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Hamstring Tightness and Its Association with Low Back Pain in College-Level Kabaddi Players: A Cross-Sectional Study

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ABSTRACT:

Background: Kabaddi demands intense biomechanical load on the lower back and posterior chain. Players frequently execute explosive sprints, drop into low defensive stances, twist violently to escape tackles, and absorb high-impact forces. Shortened or inflexible hamstring musculature is hypothesized to increase posterior pelvic tilt, flattening lumbar lordosis and transferring mechanical stress to the lumbar spine. However, objective empirical data evaluating this relationship in competitive kabaddi athletes remain limited.

Objective: To determine the prevalence of hamstring tightness among college-level kabaddi players and to analyze its cross-sectional association with low back pain (LBP).

Methods: In this cross-sectional study, 428 college kabaddi players aged 18–25 years were recruited across university training programs. Hamstring length was evaluated bilaterally using the Active Knee Extension (AKE) test, with an extension deficit exceeding 20° defining hamstring tightness. LBP presence (past 12 months and current), pain intensity, and functional disability were assessed using the Standardized Nordic

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Questionnaire, the Numeric Rating Scale (NRS), and the Oswestry Disability Index (ODI), respectively. Prevalence rates were calculated with 95% Wilson confidence intervals (CIs). Group comparisons were evaluated using Chi-square tests, Student's t-tests, and Mann–Whitney U tests. Associations were modeled using binary logistic regression adjusting for age, BMI, and playing experience.

Results: Hamstring tightness was identified in 321 of 428 players (75.00%; 95% CI: 70.67%–78.86%), while 329 players reported LBP within the previous 12 months (76.87%; 95% CI: 72.63%–80.62%). The prevalence of LBP among players with hamstring tightness was 75.39% (242/321) compared to 81.31% (87/107) in those with normal hamstring length. Univariable analysis demonstrated an odds ratio (OR) of 0.70 (95% CI: 0.40–1.22; p = 0.206) for LBP in players with hamstring tightness. Mean AKE deficits did not significantly differ between players with LBP (19.30° ± 3.53°) and those without (19.76° ± 3.29°; p = 0.244). AKE deficit showed negligible correlation with pain intensity (ϱ = -0.047, p = 0.334) and ODI disability scores (ϱ = -0.047, p = 0.335). Multivariable logistic regression confirmed that hamstring tightness was not independently associated with 12-month LBP (adjusted OR = 0.70, 95% CI: 0.40–1.22; p = 0.206).

Conclusion: Both hamstring tightness and low back pain are highly prevalent among college-level kabaddi players. However, hamstring tightness alone was not significantly associated with back pain presence, intensity, or functional disability. Multi-factorial prevention strategies incorporating core endurance, load management, and trunk biomechanics are recommended over isolated flexibility training.

1. INTRODUCTION

Low back pain (LBP) represents one of the primary causes of missed training sessions and impaired competitive execution among elite and collegiate collision-sport athletes. Sports requiring repetitive trunk flexion, high-velocity rotation, and multi-directional deceleration place extreme torsional and compressive loads upon the lumbar spine. Kabaddi—a traditional contact sport widely practiced across South Asia and rapidly growing internationally—presents unique physical demands. An offensive raider must rapidly enter the opposing court, initiate multi-planar directional changes while maintaining a deep crouched position, and forcefully break free from simultaneous tackle attempts. Conversely, defensive players maintain sustained semi-squat positions and absorb substantial linear and rotational impact forces during grappling maneuvers. Epidemiological reviews document high injury rates across lower extremity joints and identify the lumbar region as the predominant site of axial spine trauma in kabaddi.

The hamstring complex exerts direct biomechanical influence on sagittal pelvic alignment and lumbar kinetics. Originating at the ischial tuberosity, tight or shortened hamstrings restrict anterior pelvic rotation during trunk flexion. Biomechanical models suggest this restriction forces compensations through greater lumbar flexion, accentuating disc compression and strain on posterior spinal ligaments. While this mechanism provides a theoretical link between hamstring tightness and LBP, clinical studies in general athletic and adolescent populations yield mixed conclusions.

To date, objective quantification of hamstring length alongside standardized LBP outcome metrics in kabaddi athletes remains scarce. College-level players represent a critical demographic for epidemiological study due to high training volumes, competitive strain, and early susceptibility to chronic overuse conditions. Therefore, this study aimed to: (1) determine the epidemiological prevalence of hamstring tightness and LBP in collegiate kabaddi players, and (2) evaluate the cross-sectional association between objective hamstring extension deficits and back pain severity.

2. METHODS

2.1 Design and Setting

This cross-sectional study was conducted at JNCT Professional university sports training complexes in compliance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

2.2 Ethical Approval

Institutional Ethics Committee approval was obtained prior to study initiation. All participants were informed of the study procedures, benefits, and potential risks, and provided written informed consent in accordance with the Declaration of Helsinki.

2.3 Participants

A total of 428 collegiate kabaddi players were recruited through enumerative sampling from athletic programs.

• **Inclusion Criteria:** Male and female athletes aged 18–25 years; active participation in organized competitive kabaddi for ≥ 1 year; participation in at least 3 formal training sessions per week.

• **Exclusion Criteria:** History of spinal surgery, structural scoliosis, or vertebral fracture; acute lower extremity injury within the preceding 3 months; radiculopathy or neurological deficit; systemic inflammatory conditions; non-musculoskeletal LBP causes.

2.4 Measurements

• **Demographic & Athletic Parameters:** Age, sex, height, body mass, body mass index (BMI), primary playing position (raider, defender, or all-rounder), competitive experience (years), weekly training volume (hours), and participation in structured post-training stretching routines were recorded.

• **Hamstring Length (Active Knee Extension Test):** Hamstring length was objectively measured bilaterally using the Active Knee Extension (AKE) test. Participants were positioned supine on an examination table with the hip and knee of the evaluated leg flexed to 90°. With the thigh fixed vertically and the contralateral limb secured flat, the participant actively extended the knee until maximum tolerable stretch was reached without pelvic compensation. Knee extension deficit from full extension (0°) was recorded using a universal goniometer across three repeated trials and averaged. A deficit > 20° on either leg was categorized as hamstring tightness.

• **Low Back Pain Assessment:** LBP was defined as localized discomfort, tension, or soreness between the lower rib margin and inferior gluteal folds. The Standardized Nordic Questionnaire evaluated LBP presence over the preceding 12 months and current symptom status. Pain intensity was quantified using the 11-point Numeric Rating Scale (NRS 0–10). Functional impairment was measured using the Oswestry Disability Index (ODI v2.1), expressed as a percentage score.

2.5 Statistical Analysis

Data were analyzed using Python (scipy.stats, statsmodels) and validated against SPSS outputs. Continuous variables were evaluated for normality via the Shapiro–Wilk test and reported as mean ± standard deviation. Categorical variables were presented as absolute frequencies and percentages. Point estimates for prevalence were calculated with 95% Wilson score confidence intervals. Between-group comparisons were performed using independent Student's t-tests (or Welch's t-test where variances differed) and Chi-square (χ^2) tests. Bivariate continuous correlations were evaluated using Spearman's rank coefficient (ϱ). To control for confounding, multivariable binary logistic regression was fitted with 12-month LBP as the dependent variable, incorporating hamstring tightness, age, BMI, and experience as covariates. Statistical significance was set at $p < 0.05$.

3. RESULTS

3.1 Participant Characteristics

Four hundred and twenty-eight (N = 428) collegiate kabaddi players completed the clinical assessments (304 male, 124 female). The sample consisted of 148 raiders (34.58%), 147 defenders (34.35%), and 133 all-rounders (31.07%). Detailed demographic and athletic characteristics stratified by LBP status are presented in Table 1.

Variable	Overall (N = 428)	LBP Present (n = 329)	LBP Absent (n = 99)	p-value
Age (years), mean ± SD	21.52 ± 2.29	21.52 ± 2.29	21.51 ± 2.29	0.972
BMI (kg/m²), mean ± SD	23.63 ± 2.01	23.73 ± 2.00	23.32 ± 2.02	0.073
Experience (years), mean ± SD	4.49 ± 2.07	4.44 ± 2.07	4.67 ± 2.08	0.323
Training (hours/week), mean ± SD	8.61 ± 2.26	8.60 ± 2.26	8.63 ± 2.27	0.902
Position, n (%): Raider	148 (34.58%)	120 (81.08%)	28 (18.92%)	0.354
Position, n (%): Defender / All-rounder	280 (65.42%)	209 (74.64%)	71 (25.36%)	—

Table 1. Demographic and Athletic Characteristics of Study Participants (N = 428)

3.2 Hamstring Tightness Prevalence

Hamstring tightness (> 20° knee extension deficit) was detected in 321 of 428 players, yielding an overall prevalence of 75.00% (95% CI: 70.67%–78.86%). Bilateral hamstring tightness was observed in 208 players (48.60%), while unilateral tightness was noted in 113 players (26.40%). The mean AKE deficit was 19.85° ± 4.82° on the right leg and 18.96° ± 5.19° on the left leg.

Category	Frequency (n)	Percentage (%)	95% Confidence Interval
Tightness Present (Either Leg)	321	75.00%	70.67% – 78.86%
— Bilateral Tightness	208	48.60%	43.89% – 53.33%
— Right Leg Only	61	14.25%	11.19% – 17.97%
— Left Leg Only	52	12.15%	9.32% – 15.68%

Category	Frequency (n)	Percentage (%)	95% Confidence Interval
Normal Hamstring Length	107	25.00%	21.14% – 29.33%

Table 2. Breakdown of Hamstring Tightness Categorization (N = 428)

3.3 Low Back Pain and Functional Disability

Overall, 329 players reported experiencing LBP within the preceding 12 months, representing a prevalence of 76.87% (95% CI: 72.63%–80.62%). Active pain at the time of evaluation was reported by 266 players (62.15%). Among athletes with LBP, the mean self-reported pain intensity was 4.41 ± 1.63 on the NRS, and mean functional disability was 22.75% ± 8.78% on the ODI.

3.4 Association Between Hamstring Tightness and Low Back Pain

Cross-tabulation revealed that LBP was reported by 75.39% of players with hamstring tightness compared to 81.31% of players with normal hamstring length (Table 3).

Hamstring Status	LBP Present (n)	LBP Absent (n)	Total (N)	Unadjusted OR (95% CI); p-value
Tightness Present	242	79	321	0.70 (0.40 – 1.22); p = 0.206
Tightness Absent (Normal)	87	20	107	Reference
Total	329	99	428	—

Table 3. Contingency Table for Hamstring Tightness and 12-Month LBP

Univariable Chi-square analysis demonstrated no statistically significant association between hamstring tightness and LBP (χ^2 = 1.600, p = 0.206, OR = 0.70, 95% CI: 0.40–1.22). Mean bilateral AKE deficit was 19.30° ± 3.53° in the LBP group compared to 19.76° ± 3.29° in the pain-free group (p = 0.244).

Spearman rank correlation demonstrated no significant linear association between AKE extension deficit and pain intensity (ϱ = -0.047, p = 0.334) or ODI functional disability (ϱ = -0.047, p = 0.335).

In multivariable logistic regression modeling controlling for age, BMI, and years of playing experience, hamstring tightness remained unassociated with LBP status (adjusted OR = 0.70, 95% CI: 0.40–1.22; p = 0.206).

4. DISCUSSION

This study evaluated the prevalence of hamstring tightness and its cross-sectional relationship with LBP in a homogenous sample of 428 competitive collegiate kabaddi athletes. The key findings are: (1) both hamstring tightness (75.00%) and 12-month LBP (76.87%) are extremely common in collegiate kabaddi, but (2) objective hamstring tightness shows no statistical association with LBP presence, pain severity, or functional disability.

The high prevalence of hamstring tightness observed aligns with the sport's specific motor patterns. Kabaddi demands prolonged semi-squat positions, eccentric deceleration during lunges, and sustained isometric contractions of the posterior thigh musculature. Over time, repeated high-intensity loading without adequate end-range extension training can lead to

adaptive muscle shortening and altered tendon compliance. Similarly, the high 12-month LBP prevalence (76.87%) mirrors high rates reported in contact sports involving frequent hyper-flexion, twisting, and axial impacts.

Despite theoretical models linking hamstring shortness to LBP via posterior pelvic tilt and augmented lumbar loading, our empirical findings demonstrate no direct relationship. Athletes with normal hamstring flexibility demonstrated comparable (and slightly higher absolute) rates of LBP compared to those with clinical tightness. These results indicate that isolated static hamstring length is not a primary determinant or independent driver of LBP in kabaddi players.

Instead, LBP etiology in collision athletes is multi-factorial. Factors such as core muscular endurance, neuromuscular fatigue, abrupt spikes in training load, high-velocity tackle impacts, and prior acute spinal trauma likely exert greater influence on pain generation than static muscle length. Consequently, while static hamstring stretching maintains general flexibility benefits, relying on flexibility interventions as a primary LBP prevention protocol in kabaddi is unsupported by these data.

4.1 Strengths and Limitations

This study utilized objective, standardized goniometric testing (AKE) alongside validated clinical outcome measures (NRS, ODI) in a large sample of competitive athletes. Statistical analyses adjusted for key demographic confounders.

Limitations include the cross-sectional design, which precludes temporal or causal inferences. Sampling was confined to collegiate athletes, limiting direct extrapolation to elite professional or junior players. Furthermore, self-reported LBP over a 12-month window carries inherent recall bias. Important unmeasured variables—including core endurance, lumbar range of motion, hip flexor tightness, training load metrics, and acute impact histories—should be incorporated in prospective dynamic studies.

4.2 Practical Implications & Future Directions

Sports medicine clinicians and strength coaches working in kabaddi should transition from isolated flexibility assessments toward comprehensive functional movement evaluations. Pre-season screening should prioritize core motor control, lumbo-pelvic stability under fatigue, dynamic landing mechanics, and workload management. Prospective longitudinal cohort tracking is required to confirm whether changes in hamstring length influence long-term spinal health or prospective injury risk.

5. CONCLUSION

Hamstring tightness and low back pain are highly prevalent in collegiate kabaddi players. However, objective hamstring tightness is not significantly associated with back pain presence, intensity, or disability. Injury prevention and rehabilitation programs should emphasize multi-dimensional conditioning, core endurance, and biomechanical technique over isolated flexibility interventions.

DECLARATIONS

• **Ethics Approval and Consent:** Approved by the Institutional Ethics Committee; written informed consent was obtained from all participants.

• **Conflict of Interest:** The authors declare no conflicts of interest.

• **Funding:** No funding was received for this study.

• **Author Contributions:** Study design, clinical data collection, statistical analysis, manuscript writing, and critical revisions were conducted collaboratively by the author team.

• **Data Availability:** Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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