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Noncontact injury distribution and relationship with preseason training load and non-modifiable risk factors in Rugby Union players across multiple seasons.

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ABSTRACT

The study examined the distribution of noncontact injury during phases of the competitive season and the association between preseason training load (TL) and non-modifiable risk factors on injury risk during these phases. Injury data was recorded from one senior academy team over 3 seasons (2017-2020) and analysed across early, mid and late-season phases. A Generalized Estimating Equation was used to model risk factors with noncontact injury for selected phases. The highest noncontact injury incidence occurred in the late-season phase (22.2 per 1000 hours) compared to early (13.7 per 1000 hours, $p < 0.001$) and mid-season phases (15.5 per 1000 hours, $p = 0.001$). Low preseason TL (8949-12589 AU; OR, 95% CI = 4.7, 1.0-21.6; $p = 0.04$) and low preseason TL combined with high early-season TL and injury in the early-season phase (OR, 95% CI = 6.5, 1.1-35.5; p = 0.03) were associated with greater mid-season noncontact injury risk. Additionally, low preseason TL combined with previous injury was associated with increased risk of noncontact injury risk in the late season (OR, 95% CI = 12.2, 0.9-15.6, $p = 0.05$). Our results suggest players are at a greater injury risk during the late season phase, with low preseason cumulative loads combined with a history of previous injury associated with increased in-season injury risk. Strength and conditioning coaches should therefore monitor cumulative preseason TL alongside screening for previous injury history to identify athletes at greater risk of noncontact injury risk during the competitive season.

Key words: training demands, team sports, athlete monitoring, injury history, under-training

INTRODUCTION

Rugby Union is a team sport characterised by frequent collisions and intense running and has a relatively high-risk of injury particularly during match-play (43). Matches generally last ~80 minutes and include activities that call for maximal strength and power interspersed with periods of lower intensity aerobic activity and rest (32). Given the physical demands of the sport, there is a strong training emphasis, particularly during the preseason phase where practitioners have more time and flexibility with respect to training prescription. Preseason training in Rugby Union typically comprises of a 6 to 8-week intensified training period with the primary aim of promoting adaptation to enhance performance in preparation for the competitive season (38). An additional premise of preseason training is that adaptation during this phase has a protective effect against injury during the season. As such a notable body of recent research has examined the link between injury risk and training load, defined as the cumulative stress placed on an individual from a single or multiple training sessions over a period of time. Although the existence of a relationship between training load and injury is supported in the literature, the factors that influence the direction of this relationship are not clear (15).

Injury risk across the competition spectrum in Rugby Union is considered high in comparison with other team sports (17, 33, 41). Mean injury incidence during match-play is reported as 87 injuries per 1000 hours equating to approximately one injury per match, with on average 25 days lost per injury (40). Despite contact injuries being the most prevalent in Rugby Union, their cause is unpredictable in nature. Therefore, much of the research on the relationship between training and injury has focused on noncontact injuries. These injuries account for approximately 20% of total injuries in Rugby Union and are considered somewhat preventable with the correct management of training load. Recent systematic reviews confirm that an association between training load and injury exists in the literature (12, 15, 27). Nevertheless, this relationship has variously been described as direct, inverse, and U-shaped; seemingly dependent on the timing and metric of training load used (15). Within the body of recent research, many authors have examined the effect of shorter periods of cumulative training load on injury in subsequent weeks during the competitive season (6, 23). Surprisingly, little research has focused on the influence of cumulative preseason training load on injury risk within the competitive season. The limited findings available suggest that greater preseason training frequency is associated with a decreased in-season injury risk in Rugby League players (45) and low preseason cumulative workloads are associated with increased in-season injury risk in Australian Rules Football (10). Although these findings are suggestive of an upper and lower threshold of preseason training, beyond which injury risk may increase, caution must be taken due to differences in training related metrics adopted. Treating training load as an isolated risk factor of injury may also be a limited approach. Recent commentaries have demonstrated the non-linear nature of injuries, and that their complex nature commonly arises from an interaction between modifiable (e.g., training load) and non-modifiable risk factors (e.g., age, sport, previous injury history) which when combined have the potential to predispose an athlete to injury (5).

Considering that one of the primary goals of preseason training is to reduce injury risk, there is currently a paucity of research focusing on the association of cumulative preseason training load on injury risk during the competitive season, particularly when modelled alongside other well established non-modifiable injury risk factors. There is also little research in Rugby Union identifying in which phases of the season injury risk is highest. Therefore, the aim of the present study was to examine the distribution of noncontact injury in Rugby Union across the different phases of the season and to examine the relationship between cumulative preseason training load and non-modifiable factors on injury risk within those phases.

METHODS

Experimental Approach to the Problem

A three-year prospective observational design was utilized to record noncontact injury during training and match-play in senior academy male Rugby Union players across three competitive seasons. Noncontact injury incidence, calculated per 1000 player-hours, for all seasons combined was compared between phases of the season including preseason (July to late August), early season (September to November), mid-season (December to February) and late season (March to May) to determine injury risk in each phase. Non-modifiable risk factors for injury (age, previous injury, including severity and date of injury) were recorded at the start of each preseason phase. Training load was recorded for each training session and cumulative training loads for each week and phase were calculated in arbitrary units (AU). All data were analysed to examine the association of risk factors with noncontact injury for each phase of the competitive season.

Subjects

Data were collected from a male regional senior academy Rugby Union team (N = 51) across their 2017/18 (n = 29), 2018/19 (n = 29) and 2019/20 (n = 32) seasons. Player characteristics were as follows; mean age (25.7 years ± 4.5), stature (182.4 cm ± 6.2), and body mass (101.1 kg ± 12.2). Only players who completed the full preseason training phase for this team were included in the analyses. Players were competing in the Welsh Premiership tournament a semi-professional division immediately below the professional tier in Wales. The players were exposed to three full days of training which included skill work and gym sessions lead by a full-time strength and conditioning coach, and two evening rugby-based sessions. League matches were played at the weekends from September until mid-May with full-time physiotherapy provision and match-day doctors. All players provided informed consent prior to participation, and ethical approval was obtained from the Bangor University Ethics Committee.

Procedures

Injury definitions and procedures were compliant with the international consensus statement for injury data reporting in Rugby Union (Fuller et al., 2007), carried out by the designated physiotherapist, and collated in an injury coding database (cf, Orchard Sports Injury Classification System; 31). All diagnosed noncontact injuries resulting in time-loss from training and/or matches were recorded for the three seasons and further examined within the phases of the season. Each player was assigned a binary outcome for noncontact injury incidence (yes/no) for each phase of the season for analysis. For the season 2019-20, due to the COVID-19 Global Pandemic, there were no data collected for the late season phase (March-May 2020). Age (classified using z-scores) and previous injury (if a player sustained an injury in the previous season resulting in moderate to severe time-loss) were recorded at the start of every season.

Training load was quantified using Foster's rating of perceived exertion (RPE) to calculate a session RPE (sRPE) (18). This method calculates the product of the RPE for the session (training or match) and session duration to generate a value for internal training load in arbitrary units (RPE X minutes). Session RPE has been reported in the literature as a valid and reliable measure of internal training load against other internal and external measures and is the metric that shows the strongest association with respect to the relationship between training load and injury (8, 15, 25, 39). RPE values were obtained 30 minutes after completing each session on training days, which has been reported as a sufficient amount of time to enable valid recall of post-session training intensity (20, 35). Individual training load data were routinely collected for each session across the study duration. During the preseason phase players completed 6 to 8 training sessions per week (Monday, Tuesday, Thursday and Friday), which reduced to 4 to 6 training sessions per week during the competitive season (Monday, Tuesday and Thursday) with matches on Saturday. Training load was recorded for all on-feet (Rugby Conditioning, Rugby, Unit Skills, Speed, Strength and Power) and off-feet (Cross-training e.g., cycle ergometry, water-based recovery sessions) training sessions and matches during the competitive season. If a player sustained a noncontact injury during the study period, their training load was excluded over the period of rehabilitation until they returned to full training. Cumulative preseason training load were calculated at the end of each preseason phase. The classification of preseason cumulative loads from very low to very high were created by z-scores and were referenced to the mean training load (moderate range). The ranges for preseason workload classifications were as follows; very low (≤-1.00), low (-0.99 to -0.50), moderate (-0.49 to 0.49), high (0.50 to 0.99), and very high (≥1.00) (10). In assessing injury risk in the mid-season, the covariate of the athlete's cumulative early season training load was included in the model, and similarly for the late season phase the covariate of their cumulative early and mid-season training load was included.

Statistical Analysis

Injury data was collated using an Excel spreadsheet (Microsoft Corporation, (2021), Microsoft Excel Version 16.53) and statistical analysis performed with R Studio software (RStudio (2020): Integrated Development Environment for R. RStudio, PBC, Boston, MA) utilizing the package "geepack". Noncontact injuries per 1000 player-hours were calculated by dividing the total noncontact injuries by the time spent in training or match play (exposure, hours) and multiplied by 1000. General Linear Model was used with Poisson regression analysis to explore the outcome effect of each season phase (early, mid and late) on noncontact injury incidence whilst offsetting for exposure hours. Results are presented as Rate Ratio (RR) with 95% confidence intervals. Cumulative training load 95% confidence intervals were calculated via the Poisson distribution method. To effectively determine the best set of injury risk factors for any given phase of season, mixed model generalized estimating equations (GEE) were used to investigate risk factors for noncontact injuries for each of the respective time periods. GEE modelling accommodates both repeated measures and within subject correlations across the multiple seasons present within the current database and can identify the most relevant combination of fixed and preseason variables for injury risk identification. As injury incidence was a binary response (yes/no), binary logistic regression within the model was used with logit link function. A model output of odds ratios (OR) with OR > 1.0 indicative of greater likelihood, whilst OR < 1.0 signifies a lesser likelihood for injury. Univariate variables with a significance of $p < 0.2$ were included into the multivariate model, and a significance of $p < 0.05$ was accepted.

RESULTS

Training Load and Injury Incidence

Mean training load was highest during the preseason phase compared to early, mid and late season phases. However, game load from matches offset the overall figures during each phase of the competitive season (**Table 1**). Late season noncontact injury incidence was higher than early (RR, 95% CI = 2.5, 1.5-3.98, $p < 0.001$) and mid-season phases (RR, 95% CI = 2.2, 1.4-3.5, $p = 0.001$) (**Table 2**). During the competitive season, lower limb injuries were the most common accounting for 73% of all noncontact injuries across all phases and were higher in the late season phase compared to early and mid-season phases (RR, 95% CI = 2.0, 1.1-3.6, p = 0.024) **(Table 2).** Muscle and tendon noncontact injuries were the most frequent noncontact injury type for each phase of the season; late season injury rate showed a trend towards being significantly greater than the early season (RR, 95% CI = 1.9, 1.0-3.7, p = 0.051).

Cumulative Preseason Training Load and Injury Risk in Phases of the Competitive Season

When examining preseason data in relation to phase of the competitive season, low cumulative preseason training load (8949-12589 AU) was associated with a higher risk of noncontact injury in the mid-season phase (OR, 95% CI = 4.7, 1.0-21.6, p = 0.040) when compared to the reference group (13081-10909 AU) (**Table 3**). Low preseason loads also showed a trend to increase the odds of sustaining noncontact injury by more than tenfold in the late-season phase (OR, 95% CI = 10.2, 0.8-20.9, p = 0.06) (**Table 3**).

Non-modifiable Injury Risk Factors and Injury Risk in Phases of the Competitive Season

Players between the ages of 25-26 years were at lower risk of sustaining an early season noncontact injury (OR, 95% CI = 0.110, 0.0-1.0, p = 0.049; **Table 4**) compared to the reference group (22-24 years). Whereas, sustaining a moderate to severe injury in the preceding season increased noncontact injury risk in the mid-season phase (OR, 95% CI = 2.7, 1.0-6.9, p = 0.033) compared to those who did not sustain a previous injury. Injury in the previous season combined with sustaining a preseason injury significantly increased the odds of sustaining a noncontact injury in the early season phase (OR, 95% CI = 4.2, 1.3-13.1, p = 0.011) compared to those with no previous injury history (**Table 4**).

Multivariate Analysis of Preseason Training Load and Non-modifiable Risk Factors on Injury in the Competitive Season.

Combining non-modifiable risk factors and preseason training load parameters into the multivariate risk regression model revealed that low preseason loads in conjunction with sustaining an injury in the early-season phase and high early-season training load increased mid-season noncontact injury risk (OR, 95% CI = 6.5, 1.1-35.5, p = 0.03) compared to the reference group. Similarly, low preseason loads combined with moderate to severe injury sustained in the previous season as well as injury in the early season phase increased the risk of noncontact injury risk in the late-season phase (OR, 95% CI = 12.2, 0.9-15.6, p = 0.05).

DISCUSSION

The aim of this study was to examine the distribution of noncontact injury in Rugby Union for different phases of the season and to examine the relationship between cumulative preseason training load and non-modifiable risk factors on injury within those phases. To our knowledge, this is the first study to investigate the influence of preseason training load alongside non-modifiable risk factors on injury risk in the competitive season in Rugby Union providing a more holistic and realistic examination of injury risk in this sport. The main findings of the study showed that the late-season phase had the highest incidence of noncontact injury compared to both the early- and mid-season phases. In isolation, both a low preseason training load and injury in the preceding season were associated with a higher risk of noncontact injury within the competitive season, particularly in the mid-season phase. When these risk factors were examined in combination, late-season noncontact injury risk was greater with a low preseason training load, an injury in the early-season phase combined with a moderate to severe injury in the previous season. In the mid-season phase the risk of noncontact injury was greater with a low preseason and high early-season training load, combined with sustaining an injury in the early-season phase. These finding suggest that alongside recording established non-modifiable risk factors, strength and conditioning practitioners should emphasize the monitoring of players exposed to a low cumulative training load for the preseason period, particularly those that have sustained an injury in the preceding season, as they may be more prone to noncontact injury during the competitive season.

The highest incidence of noncontact injury in the current study occurred in the late-season phase (22.2 injuries per 100 player hours), with lower incidence of noncontact injury in the early and mid-season phases (13.7 and 15.5 injuries per 100 player hours, respectively). These findings contrast with others that suggest an early-season bias for injuries in Rugby Union, reporting that the total injury incidence is higher earlier in the playing season (1, 29). From these studies the authors postulated that climatic conditions and the resulting harder pitch conditions at the beginning of the season (September-October) accounted for the increased incidence of injury in the early-season phase. However, it must be noted that many of these studies examining injury distribution have not distinguished between contact and noncontact injuries and have not expressed injury frequency relative to exposure time, which confound injury risk. A possible explanation for our findings that noncontact injury incidence was greater in the late season could be related to an increase in fatigue across the competitive season, which is known to be a risk factor for injury. Injury incidence in Rugby Union is higher towards the latter phases of matches, with increased fatigue as a possible factor for this greater incidence of injury (43). Whether an increase in chronic fatigue was present towards the latter part of the season and contributed to our findings is unclear. Nevertheless, knowledge of the distribution of noncontact injury in different phases of the season is likely useful for practitioners in order to adjust training prescription at key periods of the season. Notably, an additional finding in the current study was that muscle and tendon injuries in the lower limb were the most common noncontact injury. This finding is consistent with many findings from injury surveillance studies suggesting that the lower limb is the most frequent location of noncontact injury in Rugby Union (3, 4, 7, 17, 40, 43).

The preseason phase is a key period for strength and conditioning practitioners to physically prepare Rugby Union players for the demands of the competitive season. The training loads reported in this study highlight the greater cumulative training load from practice in this period (17131 AU) compared to the competition season (mean of 12693 AU). When classifying players according to their cumulative training load in the preseason period we found that a low cumulative training load (training load between 8949-12589 AU) was associated with subsequent noncontact injury in the competitive season, particularly during the mid-season phase and a trend for increased injury risk in the late season. This is in agreement with other studies that have shown an association between low cumulative training load and grater injury risk in other team sports (10, 11, 24) and Rugby Union specifically (2, 13). Tentatively, it is suggestive that higher preseason training loads may offer a protective effect against injury during the competitive season. However, contrary to our findings, others have found a positive relationship between risk of injury and exposure to higher chronic training load (9, 34). That said, many of these studies examined cumulative training load over 1-3 weeks (9, 6, 22, 34), with others examining the relationship between injury and external training load in the form of high-speed running distances or weekly force load (6, 9). Therefore, comparison between studies is difficult. Although it is possible that our cumulative preseason training load was not enough to enable us to examine the effect of larger training load on injury risk, our range during preseason (12953-21309 AU) was greater than the cumulative preseason training loads previously reported for team sport athletes (22). To clarify the relationship between preseason training and injury risk, further research is required utilizing different training load metrics and injury within the competitive season.

A well-established linear relationship exists between noncontact injury and age and previous injury (11, 21, 28, 42). In the current study, we did not find a relationship between age and increasing injury risk. However, players between the ages of 25-26 were at a lesser risk of sustaining an injury in the competitive season compared to the younger reference group. This may be associated with greater training age, which has been found to moderate injury risk in team sport (14, 30), with players in their debut years having an increased risk of injury when exposed to sudden increases in training load compared to their older, more experienced counterparts (30). Our findings also indicate a previous moderate to severe injury significantly increases injury risk in the subsequent season. Previous injury is a predominant non-modifiable risk factor for injury across teams sports (11, 21, 28), particularly to the lower body (19, 37). Fulton et al. (2014) noted that this may be attributed to post-injury maladaptive changes in strength, proprioception, and kinematics that increase future injury risk (19). Rehabilitation and screening of injury history during preseason and the competitive season alongside recording playing experience is essential in establishing the risk an individual athlete may have to injury based on their inherent, predisposing factors, and to implement appropriate prevention strategies.

It is widely accepted that the cause of noncontact injuries is multifactorial in nature (5). Therefore, identifying a combination of injury risk factors, through a multivariate analysis, is most relevant and applicable. In the mid-season phase the odds of a noncontact injury was increased from 4.7 to 6.5 with a combination of a low preseason training load, high early-season training load combined with sustaining an injury in the early-season phase. In the late-season the odds of a noncontact injury was 12.2 with a combination of a low preseason training load, an injury in the early-season phase combined with a moderate to severe injury in the previous season. The current findings from our multivariate analysis further reinforces theorizing that the nature of injuries in sport are complex and multifactorial (5), and that the extent of injuries are not always associated with a single training load value. The magnitude of the effects of cumulative training load is heavily influenced by previous injury history (16), and understanding how these risk factors contribute to injury risk is essential when formulating injury prevention programmes. Enhanced understanding of the characteristics that predispose individuals to further injury is crucial to reduce medical costs and athlete time lost due to injury (36).

Rapid growth in training load and injury modelling research has led to multiple attempts to explain injury-risk particularly with respect to under-training and over-reaching. Some have suggested that the equivocal findings in the field are due to inadequate statistical analyses that do not account for time-varying variables, recurrent events, or repeated measures (26). In the current study, the use of mixed model generalised estimating equations (GEE) is a strength as it accounts for repeated individual measures across multiple seasons, identifying the optimal combination of non-modifiable and modifiable risk factors. GEE has previously been identified as an appropriate way to model repeated measures within injury risk studies (44), a key component of monitoring athletes across multiple seasons. A limitation to our study was that due to the COVID-19 pandemic, the final season (2019-20) was terminated early in March, therefore data from the late phase of 2019-20 season was not available for analysis. Future research should aim to include within season data across an extended longitudinal period to strengthen the reproducibility of findings. Also, to further enhance the modelling of injury risk associated with training load, more athlete monitoring variables should be incorporated to account fully for the multifactorial nature of sport injuries such as relative strength, subjective data related to fatigue, athlete capacity. Examining the association of these risk factors to specific noncontact injury diagnosis may increase the sensitivity of the model, which will aid in developing specific injury prevention strategies targeting specific locations of injury. Furthermore, future research needs to consider the impact of strength training intensity and volume alongside other factors such as volume of high-speed running and sprinting on injury risk within the competitive season and the impact of the addition or removal of exercises across modalities during the competitive season.

Conclusion

In conclusion, based on non-modifiable risk factors of injury and cumulative preseason training load, we identified that athletes exposed to lower cumulative loads in the preseason were at greater risk of noncontact injury in the later stages of competition, with the odds of sustaining an injury increasing when injury in the previous or current season was accounted for. To reduce the risk of noncontact injury, athletes below the moderate range of cumulative training load in the preseason should be closely monitored and prescribed additional training prior to exposing them to greater in-competition workloads. A previous injury alongside lower cumulative training loads in the preseason significantly increased the risk of sustaining in-competition noncontact injury, emphasising the importance of preseason screening to formulate tailored injury prevention programs prior to season commencement.

PRACTICAL APPLICATIONS

Strength and conditioning staff and coaches should place emphasis on adequate preparatory loading in the preseason to not only prepare Rugby Union athletes for greater competitive season loads, but also to protect athletes from preventable time-loss injuries during later stages of the season. Identifying players with lower thresholds of preseason loads prior to the commencement of the competitive season can aid practitioners in determining whether an athlete is sufficiently prepared and protected against injury during the competitive season. Preseason screening of previous injury history and possibly training age is an important monitoring component and applying appropriate and specific prehabilitation strategies to reduce the risk of further injury is central to a holistic approach to injury prevention.

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Table 1 Mean training and game load (95% CI) for each phase of the season.

Phase	Training Load (95% CI)	Game Load (95% CI)	Total Load (95% CI)
Preseason	17131 (12953-21309)	N/A	17131 (12953-21309)
Early Season	11172 (9717-12627)	7877 (4667-11088)	19049 (13464-24634)
Mid-Season	12097 (10909-13285)	5896 (4167-7625)	17993 (13411-22576)
Late Season	14690 (11170-18210)	4608 (3507-5709)	19298 (13876-26211)

Table 2 Noncontact injury incidence (95% CI) and proportion by location, type and severity during the competitive season.

	Early Season			Mid-Season			Late Season		
Noncontact Injury	**N**	**Injury Incidence**	**%**	**N**	**Injury Incidence**	**%**	**N**	**Injury Incidence**	**%**
Total	25	**13.7 (12.9-14.5)**		26	**15.5 (14.7-16.3)**		34	**22.2* (16.3-28.1)**	
Location									
Head/Neck	0	0.0 (-)	0	1	0.6 (0.0-2.4)	4	1	0.7 (0.0-2.6)	3
Upper Limb	4	2.2 (0.2-3.7)	16	4	2.4 (0.3-4.3)	15	5	3.3 (0.4-5.5)	15
Trunk	4	2.2 (0.2-3.7)	16	1	0.6 (0.0-2.4)	4	2	1.3 (0.1-3.2)	6
Lower Limb	17	9.3 (5.0-15.7)	68	20	11.9 (7.0-19.4)	77	26	17.0 (10.8-25.4)*	76
Type									
Bone	1	0.5 (0.0-2.3)	4	1	0.6 (0.0-2.4)	4	2	1.3 (0.0-3.2)	6
Joint/Ligament	9	4.9 (1.9-10.5)	36	5	3.0 (0.8-7.7)	19	7	4.6 (1.8-10.5)	21
Muscle/Tendon	15	8.2 (3.9-14.4)	60	20	11.9 (7.0-19.4)	77	25	15.7 (10.1-24.3)	71
Severity									
Minimal	5	2.7 (0.8-7.8)	20	5	3.0 (0.8-7.8)	19	8	5.2 (1.9-10.5)	24
Mild	4	2.2 (0.2-3.7)	16	8	4.8 (1.8-10.4)	31	8	5.2 (1.9-10.5)	24
Moderate	10	5.5 (2.6-11.8)	40	6	3.6 (1.3-9.1)	23	8	5.2 (1.9-10.5)	24
Severe	6	3.3 (0.8-7.7)	24	7	4.2 (1.4-9.2)	27	10	6.5 (3.3-13.1)	29

*Significantly different from injury incidence during other phases of the season ($p \leq 0.05$).
Severity is grouped by number of days lost from Minimal (1-3), Mild (4-7), Moderate (8-28), Severe (>28)

Table 3 Injury risk regression of cumulative preseason load groups (AU) and influence on in-season injury risk.

Cumulative Preseason TL	n	Preseason TL (AU)	% Injured	Early Season Injury Risk OR (95%CI)	*p*-value	Mid-Season Injury Risk OR (95%CI)	*p*-value	Late-Season Injury Risk OR (95%CI)	*p*-value
Very Low	17	< 7758	64	0.8 (0.2-3.8)	0.813	1.3 (0.3-5.0)	0.712	0.8 (0.1-5.3)	0.873
Low	14	8949-12589	98	0.4 (0.1-4.1)	0.509	4.7 (1.0-21.6)	0.040*	10.2 (0.8-20.9)	0.061
Moderate (reference)	26	13081-20909	55	1 (-)	-	1 (-)	-	1 (-)	-
High	20	21587-25567	70	2.6 (0.7-9.1)	0.101	2.1 (0.6-7.2)	0.229	1.7 (0.3-9.4)	0.599
Very High	14	25824 >	77	2.1 (0.5-8.8)	0.234	2.4 (0.6-9.2)	0.298	1.0 (0.2-5.2)	0.913

*Significantly greater risk ($p \leq 0.05$) of noncontact injury compared to the reference group. Abbreviation, TL, training load

Table 4 Non-modifiable injury risk factor (Age, Previous Injury) regression for each phase of the season.

		Early Season Injury Risk		Mid-Season Injury Risk		Late Season Injury Risk	
Age (years)	**N**	**OR**	***p***	**OR**	***p***	**OR**	***p***
< 20	17	0.6 (0.1-2.4)	0.445	1.3 (0.4-4.8)	0.681	0.7 (0.1-5.0)	0.129
20-21	23	0.9 (0.3-3.2)	0.990	0.8 (0.2-2.8)	0.773	1.3 (0.3-5.4)	0.745
22-24 (reference)	26	1.0	-	1.0	-	1.0	-
25-26	18	0.1 (0.0-1.0)	0.049*	1.2 (0.3-4.3)	0.792	0.9 (0.2-5.5)	0.942
27 >	6	0.4 (0.0-3.8)	0.406	0.9 (0.1-6.3)	0.956	0.1 (0.0-0.3)	0.112
Previous Injury	51	2.1 (0.8-5.7)	0.152	2.7 (1.0-6.9)	0.033*	1.0 (0.3-3.4)	0.971

*Significantly greater/reduced risk ($p \leq 0.05$) of noncontact injury compared to the reference group.