flexibility measures than the specific role of hip flexor tightness in relation to hamstring strain injury. This creates a clinically important knowledge gap

because hip flexor tightness is easily screenable using field-based clinical tests and may represent a modifiable target for preventive rehabilitation programs if associated with hamstring-related symptoms or injury history. Furthermore, football playing position may influence this relationship because attackers, midfielders, and defenders differ in sprint exposure, acceleration profiles, deceleration demands, cutting frequency, and tactical movement patterns. Position-specific analysis may therefore provide more clinically meaningful information than pooled analysis alone.

Therefore, this study aimed to determine the frequency of hip flexor tightness among male outfield football players aged 18–30 years and to examine its association with hamstring strain injury indicators across playing positions. The study was guided by the research question: among male football players, is hip flexor tightness, assessed through the Thomas test, associated with hamstring strain injury indicators assessed through clinical examination and hamstring-related functional assessment? It was hypothesized that players with hip flexor tightness would demonstrate a higher frequency of hamstring strain injury indicators, with variation across playing positions.

MATERIALS AND METHODS

This cross-sectional observational study was conducted among male outfield football players from football clubs and academies in Lahore, Pakistan, to examine the association between hip flexor tightness and hamstring strain injury indicators. A cross-sectional design was selected because the objective was to assess the frequency of hip flexor tightness and its association with hamstring-related clinical findings within an active football-playing population at a single assessment point. The study included players from Fame Football Club, Model Town Football Club, Bahria Town Football Club, Bulls Football Club, Punjab University Football Team, and Raiders Football Club. Participants were recruited through a non-probability convenience sampling strategy from active club-level football settings.

The study population consisted of 75 male football players aged 18–30 years who were actively participating in football, engaged in regular field-based practice sessions, and involved in at least two weekly matches during the competitive season. Outfield players, including defenders, midfielders, and attackers, were eligible for inclusion. Goalkeepers were excluded because their positional movement demands, sprint exposure, kicking frequency, and match-play activity patterns differ from those of outfield players, which could introduce biomechanical heterogeneity in the assessment of hip flexor tightness and hamstring injury indicators. Players were also excluded if they had a current major hamstring or hip flexor injury, knee or hip osteoarthritis, patellofemoral pain syndrome, leg length discrepancy, or a history of hip or knee surgery. These criteria were applied to reduce misclassification and to limit the influence of active or structural lower-limb conditions that could independently affect flexibility testing, pain response, or hamstring-related function.

Participants were approached at their respective football clubs and academies, and eligible players were enrolled after obtaining written informed consent. Data were collected manually using printed questionnaires and standardized clinical assessment forms. Demographic and sport-related information included age, height, weight, body mass index, playing position, daily training duration, weekly training frequency, and football participation characteristics. Playing position was categorized as defender, midfielder, or attacker. Body mass index was calculated from measured or recorded height and weight and expressed as kg/m^2. Training exposure variables were recorded to describe the athletic profile of the sample and to support interpretation of possible position-related differences in injury indicators.

Hip flexor tightness was assessed using the Thomas test and was operationally defined as a positive Thomas test finding. During the test, the participant lay supine while one hip was flexed toward the chest; elevation of the contralateral thigh from the examination surface or inability of the limb to remain relaxed in the expected extended position was recorded as a positive finding, indicating reduced hip flexor flexibility. Hamstring-related clinical status was assessed using the Functional Assessment Scale for Acute Hamstring Injuries, structured injury-history questioning, and the Modified Bent-Knee Stretch

Test. The Functional Assessment Scale for Acute Hamstring Injuries was used to record hamstring-related pain and functional limitation, with higher scores indicating better function. The Modified Bent-Knee Stretch Test was used as a clinical symptom-provocation test for hamstring involvement. For this test, the participant was positioned supine with both lower limbs extended; the examiner flexed the hip and knee maximally and then rapidly extended the knee toward full range. Pain or discomfort in the hamstring region during the maneuver was recorded as a positive test. Hamstring strain injury indicators were therefore interpreted using the combined clinical context of reported hamstring history, functional assessment, and hamstring symptom provocation during examination.

All assessments were performed using standardized procedures to reduce measurement variability. The same predefined eligibility criteria, questionnaire items, and clinical test definitions were applied across all clubs. Test findings were recorded as positive or negative immediately after examination. Data collection forms were reviewed for completeness before entry, and participant information was coded to preserve confidentiality. Access to collected data was restricted to authorized researchers. These steps were used to support data integrity, minimize recording errors, and maintain participant privacy.

The primary exposure variable was hip flexor tightness, defined by Thomas test positivity. The main outcome variable was hamstring strain injury indicator status, assessed through hamstring-related history, functional limitation, and Modified Bent-Knee Stretch Test findings. Playing position was treated as a key stratification variable because defenders, midfielders, and attackers have different physical demands during football participation. Additional descriptive variables included age, height, weight, body mass index, daily training duration, and weekly training frequency. Potential sources of bias were addressed by restricting the sample to male outfield players, excluding players with major current lower-limb conditions or previous hip/knee surgery, applying uniform clinical test procedures, and using the same data collection format across all participants. Because the study used convenience sampling and cross-sectional assessment, the analysis was interpreted as association-based rather than causal.

The sample size of 75 participants was determined using G*Power software and was distributed across defenders, midfielders, and attackers according to available eligible players from the participating football clubs. Data were analyzed using SPSS version 26. Continuous variables were summarized using mean and standard deviation, while categorical variables were summarized using frequencies and percentages. Participant characteristics were described overall and by playing position where appropriate. The frequency of Thomas test positivity and Modified Bent-Knee Stretch Test positivity was calculated for each playing position. Associations between hip flexor tightness and hamstring strain injury indicators were examined using the chi-square test, with Fisher's exact test considered where expected cell counts were small. Statistical significance was assessed at $p < 0.05$. Position-specific analyses were used to explore whether the association differed across defenders, midfielders, and attackers. Missing or incomplete responses were checked during data entry, and available valid observations were used for analysis. Ethical approval was obtained from the relevant institutional ethics committee, and all participants provided written informed consent before participation.

RESULTS

A total of 75 male outfield football players aged 18–30 years were included in the analysis. The sample comprised 18 defenders, 31 midfielders, and 26 attackers, representing 24.0%, 41.3%, and 34.7% of the study population, respectively. The overall mean age was 23.49 ± 3.52 years, while the overall mean BMI was 23.27 ± 4.13 kg/m², indicating that the sample was predominantly within the normal body-mass range. Position-wise comparison showed no statistically significant differences across defenders, midfielders, and attackers for age, height, weight, or BMI, suggesting that the three positional groups were broadly comparable in baseline anthropometric characteristics. The largest numerical difference was observed for age, with defenders being slightly older than attackers, but this difference was not statistically significant.

Table 1. Baseline Demographic and Anthropometric Characteristics of Football Players by Playing Position

Variable	Overall (n = 75), Mean ± SD	Defenders (n = 18), Mean ± SD	Midfielders (n = 31), Mean ± SD	Attackers (n = 26), Mean ± SD	Test Statistic	p-value	Effect Size
Age, years	23.49 ± 3.52	24.33 ± 3.63	23.61 ± 3.61	22.77 ± 3.32	F = 1.08	0.346	$\eta^2 = 0.029$
Height, feet	5.62 ± 0.30	5.67 ± 0.32	5.58 ± 0.31	5.63 ± 0.28	F = 0.53	0.590	$\eta^2 = 0.015$
Weight, kg	66.76 ± 8.59	67.38 ± 6.93	66.64 ± 9.45	66.46 ± 8.85	F = 0.06	0.938	$\eta^2 = 0.002$
BMI, kg/m²	23.27 ± 4.13	23.06 ± 3.43	23.52 ± 4.17	23.13 ± 4.64	F = 0.09	0.912	$\eta^2 = 0.003$

Most players reported regular football exposure during the competitive season. Based on the available aggregate data, 49 of 75 players trained for 1–2 hours per day, while 8 players trained for 5–6 hours per day. Regarding weekly training frequency, 44 players trained for 5–6 days per week and 12 players trained daily. These findings indicate that a large proportion of the sample had frequent football exposure, which is clinically relevant when interpreting flexibility limitations and hamstring-related symptoms in an athletic population.

Table 2. Available Training Exposure Characteristics of the Study Participants

Training Variable	Category	Frequency (n)	Percentage (%)
Daily training duration	1–2 hours/day	49	65.3
	5–6 hours/day	8	10.7
	Other reported duration categories combined	18	24.0
Weekly training frequency	5–6 days/week	44	58.7
	7 days/week	12	16.0
	Other reported frequency categories combined	19	25.3

Hip flexor tightness, assessed through Thomas test positivity, was identified in 46 of 75 players, giving an overall prevalence of 61.3%. The highest proportion of Thomas test positivity was observed among defenders, where 16 of 18 players were positive, corresponding to 88.9%. Midfielders showed a lower but still substantial positivity rate of 54.8%, while attackers showed a positivity rate of 50.0%. The distribution of Thomas test results differed significantly across playing positions, with a chi-square value of 7.72 and $p = 0.021$. The corresponding Cramer's V value of 0.321 suggests a moderate association between playing position and hip flexor tightness.

Hamstring-related symptom provocation assessed through the Modified Bent-Knee Stretch Test was positive in 53 of 75 players, giving an overall positivity rate of 70.7%. Midfielders showed the highest frequency of positive Modified Bent-Knee Stretch Test findings, with 23 of 31 players testing positive, corresponding to 74.2%. Defenders followed closely, with 13 of 18 players testing positive, corresponding to 72.2%, while attackers showed a positivity rate of 65.4%. Unlike the Thomas test findings, the distribution of Modified Bent-Knee Stretch Test positivity did not differ significantly by playing position, with a chi-square value of 0.56, $p = 0.757$, and Cramer's V of 0.086, indicating a weak positional association.

Table 3. Hip Flexor Tightness and Hamstring-Related Test Positivity by Playing Position

Playing Position	Thomas Test Positive, n (%)	Thomas Test Negative, n (%)	Modified Bent-Knee Stretch Test Positive, n (%)	Modified Bent-Knee Stretch Test Negative, n (%)
Defenders (n = 18)	16 (88.9)	2 (11.1)	13 (72.2)	5 (27.8)
Midfielders (n = 31)	17 (54.8)	14 (45.2)	23 (74.2)	8 (25.8)
Attackers (n = 26)	13 (50.0)	13 (50.0)	17 (65.4)	9 (34.6)
Overall (n = 75)	46 (61.3)	29 (38.7)	53 (70.7)	22 (29.3)
Between-position comparison	$\chi^2 = 7.72$; df = 2	p = 0.021	$\chi^2 = 0.56$; df = 2	p = 0.757
Effect size	Cramer's V = 0.321	Moderate association	Cramer's V = 0.086	Weak association

Position-specific analysis of the association between hip flexor tightness and hamstring strain injury indicators showed that the relationship was statistically significant only among attackers. In attackers, the association between Thomas test positivity and hamstring injury indicators reached statistical significance, with $p = 0.008$. In contrast, no statistically significant association was observed among defenders, where $p = 0.908$, or among midfielders, where $p = 0.496$. These findings suggest that although defenders had the highest prevalence of hip flexor tightness, the clinically relevant association between hip flexor tightness and hamstring strain injury indicators was most evident among attackers. This pattern may reflect the greater reliance of attacking players on repeated acceleration, sprinting,

deceleration, and explosive directional changes, which may increase posterior-chain loading when hip mobility is restricted.

Overall, the findings demonstrate that hip flexor tightness was common among male football players, affecting 61.3% of the total sample, with the highest prevalence among defenders. Hamstring-related Modified Bent-Knee Stretch Test positivity was also frequent, affecting 70.7% of participants overall, with the highest rate among midfielders. However, the position-stratified association analysis indicated that statistical significance was limited to attackers, where hip flexor tightness was significantly associated with hamstring strain injury indicators. Therefore, the results support a position-specific interpretation rather than a generalized conclusion across all football players.

Table 4. Position-Specific Association Between Hip Flexor Tightness and Hamstring Strain Injury Indicators

Playing Position	Association Tested	p-value
Defenders	Thomas test positivity with hamstring strain injury indicators	0.908
Midfielders	Thomas test positivity with hamstring strain injury indicators	0.496
Attackers	Thomas test positivity with hamstring strain injury indicators	0.008

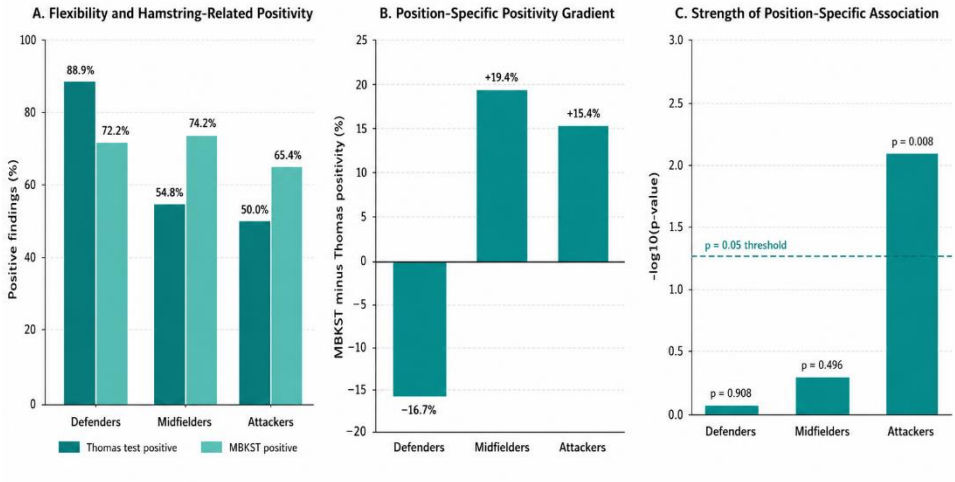

Figure 1. Position-Specific Flexibility–Hamstring Injury Pattern Among Male Football Players.

The panelled figure demonstrates distinct position-specific patterns in hip flexor tightness, hamstring-related test positivity, and association strength. Defenders showed the highest Thomas test positivity at 88.9% (16/18), exceeding their Modified Bent-Knee Stretch Test positivity of 72.2% (13/18), producing a negative positivity gradient of −16.7 percentage points. In contrast, midfielders showed higher hamstring-related positivity than hip flexor tightness, with MBKST positivity of 74.2% (23/31) compared with Thomas test positivity of 54.8% (17/31), yielding the largest positive gradient of +19.4 percentage points. Attackers showed Thomas test positivity of 50.0% (13/26) and MBKST positivity of 65.4% (17/26), with a +15.4 percentage-point gradient; however, only attackers demonstrated a statistically significant association between hip flexor tightness and hamstring strain injury indicators ($p = 0.008$), while defenders ($p = 0.908$) and midfielders ($p = 0.496$) showed no statistically significant association. This pattern suggests that although hip flexor tightness was most prevalent among defenders, its clinically meaningful relationship with hamstring injury indicators was strongest among attackers, likely reflecting the higher sprinting, acceleration, deceleration, and explosive directional-change demands of the attacking role.

DISCUSSION

This cross-sectional study examined the association between hip flexor tightness and hamstring strain injury indicators among male outfield football players aged 18–30 years. The findings showed that both hip flexor tightness and hamstring-related clinical positivity were common in this sample. Thomas test positivity was identified in 61.3% of players, while Modified Bent-Knee Stretch Test positivity was

observed in 70.7%. However, the relationship between hip flexor tightness and hamstring strain injury indicators was not uniform across playing positions. The association was statistically significant among attackers ($p = 0.008$), whereas no statistically significant association was observed among defenders ($p = 0.908$) or midfielders ($p = 0.496$). These findings suggest that hip flexor tightness may have greater clinical relevance in attacking players, whose positional demands typically involve repeated sprinting, acceleration, deceleration, explosive changes of direction, and high-velocity kicking actions.

The high prevalence of Thomas test positivity among defenders, reaching 88.9%, indicates that hip flexor tightness was particularly frequent in this subgroup. However, despite this high frequency, defenders did not show a statistically significant association between hip flexor tightness and hamstring strain injury indicators. This distinction is clinically important because it shows that the presence of tightness alone may not be sufficient to explain hamstring-related symptoms across all playing positions. In defenders, hip flexor tightness may reflect repeated defensive stances, backward running, tackling posture, or position-specific loading patterns, but the available data do not support a direct association with hamstring injury indicators in this subgroup. Midfielders showed the highest Modified Bent-Knee Stretch Test positivity at 74.2%, yet the association with hip flexor tightness was also not statistically significant. This may reflect the mixed physical demands of midfield play, where repeated running volume, multidirectional movement, fatigue, and accumulated load may contribute to hamstring-related findings independently of isolated hip flexor tightness.

The strongest clinically relevant finding was observed among attackers. Although attackers had a lower frequency of Thomas test positivity than defenders, the association between hip flexor tightness and hamstring strain injury indicators was statistically significant in this group. This suggests that the functional consequences of restricted hip mobility may differ according to positional demands. Attackers frequently perform rapid acceleration, sprinting into space, abrupt stopping, directional change, and powerful shooting actions. During these tasks, adequate hip extension and coordinated pelvic control are essential for efficient stride mechanics and posterior-chain force transfer. When hip flexor tightness restricts hip extension or contributes to altered pelvic positioning, the hamstrings may be exposed to greater compensatory loading during terminal swing, acceleration, or kicking. This interpretation is consistent with previous sports medicine literature identifying sprinting mechanics, eccentric hamstring loading, strength imbalance, and restricted lower-limb range of motion as relevant contributors to hamstring strain injury risk in football and athletic populations (5, 10, 12).

The findings also align with previous studies emphasizing the multifactorial nature of hamstring strain injury. Prior investigations have reported that hamstring-to-quadriceps strength ratio, eccentric hamstring deficits, previous injury, and lower-limb flexibility limitations may contribute to hamstring injury susceptibility in football players and related athletic groups (1, 15–17). However, the present study adds a more specific clinical perspective by focusing on hip flexor tightness rather than only hamstring strength or hamstring-to-quadriceps ratios. This is relevant because hip flexor tightness can be assessed using a simple field-based clinical test and may represent a modifiable impairment within screening and preventive rehabilitation programs. Nevertheless, the findings should not be interpreted as showing that hip flexor tightness causes hamstring strain injury. Because the study used a cross-sectional design, temporality cannot be established, and the observed association among attackers may reflect a combination of flexibility restriction, previous injury history, training exposure, positional workload, and unmeasured neuromuscular factors.

The clinical implication of this study is that football injury-prevention programs should consider position-specific screening rather than relying only on generalized lower-limb flexibility assessment. For attackers, assessment of hip flexor tightness may be particularly useful when combined with hamstring strength testing, eccentric control evaluation, sprint exposure monitoring, and previous injury screening. For defenders and midfielders, hip flexor tightness and hamstring-related test positivity were frequent, but their lack of statistically significant association suggests that other factors may be more

influential in these positions. Therefore, rehabilitation and conditioning programs should avoid a one-size-fits-all approach and should instead integrate flexibility, strength, workload, and position-specific movement demands.

This study has several limitations that should be considered when interpreting the findings. The cross-sectional design prevents causal inference and does not establish whether hip flexor tightness preceded hamstring strain injury indicators. The use of non-probability convenience sampling limits generalizability beyond the participating football clubs in Lahore. Subgroup sizes were small, particularly among defenders, which may reduce statistical power for position-specific comparisons. The analysis relied on clinical tests and available injury indicators rather than prospective injury surveillance, imaging confirmation, or objective biomechanical assessment. Potential confounders such as previous hamstring injury, training load, sprint exposure, eccentric hamstring strength, hip extensor strength, fatigue, warm-up practices, and recovery status were not controlled through multivariable analysis. In addition, the study included only male players, so the results cannot be generalized to female football players, who may differ in flexibility profiles, biomechanics, injury patterns, and neuromuscular control.

Despite these limitations, the study provides useful preliminary evidence that the association between hip flexor tightness and hamstring strain injury indicators may vary by playing position. The significant finding among attackers supports the need for further prospective research using larger samples, standardized injury definitions, objective strength measures, training-load monitoring, and multivariable modeling. Future studies should examine whether targeted hip flexor mobility interventions, combined with eccentric hamstring strengthening and sprint-specific conditioning, reduce hamstring strain incidence among attacking players over a competitive season.

CONCLUSION

Hip flexor tightness and hamstring-related clinical positivity were common among male outfield football players aged 18–30 years, but the association between hip flexor tightness and hamstring strain injury indicators was position-specific rather than uniform across all players. Although defenders showed the highest prevalence of hip flexor tightness, a statistically significant association with hamstring strain injury indicators was observed only among attackers. These findings suggest that hip flexor tightness may be particularly relevant for players exposed to repeated sprinting, acceleration, deceleration, and explosive directional-change demands. Position-specific screening and prevention strategies that combine hip flexor flexibility assessment with hamstring strength, workload monitoring, and sport-specific movement evaluation may improve clinical interpretation and injury-prevention planning in football players.

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