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Epidemiological characteristics of lateral ankle sprains in male collegiate rugby union players with and without injury history

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Abstract

Lateral ankle sprains (LAS) account for a substantial proportion of ankle injuries in rugby union and are associated with a high recurrence rate. A history of LAS is known to increase future injury risk, yet few studies have quantitatively examined this relationship. This study aimed to investigate the epidemiological characteristics of LAS among male collegiate rugby players based on the presence or absence of prior injury history. A total of 146 players were prospectively followed over seven seasons and divided into two groups according to their LAS history. Group-specific exposure time was used to calculate injury incidence, severity, and mechanism-specific burden. A total of 131 LAS cases were recorded. The History group showed a significantly higher incidence rate (1.22/1,000 PHs) than the No History group (0.72/1,000 PHs), while no significant difference in severity was observed. Contact-related mechanisms, including other player collisions and lineout landings, were more frequent and burdensome in the History group. These findings suggest that injury history is not merely a contextual factor, but a key determinant of future injury risk and characteristics. Prevention and rehabilitation strategies should be tailored accordingly. Mechanism-specific training and history-informed return-to-play protocols are essential to reduce the burden of LAS in athletes with prior injuries.

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Keywords: Lateral ankle sprain, Injury history, Injury epidemiology, Injury burden, Injury prevention

Title :

既往歴の有無による男子大学生ラグビー選手における外側足関節捻挫の疫学的特性

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Abstract

ラグビーにおける外側足関節捻挫（LAS）は、足関節外傷の中でも相当な割合を占めており、再発率が高いことが知られている。LAS の既往歴は将来的な受傷リスクを高める要因とされるが、この関係を定量的に検討した研究は限られている。本研究では、男子大学ラグビー選手 146 名を 7 シーズンにわたり前向きに調査し、LAS の既往歴の有無によって 2 群に分類した。各群における曝露時間に基づき、発生率、重症度、および受傷機序別バーデンを算出した。その結果、LAS は 131 件記録され、既往歴あり群の発生率（1.22 件/1,000PHs）は既往歴なし群（0.72 件/1,000PHs）より有意に高かった。重症度には有意差は認められなかったが、他選手との衝突やラインアウト着地などの接触系機序は、既往歴あり群でより多く、バーデンも高かった。これらの結果より、LAS の既往歴は単なる背景因子ではなく、将来的な受傷リスクとその特徴を左右する決定的な要因であることが示唆された。したがって、既往歴を考慮した予防およびリハビリテーション戦略の構築が求められる。

Introduction

Rugby union is known to carry one of the highest overall risks of injury among sports, and the ankle joint has been consistently identified as one of the most frequently affected sites[1),2)]. In this sport, ankle injuries have been reported to account for 8% to 20% of all injuries[3)], with lateral ankle sprains (LAS) comprising approximately 43% of these cases[3)]. The incidence of LAS in rugby ranges from 0.15 to 4.20 injuries per 1,000 player-hours[3)-6)], and the average return-to-play (RTP) time is reported to be between 19 and 25.7 days[6)-8)]. Furthermore, previous studies indicate that 26% to 39% of LAS cases are recurrent[5),6)]. These findings emphasize the impact of LAS in rugby union; however, epidemiological studies and prevention strategies specific to this sport remain insufficient.

LAS have the highest recurrence rate among lower extremity injuries[9)], with rates reported up to 73% in sport[10)]. The most significant risk factor for such recurrence is a history of LAS[11),12)], which is also associated with a higher likelihood of sustaining high-grade sprains[13)] and an increased risk of contralateral ankle injury[14)]. Despite the high recurrence rate, LAS is often underestimated compared to other injuries, as mild cases frequently allow for early RTP. As a result, athletes may return to play before complete physiological healing[15)], potentially increasing the risk of reinjury. Recurrent sprains often lead to residual symptoms such as pain, swelling, and instability[16),17)], and 40% to 75% of individuals with prior LAS develop chronic ankle instability (CAI)[18]. Therefore, prior injury history must be a central consideration when evaluating the risk of LAS recurrence.

While the association between prior LAS and recurrence is well established[11),12)], few studies have quantitatively examined how injury history influences the actual risk of future sprains. Most previous research has merely collected individual characteristics such as injury history at a single time point and statistically inferred associations with subsequent injury occurrence[11),12)]. As a result, few have quantitatively examined how injury history actually influences future LAS incidence. In particular, for injuries like LAS, which have high recurrence rates and for which prior history itself poses a significant risk, group-based descriptive epidemiological analysis is essential for more practical and accurate risk evaluation.

Descriptive epidemiological studies are useful for quantifying injury incidence, severity, and mechanisms in sports. In prospective studies, this typically involves tracking athletes' exposure time and calculating injury rates per unit of exposure[19)-21)]. However, most previous research has treated the entire athlete population as a single unit and calculated injury rates using team-based exposure estimates[22)-24)]. Such approaches fail to account for inter-individual variation in risk level and instead produce averaged values. In cases like LAS, where prior history substantially affects injury risk, athletes may face different levels of actual risk despite identical exposure durations. Therefore, it is necessary to stratify athletes by injury history and separately calculate exposure time and injury rates for each group.

Therefore, this study aimed to examine the epidemiological characteristics of LAS among male collegiate rugby union players by comparing athletes with and without a history of ankle sprains. We hypothesized that players with a history of LAS would demonstrate higher injury incidence and greater injury severity than those without such a history. By stratifying athletes based on injury history and evaluating LAS risk using group-specific exposure data, this study seeks to provide more accurate evidence to inform targeted prevention and management strategies.

Materials and Methods

Participants

Over seven seasons from 2017 to 2023, a total of 211 male collegiate rugby union players from one university's competitive-level team that participated in the annual All-Japan University Rugby Championship were eligible for recruitment. During the preseason of each player's freshman year, we recorded their physical characteristics, including age, height, weight, and years of rugby experience, using a standardized questionnaire. This questionnaire also assessed their history of LAS during high school.

The exclusion criteria were as follows: (1) second- to fourth-year players at baseline in 2017, because LAS history during high school could not be determined retrospectively with sufficient accuracy; (2) players with a history of LAS prior to high school; (3) players unable to participate in an entire season due to rehabilitation; and (4) players who joined or left the team mid-season. No players met criteria (2)–(4) during the study period. After applying these criteria, 146 players (70 forwards: 30 front row, 19 second row, and 21 back row; and 76 backs: 15 halves, 38 inside backs, and 23 outside backs) were included in the analysis.

High school LAS history was determined based on responses to the preseason baseline questionnaire administered during each player's freshman year. The questionnaire included the date, injured body part, injury mechanism, and time required for RTP. LAS cases were identified when the injured body part was the ankle and the injury mechanism was consistent with a lateral ankle sprain, with ≥24 hours of absence from training or match participation—consistent with the time-loss definition used for university LAS. All responses were reviewed and evaluated by team trainers.

Based on the questionnaire responses, 43 players were identified as having a history of LAS in one or both ankles during high school (History Group), whereas 103 players were classified as not having such a history (No History Group). These histories were used to divide the athletes into two distinct groups for comparison, and group classification remained unchanged throughout the study, regardless of injury occurrence after enrollment (Figure 1).

[Figure. 1 about here.]

Table 1 presents the physical characteristics of the participants, including their age, height, weight, years of rugby experience, and playing position distribution, categorized by LAS history (History group vs No History group).

[Table. 1 about here.]

The authors obtained written informed consent from all volunteers before their participation, following approval by the Ethics Committee of the Faculty of Health and Sports Sciences at the University of Tsukuba (approval number 023-120).

Injury surveillance

The study spanned seven years, from 2017 to 2023. During this period, LAS occurrence during rugby matches and training sessions were meticulously recorded. All injury data and exposure times were documented by the teams' athletic trainers. Information recorded immediately after a LAS included involvement of the lateral ligament, whether the injury was new or recurrent, the player's position, the context of the injury (match or training), the mechanism of injury, and the time taken for the player to RTP. The mechanisms of injury were categorized as contact play (tackled, tackling, ruck, other player collision, scrumming, lineouts, maul) and non-contact play (stepping). Infrequent non-contact play was classified as "others," and unclear mechanisms were labeled as "unknown." LAS diagnoses were confirmed by board-certified sports medicine physicians. Injuries were defined as those preventing participation in a match or training for at least 24 hours post-injury[19]. Recurrence was defined as a LAS of the same type occurring at the same anatomical site as a previous LAS, after complete recovery and return to unrestricted participation[19]. Because group classification was determined at the time of enrollment based on injury history, it was possible for both initial and recurrent LAS to occur in each group during the study period. For example, a player with a prior LAS in one ankle may sustain a new sprain in the contralateral ankle (initial injury), while a player without any prior history may sustain a recurrent sprain after an initial episode during college.

Data analysis

The incidence rate was defined as the number of injuries per 1,000 player-hours (PHs) of match or training exposure. Specifically, ankle sprain incidence was calculated by dividing the total occurrences by the exposure time in hours and multiplying by 1,000. We calculated the incidence rates of LAS separately for the two groups based on the presence or absence of a history of LAS. To ensure an accurate comparison, we computed the incidence rates per 1,000 PHs for each group individually. This approach allowed us to account for differences in exposure time between groups, providing a precise reflection of the risk of LAS in each group. Significant differences in incidence rates were inferred if the 95% confidence intervals (CIs) did not include 1[25].

Injury severity was quantified by the number of days from the occurrence of the LAS until the player could fully return to training and match play without any limitations. RTP was permitted only when the team's medical doctor confirmed that the athlete had fully recovered and was ready for unrestricted participation in team activities. The mean severity between the two groups was compared using a t-test.

In addition, we separately calculated the incidence and severity of initial and recurrent injuries, both overall and within each group, and computed rate ratios to compare the relative risk between injury types. These comparisons were conducted as secondary analyses to complement the primary comparison based on injury history.

The burden, expressed as days lost per 1,000 PHs, was calculated by multiplying the incidence rate by the average severity of injuries[21)]. Burden was only calculated for injury mechanisms, as the analysis aimed to identify the most impactful play types leading to time-loss.

Results

During the seven-season study period, the total exposure time was 148,879.10 hours, of which the History Group accounted for 46,802.1 hours (forwards: 26,896.5 hours; backs: 19,905.6 hours) and the No History Group accounted for 102,077.0 hours (forwards: 49,066.5 hours; backs: 53,010.5 hours). A total of 131 LAS incidents were recorded during this period, with 57 incidents in the History Group and 74 incidents in the No History Group. Based on all recorded cases, the overall incidence of LAS was 0.88 injuries per 1,000 PHs. The incidence of LAS in the History Group (1.22 injuries/1,000 PHs; 95% CI: 0.90–1.53) was 1.68 times higher than that in the No History Group (0.72 injuries/1,000 PHs; 95% CI: 0.56–0.89) (Table 2). The average severity of ankle sprains was 27.3 ± 19.6 days, with no significant difference between the History Group (27.0 ± 21.1 days) and the No History Group (27.5 ± 18.6 days).

[Table. 2 about here.]

To complement the primary comparison based on injury history, the incidence of new and recurrent LAS was further examined between the History and No History groups (Table 3). The incidence of new LAS was significantly higher in the No History Group (0.52 injuries per 1,000 PHs; 95% CI: 0.38–0.66) than in the History Group (0.26 injuries per 1,000 PHs; 95% CI: 0.11–0.40), with a rate ratio of 0.49 (95% CI: 0.26–0.92). In contrast, the incidence of recurrent LAS was significantly higher in the History Group (0.96 injuries per 1,000 PHs; 95% CI: 0.68–1.24) compared to the No History Group (0.40 injuries per 1,000 PHs; 95% CI: 0.23–0.57), with a rate ratio of 4.67 (95% CI: 2.78–7.85).

[Table. 3 about here.]

As shown in Table 4, at the overall level, new LAS had a significantly higher average severity (30.8 ± 20.5 days) than recurrent LAS (23.9 ± 18.3 days, $p < 0.05$). In subgroup comparisons, severity was also higher for new injuries than recurrent ones in both the History

Group (36.0 ± 20.8 vs. 24.1 ± 20.7 days) and the No History Group (29.6 ± 20.4 vs. 22.4 ± 11.8 days), but these differences were not statistically significant.

[Table. 4 about here.]

The incidence of LAS by injury mechanism showed that stepping was the most frequent mechanism overall, accounting for the highest total number of cases (n = 36) and the highest incidence rate (0.24 injuries/1,000 PHs) among all mechanisms. However, no significant difference in stepping incidence was observed between the History (0.28 injuries/1,000 PHs) and No History (0.23 injuries/1,000 PHs) groups. In contrast, contact-related mechanisms such as other player collisions and lineouts exhibited significantly higher incidence rates in the History Group (0.26 injuries/1,000 PHs and 0.21 injuries/1,000 PHs, respectively) than in the No History Group (0.09 injuries/1,000 PHs and 0.03 injuries/1,000 PHs, respectively), with rate ratios of 2.91 (95% CI: 1.23–6.90) and 7.27 (95% CI: 2.00–26.42), respectively (Table 5).

[Table. 5 about here.]

With regard to severity, the overall average severity was 27.3 ± 19.6 days. No significant differences in severity were found across mechanisms, except for the 'unknown' mechanism, which showed a significantly lower severity in the History Group (5.5 ± 3.4 days) compared to the No History Group (33.2 ± 23.2 days) ($p = 0.034$) (Table 6).

[Table. 6 about here.]

Regarding burden, stepping demonstrated the highest values across all mechanisms in both groups, with 8.1 days/1,000 PHs in the History Group and 6.7 days/1,000 PHs in the No History Group (Figure 2). Although its severity was not markedly higher than other mechanisms, stepping's high burden appeared to stem from its high frequency. In the History Group, contact-related mechanisms such as lineouts (7.1 days/1,000 PHs) and other player collisions (6.8 days/1,000 PHs) also showed notably high burden values compared to the No History Group.

[Figure. 2 about here.]

Discussion

Previous studies have often identified a history of LAS as a strong risk factor for future injuries[11),12)]. However, most of them merely examined statistical associations between prior injury and subsequent occurrence, based on data collected at a single time point. Furthermore, their injury rates were typically calculated using team-based exposure estimates, failing to reflect individual differences in risk. In contrast, this study divided athletes into groups based on the presence or absence of LAS history and calculated injury incidence using group-specific exposure time[22)-24)]. This approach allowed for a more direct and quantitative comparison of LAS risk, providing clearer insight into the actual impact of injury history.

The incidence of LAS was 1.68 times higher in the History Group than in the No History Group (Table 2). This finding provides quantitative evidence that a prior injury history—long identified as a major risk factor—is indeed associated with an elevated risk of future LAS. Similar tendencies regarding the elevated risk associated with a history of ankle sprain have been observed across various sports, with reported rate ratios of 1.41 in basketball[26)] and 6.5 in American football[27)], and risk ratios ranging from 3.83 to 5.28 in soccer and volleyball[28)]. Although the magnitude of risk varies by sport, the consistently elevated injury risk among athletes with a history of ankle sprain underscores the importance of tailored prevention strategies. Furthermore, the individualized exposure-based approach employed in this study offers a more precise estimation of injury risk, highlighting the value of detailed exposure tracking in epidemiological research.

Contrary to our hypothesis, no significant difference in LAS severity—measured by return-to-play time—was found between the History and No History groups. While this suggests that current rehabilitation programs may support comparable recovery timelines, it remains unclear whether they sufficiently address the elevated recurrence risk associated with prior LAS. Athletes with a history of LAS may still carry unresolved deficits that are not reflected in RTP duration alone. Further research is needed to determine whether tailored rehabilitation protocols could more effectively reduce reinjury risk in this population.

To complement the group-based analysis, we compared LAS incidence by injury type across the History and No History groups. As shown in Table 3, the No History group was predominantly composed of new injuries, while the History group showed a clear dominance of recurrent cases. Although previous studies have reported that a history of LAS in one ankle may increase the risk of new LAS in the contralateral ankle[14)], such cases remained relatively infrequent even in the History group. This discrepancy may reflect more cautious behavior or bilateral preventive measures (e.g., taping) adopted by athletes with prior LAS. This structural divergence, as demonstrated through stratified incidence analysis, suggests that injury history influences not only the likelihood of recurrence but also the broader composition of future injuries. By quantifying this difference, the present study adds empirical clarity to what has often been assumed, offering practical insights for developing more targeted prevention strategies.

Initial LAS showed greater severity than recurrent LAS (Table 4), likely due to a lack of rehabilitation experience or physical readiness in first-time cases. In contrast, recurrent injuries may benefit from prior rehabilitation, behavioral adaptations, or protective measures such as taping or bracing. Ankle sprains are often underestimated, and many athletes return to play before full ligament recovery, which typically takes 6 to 12 weeks[29]. In fact, more than 50% resume activity within a week[30], increasing the risk of incomplete healing. This may partly explain the lower observed severity in recurrent LAS, as athletes gradually adapt to residual symptoms. Given its longer recovery demands, premature return after initial LAS may elevate the risk of reinjury, highlighting the importance of sufficient rehabilitation.

Stepping, a non-contact mechanism, consistently exhibited the highest burden across all mechanisms, with 8.1 and 6.7 days/1,000 PHs in the History and No History groups, respectively (Figure 2). This trend was largely driven by its high frequency of occurrence—stepping had the highest incidence rate overall (0.24 injuries/1,000 PHs), regardless of injury history (Table 5). Although its severity (28.8 and 29.2 days, respectively) was not markedly higher than other mechanisms (Table 6), the cumulative time loss was amplified by the high number of cases. Given that stepping frequently occurs during cutting, pivoting, and rapid directional changes—core components of rugby's multidirectional movement patterns—its high incidence may be attributed to these sport-specific movement demands. Such movements are well-established risk factors for ligamentous ankle injuries[31)-34]. These findings suggest that stepping is a predominant contributor to LAS burden in rugby union, not necessarily due to more severe injuries but because of its high incidence. Accordingly, prevention strategies—

such as balance, strength, proprioceptive, and functional training[35]—should be universally implemented regardless of LAS history to reduce injury occurrence and mitigate overall burden.

Contact-related LAS occurred more frequently in the History Group, especially during collisions with other players (0.26 injuries/1,000 PHs) and lineouts (0.21 injuries/1,000 PHs), compared to the No History Group (0.09 and 0.03 injuries/1,000 PHs, respectively) (Table 5). These mechanisms also resulted in the highest burden in the History Group, with 6.8 and 7.1 days lost per 1,000 PHs, respectively (Figure 2). These findings highlight the elevated risk and impact of contact-related injuries in athletes with prior LAS. This pattern aligns with previous research showing that contact situations such as tackling and ruck are common mechanisms of LAS in rugby[6]. Our results further suggest that these scenarios may pose an even greater risk to athletes with a history of LAS, underscoring the need for targeted prevention in this population. The increased injury risk in these contact scenarios may stem from biomechanical vulnerabilities commonly observed in individuals with a history of LAS, such as functional instability[36], reduced muscle strength[37], impaired proprioception[38], and limited joint mobility[39].

For athletes with a history of LAS, prevention strategies should prioritize enhancing body positioning awareness—including proper foot placement—particularly during contact scenarios such as collisions. In lineout situations, training should emphasize well-coordinated and clearly communicated teamwork between lifters and jumpers, along with safe landing techniques for jumpers. Additionally, it is crucial to address residual functional deficits—such as instability, limited range of motion, and proprioceptive dysfunction—through targeted rehabilitation. Protective measures such as taping and structured contact drills should also be incorporated before returning to full training.

The 'Activate' program, introduced by World Rugby, is a pre-activity exercise regimen aimed at injury prevention[40)]. It includes balance, strength, and movement control exercises and has been shown to reduce lower limb injuries[41),42)]. While particularly effective for non-contact injuries such as LAS linked to agility-based movements, its impact on contact-related injuries—like collisions or lineout landings—may be limited. To enhance the effectiveness of existing prevention programs, incorporating contact-specific drills may offer broader protection while particularly benefiting athletes with a history of LAS who are at greater risk in contact scenarios.

RTP timelines are essential in sports injury management, especially for collegiate athletes balancing academic and athletic responsibilities. This study highlights the need to consider injury history in RTP planning, as athletes with prior LAS face distinct risks such as higher recurrence rates and greater burden from contact-related injuries. Developing and validating RTP protocols that differentiate criteria based on LAS history may improve safety, support efficient recovery, and reduce reinjury risk.

This study has several limitations. It was conducted on a single university team, limiting the generalizability of the findings to other populations. High school LAS history was determined through retrospective self-reporting, which may introduce recall bias, and not all cases were confirmed by medical professionals, unlike university LAS. In addition, LAS during university was not consistently evaluated using objective imaging techniques, which may have affected diagnostic accuracy. Furthermore, the use of preventive interventions such as ankle taping was not systematically recorded during the study period. This may have affected injury occurrence or severity, particularly in athletes with a history of LAS, and limits our ability to account for its potential confounding effects. Although group-specific exposure time was calculated to reduce bias, limb-specific exposure was not considered.This approach may have overestimated injury rates in cases involving multiple injuries within the same individual. Future studies should consider calculating exposure time at the limb or injury-event level to more accurately reflect mechanism-specific and qualitative risks.

Conclusions

This study quantitatively investigated the epidemiological characteristics of LAS, comparing male collegiate rugby players with and without prior injury history. The incidence rate was significantly higher in the History group, while severity did not differ between groups. Contact-related mechanisms, such as other player collisions and lineout landings, showed higher incidence rates and greater injury burden in the History group. These findings demonstrate that a history of LAS is not just a contextual factor, but a key determinant of future injury risk and characteristics. Therefore, history-informed strategies are essential for effective prevention and rehabilitation.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

Author Contributions

Conceptualization and design: HK, RO and TM**;** Data collection: HK, RO, AO and TS**;** Data analysis: HK, RO and TM**;** Paper composition: HK**;** Conceptual advice: NM, TF.

All authors have critically reviewed, revised, and approved the final version of the manuscript.

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Table 1. Physical characteristics of participants by LAS history (mean ± SD).

Variables	**History** (n = 43)	**No History** (n = 103)	***P* value**
Age (years)	18.4 ± 0.6	18.4 ± 0.6	0.718
Body height (cm)	175.5 ± 7.4	174.7 ± 6.0	0.529
Body weight (kg)	84.6 ± 13.2	83.8 ± 11.9	0.721
Rugby experience (years)	10.0 ± 4.2	9.2 ± 4.0	0.280
Position, No.(%)			0.386
-Forwards	23 (53.5)	47 (45.6)	
-Backs	20 (46.5)	56 (54.4)	

Table 2. LAS incidence comparison between the History and No History groups

	History		No History		Rate ratio (95%CI)
	No. (%)	**Incidence/1000PHs (95%CI)**	**No. (%)**	**Incidence/1000PHs (95%CI)**	
Total ankle sprains	57 (43.5)	1.22 (0.90-1.53)	74 (56.5)	0.72 (0.56-0.89)	1.68 (1.19-2.37)*

PHs: player hours; CI: Confidence interval; Rate ratio = History/No History

*Significant difference between groups ($P < 0.05$)

Table 3. Comparison of LAS incidence between injury history groups by injury type (new and recurrent)

Injury Type	**Group**	**No. (%)**	**Incidence/1000PHs (95%CI)**	**Rate Ratio (95% CI)**
New	History	12 (21.1)	0.26 (0.11 to 0.40)	Ref
	No History	53 (71.6)	0.52 (0.38 to 0.66)	0.49 (0.26 to 0.92)*
Recurrent	History	45 (78.9)	0.96 (0.68 to 1.24)	Ref
	No History	21 (22.4)	0.40 (0.23 to 0.57)	4.67 (2.78 to 7.85)*

PHs: player hours; CI: Confidence interval; Rate ratio = History/No History; Ref: reference group

*Significant difference between groups (P < 0.05)

Table 4. Comparison of injury severity between new and recurrent LAS

	New LAS (Mean ± SD)	**Recurrent LAS (Mean ± SD)**	***P* value**
Total	30.8 ± 20.5	23.9 ± 18.3	0.045*
History	36.0 ± 20.8	24.1 ± 20.7	0.096
No History	29.6 ± 20.4	22.4 ± 11.8	0.063

Mean: Average value; SD: Standard deviation

*Significant difference between groups ($P < 0.05$)

Table 5. Incidence of LAS by injury mechanism based on injury history

	History		No History			Total	
	No. (%)	**Incidence/1000 PHs (95%CI)**	**No. (%)**	**Incidence/1000 PHs (95%CI)**	**Rate ratio (95% CI)**	**No. (%)**	**Incidence/1000 PHs (95%CI)**
Tackled	8 (14.0)	0.17 (0.05-0.29)	13 (17.6)	0.13 (0.06-0.20)	1.34 (0.56-3.24)	21(16.1)	0.14(0.08 to 0.20)
Tackling	1 (1.8)	0.02 (-0.02-0.06)	3 (4.1)	0.03 (0.00-0.06)	0.73 (0.08-6.99)	4(3.1)	0.03(0.00 to 0.05)
Ruck	4 (7.0)	0.09 (0.00-0.17)	10 (13.5)	0.10 (0.04-0.16)	0.87 (0.27-2.78)	14(10.7)	0.09(0.04 to 0.14)
Other player collision	12 (21.1)	0.26 (0.11-0.40)	9 (12.2)	0.09 (0.03-0.15)	2.91 (1.23-6.90)*	21(16.0)	0.14(0.08 to 0.20)
Scrum	0 (0.0)	0.00	1 (1.4)	0.01 (-0.01-0.03)	0.00	1(0.8)	0.01(-0.01 to 0.02)
Lineout	10 (17.5)	0.21 (0.08-0.35)	3 (4.1)	0.03 (0.00-0.06)	7.27 (2.00-26.42)*	13(9.9)	0.09(0.04 to 0.13)
Maul	3 (5.3)	0.06 (-0.01-0.14)	2 (2.7)	0.02 (-0.01-0.05)	3.27 (0.55-19.58)	5(3.8)	0.03(0.00 to 0.06)
Stepping	13 (22.8)	0.28 (0.13-0.43)	23 (31.1)	0.23 (0.13-0.32)	1.23 (0.62-2.43)	36(27.5)	0.24(0.16 to 0.32)
Others	2 (3.5)	0.04 (-0.02-0.10)	4 (5.4)	0.04 (0.00-0.08)	1.09 (0.20-5.95)	6(4.6)	0.04(0.01 to 0.07)
Unknown	4 (7.0)	0.09 (0.00-0.17)	6 (8.1)	0.06 (0.01-0.11)	1.45 (0.41-5.15)	10(7.6)	0.07(0.03 to 0.11)

PHs: player hours; CI: Confidence interval; Rate ratio = History/No History

*Significant difference between groups ($P < 0.05$)

Table 6. Severity of LAS by injury mechanism based on injury history

	All Severity (Mean ± SD)	History Severity (Mean ± SD)	No History Severity (Mean ± SD)	*P* value
Tackled	23.5 ± 12.0	18.9 ± 12.3	26.4 ± 11.2	0.167
Tackling	28.3 ± 15.1	50.0	21.0 ± 5.3	-[a]
Ruck	30.3 ± 25.1	34.1 ± 14.6	30 ± 30.9	0.786
Other player collision	26.7 ± 18.4	26.0 ± 19.1	27.7 ± 18.5	0.843
Scrum	10.0	-	10.0	-[b]
Lineout	31.1 ± 20.4	34.0 ± 20.0	21.3 ± 22.4	0.367
Maul	22.4 ± 20.8	29.7 ± 25.6	11.5 ± 4.9	0.414
Stepping	24.6 ± 19.8	28.8 ± 26.9	29.2 ± 19.3	0.958
Others	27.9 ± 19.5	46.5 ± 21.9	25.0 ± 16.0	0.232
Unknown	32.2 ± 19.3	5.5 ± 3.4	33.2 ± 23.2	0.034*
Total	27.3 ± 19.6	27.0 ± 21.1	27.5 ± 18.6	0.883

Mean: Average value; SD: Standard deviation;

[a]p-value could not be calculated due to insufficient data in the History Group (n=1)

[b]No injuries were recorded in the History Group

*Significant difference between groups ($P < 0.05$)

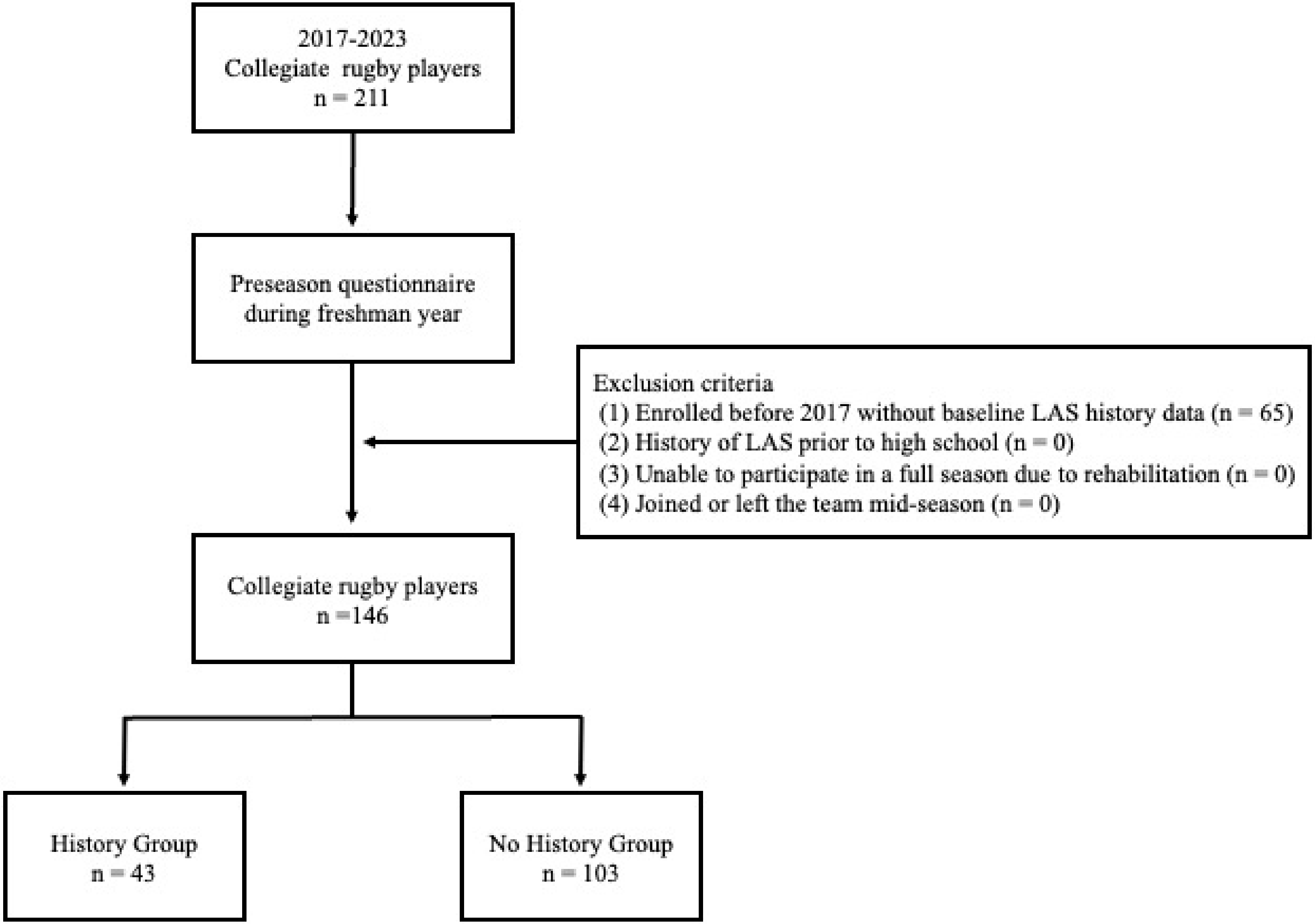
Fig. 1. Flow diagram of participant selection and group classification

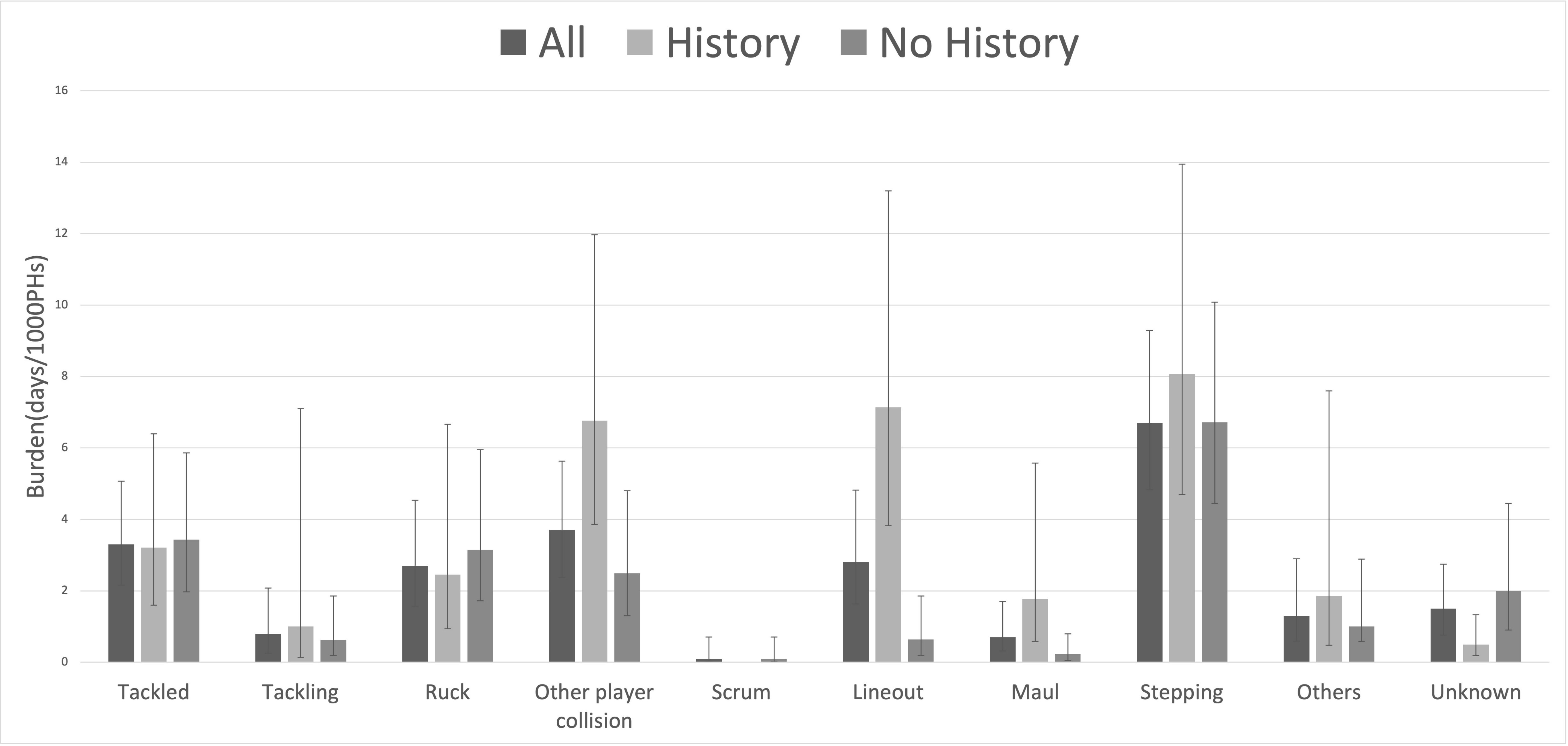
A total of 211 male collegiate rugby players were eligible during the seven-season period, and 146 were included in the final analysis based on the inclusion and exclusion criteria. Participants were classified into the History and No History groups based on LAS history during high school.

Fig. 2. Burden of LAS (days/1,000 PHs) by injury mechanism, including overall burden (All), for History and No History groups

Burden of lateral ankle sprains (LAS) by injury mechanism (days/1,000 player-hours), shown for all injuries and by injury history (History vs No History groups). Error bars represent standard deviation.

Stepping-related injuries (non-contact) showed the highest burden regardless of injury history, while contact mechanisms such as lineouts and player collisions contributed to a greater burden particularly in the History group.


2017-2023
Collegiate rugby players
n = 211
Preseason questionnaire
during freshman year
Exclusion criteria
(1) Enrolled before 2017 without baseline LAS history data (n = 65)
(2) History of LAS prior to high school (n = 0)
(3) Unable to participate in a full season due to rehabilitation (n = 0)
(4) Joined or left the team mid-season (n = 0)
Collegiate rugby players
n =146
History Group
n = 43
No History Group
n = 103


All
History
No History
Burden(days/1000PHs)
0
2
4
6
8
10
12
14
16
Tackled
Tackling
Ruck
Other player collision
Scrum
Lineout
Maul
Stepping
Others
Unknown