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Preseason injury epidemiology and associated injury risk factors among South African junior provincial rugby players: a prospective cohort study

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ABSTRACT

Background: The preseason period in rugby plays a key role in athlete preparation for the demands of the sport during the in-competition period. Epidemiological data pertaining to rugby have focused mainly on senior elite professional with little evidence available for junior elite professionals, and even less during the preseason period. This may limit the ability of stakeholders in the sport to understand the effects of injury on participants during the preseason period.

Objective: To determine the epidemiology, clinical characteristics, and associated risk factors for injury among elite male junior provincial rugby players in South Africa during a 14-week preseason period.

Design: A prospective cohort study.

Methods: Data collection procedures were in-line with consensus statements in sports and rugby. Prospective injury data related to 53 male participants were collected. Descriptive statistics was used to describe clinical characteristics of injury, cross-tabulations were created to investigate risk factor associations, and logistic regression was used to model the risk factors.

Results: The overall injury prevalence was 75.5%. The incidence of match play injuries (149.26/1000 h) were higher than training injuries (23.32/1000 h). Injuries to the lower limb (48.8%) and muscle/tendon injuries (48.2%) were most commonly reported injuries by anatomical region and tissue type during the preseason period. When controlling for age and playing position, baseline injury was associated with a higher risk of sustaining a subsequent injury during preseason. Age, baseline injury, and playing position showed no statistically significant association with injury risk.

Conclusion: A high number of training and match play injury incidence were recorded for elite male junior provincial rugby players. Baseline injury was associated with a higher risk of sustaining a subsequent injury during preseason when controlling for playing position and age.

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1. Introduction

Rugby union (hereafter rugby) is a popular sport played worldwide [1]. Two opposing teams of 15 players compete to outscore each other by carrying and grounding the ball over the opposing goal line and/or kicking the ball through the opposing goal [2–4]. Rugby is a dynamic sport in terms of players' age (junior to senior), their gender (male and female), and the level of play (amateur, semiprofessional, and professional) [5]. In rugby, a variety of skill levels and physical characteristics are required to manage the frequent contact situations (tackling, rucking, mauling, and scrummaging), periods of more intense incidents (acceleration, sprinting, and collisions), and less intense events (walking and jogging) [6–9]. World Rugby (WR) recommends that for a strong comprehension of safe gameplay, participants need a foundation that prepares them both physically and mentally for the demands of the sport [10].

A rugby season, like most professional sports, typically consists of a preseason period and an in-competition period. During the preseason period, teams aim to prepare players for the demands of matches during the in-competition period [9,11]. This preparatory period has varied injury incidence rates between age and level of play in rugby [9,12,13].

Few studies have reported on injury (epidemiology, clinical characteristics, and risk factors) in rugby during the preseason. Ball et al. reported an injury prevalence of 49% during the preseason period, an injury incidence of 107.3 match and 9.2 training injuries per 1000 h [9]. The same study reported the lower limb (66.7 match and 6.6 training injuries per 1000 h) as the most commonly injured area by body location and muscle/tendon (22.7 match and 3.3 training injuries per 1000 h) as the highest definable injury by classification type [9]. The evidence reports that there may exist an association between injury rates and increased level of participation in preseason training but may be confounded by subjectivity [12]. Chalmers et al., found no association between injury rate and preseason training or preseason physical conditioning [14].

In South Africa, a 3-year retrospective study reported the same preseason match injury incidence (50 injuries per 1000 h) for year 1 and year 2 with an increase in year 3 (175 injuries per 1000 h). The same study also reported a steady year-on-year increase in the overall injury incidence during preseason

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(year 1: 0.8 injuries per 1000 h, year 2: 2.4 injuries per 1000 h, and year 3: 4.2 injuries per 1000 h). The authors attributed both findings to hours of exposure. In another study on injury profiles in elite South African rugby union, the overall injury incidence reported was 3.6 injuries per 1000 h during the preseason [15]. Neither study reported injury risk or clinical injury characteristics during the preseason period.

Junior provincial rugby players in South Africa are a unique population in comparison to other populations, as they are considered professional rugby players with an age range of 18–21 years. Numerous studies investigated epidemiology (incidence and prevalence related to injury occurrence), clinical characteristics (the description of injury beyond its occurrence, such as, injury type, injury location, and injury severity), and associated injury risk factors (measurable injury characteristics that increase the likelihood for injuries such as age, playing position and/or baseline injury) for rugby injuries. However, they primarily concentrate on the senior elite (international and professional) and adolescent levels of rugby, focusing on the in-competition periods [16–18]. Additionally, it is difficult to apply the same injury risk management strategy across different levels of play because of the numerous studies on rugby injuries that have produced conflicting results [5,9,18]. Therefore, for professional junior provincial rugby players in South Africa, there may be challenges in developing context-specific risk management approaches, as they may be based on assumptions from dissimilar cohorts, potentially reducing their effectiveness during the preseason period.

The aim of this study was to prospectively determine the incidence, prevalence, and clinical characteristics of injury among professional male junior provincial rugby players in South Africa over the 14-week preseason period.

2. Methods

2.1. Study design

A prospective cohort study design was used to collect quantitative data over a one-year rugby season (2022). Participants were followed for a period of 27 weeks (14 weeks in the preseason and 13 weeks in competition). For the purpose of this study, only data relating to the preseason period was analyzed.

2.2. Participants and data collection

Participants under investigation included junior provincial rugby players at a provincial rugby union in South Africa. A total of 57 junior players were registered at this provincial rugby union. Participants were 18–21 years old and were eligible to play for the respective Under 19 (u19) and Under 21 (u21) provincial teams. All included players provided informed consent to participate in this study. A total of four players were excluded based on their participation with the team in less than 4 weeks. The study was conducted in accordance with the Declaration of Helsinki [19] and approved by the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria (REC no: 237/2022).

As part of the annual screening regime, baseline data was collected from the team and completed during the first 2 days of preseason. All players completed an online questionnaire, which included questions relevant to their personal injury history over the previous 12 months, demographics and playing position. For this study, the authors defined baseline injuries as injuries at the start of the study period determined and collected through clinical assessments. For participants who were injured before the commencement of this study, these injuries were confirmed through clinical assessment (not the subjective questionnaire) and then registered as an injury at baseline.

During the u19 and u21 preseasons, injury data was collected by the primary researcher (1st Team Physiotherapist) and three research assistants (a medical doctor and two physiotherapists of the respective u19 and u21 teams). Injuries were recorded on an online injury surveillance platform, Kitman Labs, which is a sports performance and athlete management technology company used in professional sports, such as rugby, soccer, basketball, etc. In cases where a Microsoft Excel document was used to record injury data, the data was transferred onto Kitman Labs. The research assistants were familiar with these injury surveillance methods, and no additional training was required as this was part of the high-performance standard data collection procedure. The recording of epidemiological data aligned with two consensus statements: 1) the IOC consensus statement in sport [20] and 2) the Rugby Injury Consensus Group (RICG) agreement for injuries in rugby [21]. Although the definitions and methodologies of the two consensus statements are largely similar, allowing for meaningful inter-sports comparisons, RICG was preferred in situations where data recording and reporting specific to rugby were required for the use of WR statistics. Based on these consensus statements, the collection of injury data included the following: date of injury, injured area, injured side, type of injury, injury diagnosis, the categorization of injury (new and recurrent), injury definition (medical-attention and time-loss), the activity during which the injury had occurred (training or match), the injury event (facet of play and mechanism of injury), and the period of match-play. During preseason training and match play, the facet of play was recorded in line with the RICG agreement.

For injury definitions (medical attention and time-loss), all injuries were recorded as a medical attention-type injury and defined under an operational definition of medical attention: an injury that results in a player receiving medical attention irrespective of the player losing time from training [21]. When considering injury severity, the calculation was based on its conceptual definition: 'the number of days that have elapsed from the date of injury to the date of the player's return to full participation' [21]. In instances where a participant was injured at the end of the season, clinicians used clinical judgment on the number of days the participant would be unable to participate (time-loss). In addition, this study only considered an injury as 'recurrent' if the injury reoccurred after being reported as resolved. An injury was considered resolved when the participant no longer required medical attention from any of the three research assistants. Instead,

participants received continued preventative injury management (such as individualized weekly joint mobility and muscle flexibility screening, daily sessional rates of perceived exertion scores and daily wellness questionnaires) from the strength and conditioning coach.

Upon the preseason completion, all injury data was exported from Kitman labs and populated onto an Excel spreadsheet for analysis. The same data extraction process was used for exposure hours data obtained from a Global Position System (GPS) software, Catapult, which is a sports technology company that specializes in GPS-based athlete tracking and performance analytics.

The injury surveillance was separated into three phases (Figure 1), Phase 1; u19 and u21 preseason (14 weeks), Phase 2; u21 in-competition (10 weeks) and Phase 3; u19 in-competition. This paper will focus on Phase 1, u19 and u21 preseason.

2.3. Primary outcomes

The primary outcomes, based on injury data collected through clinical assessments, were to determine 1) the incidence (per 1000 player-hours) of injuries, 2) the prevalence of injuries (% of injured participants during the preseason period), 3) the frequency (n, %) of injury clinical characteristics [anatomical region (body area), tissue and pathology type, severity of injury (time-loss), recurring and new injuries, period of play and injury event {injury mechanism (contact and non-contact)} and facet of play (maul; occurs when a ball carrier is held by one or more opponents and teammates with the ball remaining off the ground, ruck; a phase of play where players from both teams remain on their feet, contest for a ball that is on the ground, binded together in physical contact over the ball, scrum; restart of play from a stoppage involving eight forward players from each team binded together in formation, competing for possession of the ball, and open play; a phase of play not controlled by a set piece, where the ball is in an active motion)], and 4) the selected risk factors associated with injuries among u19 and u21 provincial rugby players during their 2022 preseason (training and match).

2.4. Statistical analysis

Quantitative statistics was used in the data analysis as we collected numerical data in this study. The data analysis was completed with the help of a statistician. It consisted of descriptive and inferential statistics with a particular focus on the type of injuries, their incidence, prevalence, and the investigation of possible risk factors. The injury incidence was calculated by dividing the number of new cases by the population under consideration and the timeframe being considered. The injury prevalence was calculated by dividing the number of participants with injuries by the total number of participants. Cross-tabulations were created to investigate risk factor associations, and logistic regression was used to model the risk factors. All statistical tests were performed at a 5% significance level ($p < 0.05$).

3. Results

3.1. Participants' demographics

The study sample included 53 participants with an average age of 19.5 (±0.7) years. U19 and u21 players represented 56.6% ($n = 30$) and 43.4% ($n = 23$) of the study sample. Forwards comprised the majority of participants ($n = 31$; 58.5%), and 75.5% ($n = 40$) of participants were injured at baseline. Table 1 presents the participants' demographics (age), playing position and previous injury history for the preseason period.

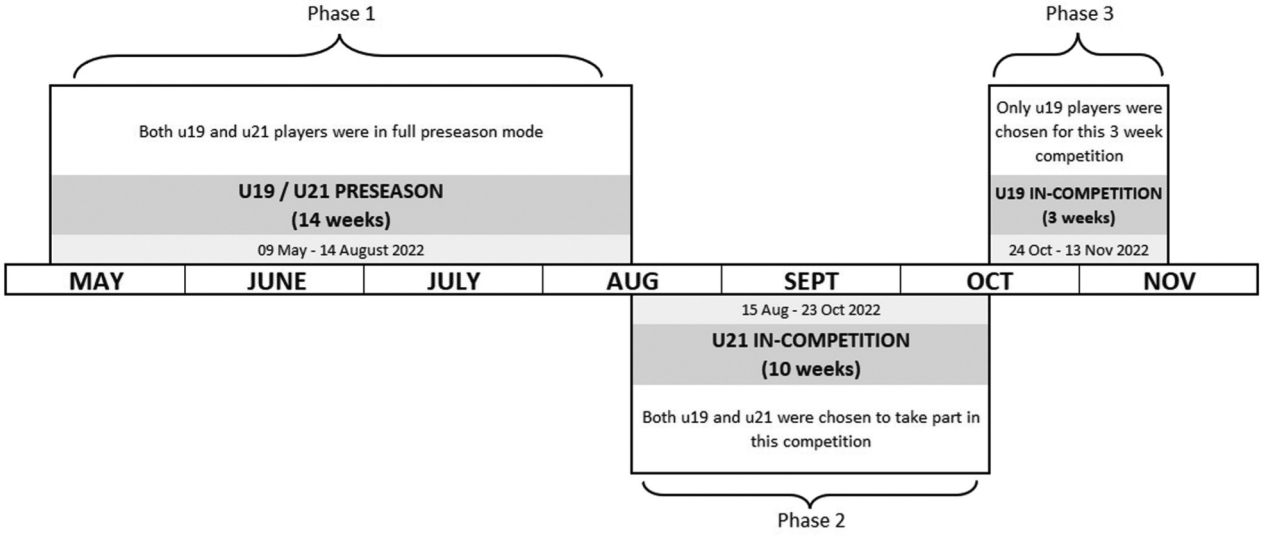

Figure 1. Three-phase injury surveillance timeline with the focus of this study placed on phase 1.

Table 1. Participant demographics for age, playing position and previous injury history of all participants during the preseason.

Characteristic		Participants		
		All ($n = 53$)	u19 ($n = 30$)	u21 ($n = 23$)
Age (years) mean (SD)	Junior Provincial	19.5 (0.7)	19.0 (0.3)	20.1 (0.3)
Playing position n, (%)	Backs	22 (41.5)	11 (36.7)	11 (47.8)
	Forwards	31 (58.5)	19 (63.3)	12 (52.2)
Previous injury history n, (%)	All	40 (75.5)	20 (66.7)	20 (87.0)
	Backs	17 (32.1)	8 (26.7)	9 (39.1)
	Forwards	23 (43.4)	12 (40.0)	11 (47.8)

Abbreviation: n: Total number

There were more injuries by playing position for u19 forwards (63.3%, $n = 19$) compared to u19 backs (36.7%, $n = 11$). A high number of players were confirmed to have a previous injury (75.5%, $n = 40$).

3.2. Epidemiology of injury (injury incidence and prevalence)

3.2.1. Injury incidence

The overall injury incidence for preseason was 30.73 injuries per 1000 h. The incidence of match injuries (149.26 injuries per 1000 h) was substantially higher than training injuries (23.32 injuries per 1000 h). U19 participants' injury incidence (167.49 injuries per 1000 h) during preseason match play was higher than u21 participants (132.01 per 1000 h). The incidence of injuries during preseason training was higher for u19 participants (25.02 injuries per 1000 h) compared to u21 participants (21.44 injuries per 1000 h).

3.2.2. Injury prevalence

A total injury prevalence of 75.5% ($n = 40$) occurred during the preseason. The injury prevalence was higher among u19 participants (83.3%, $n = 25$) compared to u21 participants (65.2%, $n = 15$) during preseason. The prevalence of preseason injuries during match play (22.6%, $n = 12$) was lower than in training (52.8%, $n = 28$).

3.3. Clinical characteristics of injury

3.3.1. Anatomical region and body area of injury

Table 2 depicts the frequency (n, %) of all injuries based on the injury location for training and matches in the categories of age group (u19 and u21) and playing position (forwards and backs) participants during the preseason.

For both preseason match play (43.5%, $n = 10$) and preseason training (51.7%, $n = 31$), the lower limb was mostly injured. This was followed by match play injuries to the upper limb (26.1%, $n = 6$) and the head and neck (17.4%, $n = 4$). The specific body area affected the most by injuries during preseason training was the lumbosacral area (13.3%, $n = 8$) and for preseason match play, it was the neck area (17.4%, $n = 4$).

3.3.2. Tissue and pathology type of injury

Table 3 represents the frequency (n, %) of all injuries based on the injured tissue and pathology type used for training and matches in the categories of age group (u19 and u21) and playing position (forwards and backs) participants during the preseason.

For both match play (39.1%, $n = 9$) and training (51.7%, $n = 31$), the tissue mostly injured was muscle/tendon. This was followed by ligament/joint capsule tissue type during preseason match play (30.4%, $n = 7$) and preseason training (30.0%, $n = 18$). The specific pathology type that was affected the most by injuries during preseason training was muscular injuries (33.3%, $n = 20$) and for preseason match play, it was joint sprains (30.4%, $n = 7$).

3.3.3. Injury severity

Table 4 displays the frequency (n, %) of injury severity for training and matches in the age group categories (u19 and u21) during the preseason.

The injury severity classification of moderate severity (8–28 days) was the largest proportion of injuries recorded for both preseason training (41.7%, $n = 25$) and preseason match play (30.4%, $n = 7$). Of all the preseason severe injuries (>28 days, 17.9%, $n = 15$), most (53.3%, $n = 8$) resolved within 29–60 days.

3.3.4. New and recurrent injury

During preseason, all new injuries accounted for 91.7% ($n = 77$), and 8.3% ($n = 7$) of all injuries were recurrent. U19 (4.8%, $n = 4$) and u21 (3.6%, $n = 3$) had similar injury recurrences. The frequency of new injuries was higher for u19 (51.2%, $n = 43$) than for u21 (40.5%, $n = 34$) during preseason.

3.3.5. Injury mechanism

Table 5 indicates the frequency (n, %) of injury mechanism for training and matches in the age group categories (u19 and u21) during the preseason.

Contact events attributed to the highest proportion of injuries during preseason (48.8%, $n = 41$), the main contributor to this involving a participant being tackled (14.3%, $n = 12$). Non-contact injuries (45.0%, $n = 27$) were higher during preseason training, whereas contact injuries (78.3%, $n = 18$) were higher during preseason match play.

3.3.6. Facet of play

Table 6 describes the frequency (n, %) of injuries during various facets of play for training and matches in the categories of age group (u19 and u21) during the preseason period.

During preseason, open play (42.9%, $n = 36$) resulted in the second-highest proportion of injuries behind unspecified (46.4%, $n = 39$). 'Unspecified' were injuries sustained where neither the participant nor the research assistant could accurately account for the facet of play in which the injury to the participant occurred. Unspecified injuries (55.0%, $n = 33$) contributed the highest number during preseason training. The proportion of preseason match play injuries mainly occurred during open play (65.2%, $n = 15$).

Table 2. The number (n) and proportion (%) of all medical attention injuries, training, and match medical attention injuries as a function of playing position and location of injury during preseason.

Injury location			Training injuries							Match injuries						
				u19			u21				u19			u21		
Anatomical region	Body area	All preseason injuries	All injuries	All	Backs	Forwards	All	Backs	Forwards	All injuries	All	Backs	Forwards	All	Backs	Forwards
Head and neck	All	10 (11.9)	6 (10.0)	3 (8.8)	2 (5.9)	1 (2.9)	3 (11.5)	1 (3.8)	2 (7.7)	4 (17.4)	3 (23.1)	–	3 (23.1)	1 (10.0)	1 (10.0)	–
n, (%)	Head	1 (1.2)	1 (1.7)	–	–	–	1 (3.8)	1 (3.8)	–	–	–	–	–	–	–	–
	Neck	9 (10.7)	5 (8.3)	3 (8.8)	2 (5.9)	1 (2.9)	2 (7.7)	–	2 (7.7)	4 (17.4)	3 (23.1)	–	3 (23.1)	1 (10.0)	1 (10.0)	–
Upper limb	All	16 (19.0)	10 (16.7)	5 (14.7)	2 (5.9)	3 (8.8)	5 (19.2)	–	5 (19.2)	6 (26.1)	3 (23.1)	1 (7.7)	2 (15.4)	3 (30.0)	1 (10.0)	2 (20.0)
n, (%)	Shoulder	9 (10.7)	7 (11.7)	3 (8.8)	1 (2.9)	2 (5.9)	4 (15.4)	–	4 (15.4)	2 (8.7)	1 (7.7)	–	1 (7.7)	1 (10.0)	–	1 (10.0)
	Upper arm	2 (2.4)	1 (1.7)	1 (2.9)		1 (2.9)		-		1 (4.3)	–	–	–	1 (10.0)	–	1 (10.0)
	Elbow	2 (2.4)	1 (1.7)	–	–	–	1 (3.8)	–	1 (3.8)	1 (4.3)	1 (7.7)	–	1 (7.7)	–	–	–
	Forearm	1 (1.2)	1 (1.7)	1 (2.9)	1 (2.9)	–	–	–	–	–	–	–	–	–	–	–
	Wrist	1 (1.2)	–	–	–	–	–	–	–	1 (4.3)		-	–	1 (10.0)	1 (10.0)	–
	Hand	1 (1.2)	–	–	–	–	–	–	–	1 (4.3)	1 (7.7)	1 (7.7)	–	–	–	–
Trunk	All	17 (20.2)	13 (21.7)	9 (26.5)	3 (8.8)	6 (17.6)	4 (15.4)	4 (15.4)	–	3 (13.0)	2 (15.4)	1 (7.7)	1 (7.7)	1 (10.0)	–	1 (10.0)
n, (%)	Chest	4 (4.8)	3 (5.0)	3 (8.8)	–	3 (8.8)	–	–	–	1 (4.3)	1 (7.7)	1 (7.7)	–	–	–	–
	Abdomen	2 (2.4)	1 (1.7)	1 (2.9)	1 (2.9)	–	–	–	–	1 (4.3)	–	–	–	1 (10.0)	–	1 (10.0)
	Thoracic spine	1 (1.2)	1 (1.7)	1 (2.9)	–	1 (2.9)	–	–	–	–	–	–	–	–	–	–
	Lumbosacral	9 (10.7)	8 (13.3)	4 (11.8)	2 (5.9)	2 (5.9)	4 (15.4)	4 (15.4)	–	1 (4.3)	1 (7.7)	–	1 (7.7)	–	–	–
Lower limb	All	41 (48.8)	31 (51.7)	17 (50.0)	7 (20.6)	10 (29.4)	14 (53.8)	5 (19.2)	9 (34.7)	10 (43.5)	5 (38.5)	2 (15.4)	3 (23.1)	5 (50.0)	4 (40.0)	1 (10.0)
n, (%)	Hip/Groin	7 (8.3)	6 (10.0)	4 (11.8)	1 (2.9)	3 (8.8)	2 (7.7)	–	2 (7.7)	1 (4.3)	1 (7.7)	–	1 (7.7)	–	–	–
	Thigh anterior	6 (7.1)	4 (6.7)	2 (5.9)	2 (5.9)	–	2 (7.7)	–	2 (7.7)	2 (8.7)	2 (15.4)	1 (7.7)	1 (7.7)	–	–	–
	Thigh posterior	7 (8.3)	6 (10.0)	2 (5.9)	1 (2.9)	1 (2.9)	4 (15.4)	2 (7.7)	2 (7.7)	1 (4.3)	–	–	–	1 (10.0)	1 (10.0)	–
	Knee	6 (7.1)	4 (6.7)	3 (8.8)	1 (2.9)	2 (5.9)	1 (3.8)	1 (3.8)	–	2 (8.7)	1 (7.7)	1 (7.7)	–	1 (10.0)	1 (10.0)	–
	LL anterior	2 (2.4)	2 (3.3)	1 (2.9)	1 (2.9)	–	1 (3.8)	1 (3.8)	–	–	–	–	–	–	–	–
	LL posterior	4 (4.8)	2 (3.3)	–	–	–	2 (7.7)	–	2 (7.7)	2 (8.7)	–	–	–	2 (20.0)	1 (10.0)	1 (10.0)
	Ankle	7 (8.3)	6 (10.0)	5 (14.7)	1 (2.9)	4 (11.8)	1 (3.8)	1 (3.8)		1 (4.3)	–	–	–	1 (10.0)	1 (10.0)	–
	Foot	2 (2.4)	1 (1.7)	–	–	–	1 (3.8)	–	1 (3.8)	1 (4.3)	1 (7.7)	–	1 (7.7)	–	–	–
Non-rugby related*		1 (1.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
All locations n, (%)		84 (100)	60 (100)	34 (100)	14 (41.2)	20 (58.8)	26 (100)	10 (38.5)	16 (61.5)	23 (100)	13 (100)	4 (30.8)	9 (69.2)	10 (100)	6 (60.0)	4 (40.0)

Abbreviations: n: Total number of injuries; LL: Lower Limb.
*One u21 injury occurred outside of training/match.

Table 3. The number (n) and proportion (%) of all medical attention injuries, training, and match medical attention injuries as a function of playing position and injury type during preseason.

Injury type			Training injuries							Match injuries						
				u19			u21				u19			u21		
Tissue	Pathology type	All preseason injuries	All injuries	All	Backs	Forwards	All	Backs	Forwards	All injuries	All	Backs	Forwards	All	Backs	Forwards
Nervous	All	1 (1.2)	–	–	–	–	–	–	–	1 (4.4)	1 (7.7)	–	1 (7.7)	–	–	–
n, (%)	Peripheral NI	1 (1.2)	–	–	–	–	–	–	–	1 (4.4)	1 (7.7)	–	1 (7.7)	–	–	–
Bone	All	13 (15.8)	9 (15)	5 (14.7)	1 (2.9)	4 (11.8)	4 (15.4)	1 (3.8)	3 (11.5)	4 (17.4)	3 (23.1)	1 (7.7)	2 (15.4)	1 (10.0)	–	1 (10.0)
n, (%)	Fracture	1 (1.2)	1 (1.7)	–	–	–	1 (3.8)	1 (3.8)	–	–	–	–	–	–	–	–
	Bone stress injury	2 (2.4)	2 (3.3)	2 (5.9)	1 (2.9)	1 (2.9)	–	–	–	–	–	–	–	–	–	–
	Bone contusion	10 (11.9)	6 (10.0)	3 (8.8)		3 (8.8)	3 (11.5)	–	3 (11.5)	4 (17.4)	3 (23.1)	1 (7.7)	2 (15.4)	1 (10.0)	–	1 (10.0)
Ligament/joint capsule	All	25 (29.8)	18 (30.0)	11 (32.4)	5 (14.7)	6 (17.6)	7 (26.9)	5 (19.2)	2 (7.7)	7 (30.4)	5 (38.5)	1 (7.7)	4 (30.8)	2 (20.0)	2 (20.0)	–
n, (%)	Joint sprain	25 (29.8)	18 (30.0)	11 (32.4)	5 (14.7)	6 (17.6)	7 (26.9)	5 (19.2)	2 (7.7)	7 (30.4)	5 (38.5)	1 (7.7)	4 (30.8)	2 (20.0)	2 (20.0)	–
Cartilage/synovium/bursa	All	4 (4.8)	2 (3.3)	1 (2.9)	1 (2.9)	–	1 (3.8)	1 (3.8)	–	2 (8.7)	1 (7.7)	1 (7.7)	–	1 (10.0)	1 (10.0)	–
n, (%)	Cartilage injury	2 (2.4)	–	–	–	–	–	–	–	2 (8.7)	1 (7.7)	1 (7.7)	–	1 (10.0)	1 (10.0)	–
	Synovitis/ capsulitis	1 (1.2)	1 (1.7)	–	–	–	1 (3.8)	1 (3.8)	–	–	–	–	–	–	–	–
	Bursitis	1 (1.2)	1 (1.7)	1 (2.9)	1 (2.9)	–	–	–	–	–	–	–	–	–	–	–
Muscle/tendon	All	40 (47.6)	31 (51.7)	17 (50.0)	7 (20.6)	10 (29.4)	14 (53.8)	3 (11.5)	11 (42.3)	9 (39.1)	3 (23.1)	1 (7.7)	2 (15.4)	6 (60.0)	3 (30.0)	3 (30.0)
n, (%)	Muscle injury	24 (28.6)	20 (33.3)	12 (35.3)	4 (11.8)	8 (23.5)	8 (30.8)	1 (3.8)	7 (26.9)	4 (17.4)				4 (40.0)	2 (20.0)	2 (20.0)
	Muscle contusion	10 (11.9)	6 (10.0)	3 (8.8)	3 (8.8)	–	3 (11.5)	2 (7.7)	1 (3.8)	4 (17.4)	3 (23.1)	1 (7.7)	2 (15.4)	1 (10.0)	–	1 (10.0)
	Tendinopathy	5 (6.0)	4 (6.7)	1 (2.9)	–	1 (2.9)	3 (11.5)	–	3 (11.5)	1 (4.4)	–	–	–	1 (10.0)	1 (10.0)	–
	Tendon rupture	1 (1.2)	1 (1.7)	1 (2.9)	–	1 (2.9)	–	–	–	–	–	–	–	–	–	–
Non-rugby related*		1 (1.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
All locations n, (%)		84 (100)	60 (100)	34 (100)	14 (41.2)	20 (58.8)	26 (100)	10 (38.5)	16 (61.5)	23 (100)	13 (100)	4 (30.8)	9 (69.2)	10 (100)	6 (60.0)	4 (40.0)

Abbreviations: n: Total number of injuries; NI: Nerve Injury.
*One u21 injury occurred outside of training/match.

Table 4. The number (n) and proportion (%) of all medical attention injuries, training, and match medical attention injuries by severity categories during the preseason.

			Training injuries			Match injuries		
Severity category		All injuries	All	u19	u21	All	u19	u21
All n, (%)		84 (100)	60 (100)	34 (56.7)	26 (43.3)	23 (100)	13 (56.5)	10 (43.5)
Slight (0–1 days) n, (%)		3 (3.6)	3 (5.0)	2 (3.3)	1 (1.7)	–	–	–
Minimal (2–3 days) n, (%)		13 (15.5)	7 (11.7)	4 (6.7)	3 (5.0)	6 (26.1)	1 (4.3)	5 (21.7)
Mild (4–7 days) n, (%)		20 (23.8)	15 (25.0)	8 (13.3)	7 (11.7)	5 (21.7)	4 (17.4)	1 (4.3)
Moderate (8–28 days) n, (%)		32 (38.1)	25 (41.7)	15 (25.0)	10 (16.7)	7 (30.4)	5 (21.7)	2 (8.7)
Severe (> 28 days)	All	15 (17.9)	10 (16.7)	5 (8.3)	5 (8.3)	5 (21.7)	3 (13.0)	2 (8.7)
n, (%)	29–60 days	8 (9.5)	5 (8.3)	3 (5.0)	2 (3.3)	3 (13.0)	3 (13.0)	–
	61–90 days	3 (3.6)	2 (3.3)	–	2 (3.3)	1 (4.3)	–	1 (4.3)
	91–120 days	1 (1.2)	1 (1.7)	–	1 (1.7)	–	–	–
	> 120 days	3 (3.6)	2 (3.3)	2 (3.3)	–	1 (4.3)	–	1 (4.3)
Non-rugby related*		1 (1.2)	–	–	–	–	–	–

Abbreviations: n: Total number of injuries.
*One u21 injury occurred outside of training/match

Table 5. The number (n) and proportion (%) of all medical attention injuries, training, and match medical attention injuries by mechanism of injury during preseason.

			Training injuries			Match injuries		
Injury mechanism		All injuries	All	u19	u21	All	u19	u21
All n, (%)		84 (100)	60 (100)	34 (56.7)	26 (43.3)	23 (100)	13 (56.5)	10 (43.5)
Non-contact n, (%)	All	31 (36.9)	27 (45.0)	14 (23.3)	13 (21.7)	4 (17.4)	–	4 (17.4)
	Running	12 (14.3)	9 (15.0)	5 (8.3)	4 (6.7)	3 (13.0)	–	3 (13.0)
	Sidestep	3 (3.6)	2 (3.3)	–	2 (3.3)	1 (4.3)	–	1 (4.3)
	Landing	1 (1.2)	1 (1.7)	–	1 (1.7)	–	–	–
	Gym strength	10 (11.9)	10 (16.7)	6 (10.0)	4 (6.7)	–	–	–
	F&C	5 (6.0)	5 (8.3)	3 (5.0)	2 (3.3)	–	–	–
Contact n, (%)	All	41 (48.8)	23 (38.3)	14 (23.3)	9 (15.0)	18 (78.3)	12 (52.2)	6 (26.1)
	Tackled	12 (14.3)	6 (10.0)	3 (5.0)	3 (5.0)	6 (26.1)	4 (17.4)	2 (8.7)
	Tackling	10 (11.9)	7 (11.7)	4 (6.7)	3 (5.0)	3 (13.0)	3 (13.0)	
	Collision	8 (9.5)	6 (10.0)	5 (8.3)	1 (1.7)	2 (8.7)	1 (4.3)	1 (4.3)
	Other Contact	11 (13.1)	4 (6.7)	2 (3.3)	2 (3.3)	7 (30.4)	4 (17.4)	3 (13.0)
Player has no recall n, (%)		11 (13.1)	10 (16.7)	6 (10.0)	4 (6.7)	1 (4.3)	1 (4.3)	–
Non rugby related*		1 (1.2)	–	–	–	–	–	–

Abbreviations: n: Total number of injuries; F&C: Fitness and conditioning; NC: Non-contact.
*One U21 injury occurred outside of training/match.

Table 6. The number and proportion of all medical attention injuries, training, and match medical attention injuries by facet of play during the u19 and u21 preseason.

		Training injuries n (%)			Match injuries n (%)		
Facet of play	All injuries n (%)	All	u19	u21	All	u19	u21
All	84 (100)	60 (100)	34 (56.7)	26 (43.3)	23 (100)	13 (56.5)	10 (43.5)
Maul	2 (2.4)	2 (3.3)	1 (1.7)	1 (1.7)	–	–	–
Ruck	4 (4.8)	3 (5.0)	3 (5.0)	–	1 (4.3)	–	1 (4.3)
Scrum	2 (2.4)	1 (1.7)	–	1 (1.7)	1 (4.3)	1 (4.3)	–
Open play	36 (42.9)	21 (35.0)	11 (18.0)	10 (16.7)	15 (65.2)	10 (43.5)	5 (21.8)
Unspecified	39 (46.4)	33 (55.0)	19 (31.7)	14 (23.3)	6 (26.1)	2 (8.7)	4 (17.4)
Non-rugby related*	1 (1.2)	–	–	–	–	–	–

*One u21 injury occurred outside of training/match.

3.3.7. Period of play

The period of play was unknown for most of the injuries during the preseason (78.3%, $n = 18$), including 50% ($n = 5$) of the total number of all u21 injuries ($n = 10$) and all ($n = 13$) u19 injuries. For u21 injuries, 13% ($n = 3$) occurred in the 2nd quarter, and only 4.3% ($n = 1$) occurred in the 1st and 4th quarters.

3.4. Risk factors

Table 7 presents the possible risk factors associated with injury in the participants during the preseason. It is investigated under the following categories: baseline injury, age-related demographics, and player position (forwards).

Forwards had higher odds (OR = 3,046) of sustaining an injury during preseason relative to backs while controlling for age and baseline injury. Controlling for age and playing position, baseline injuries also resulted in higher odds (OR = 3.388) of sustaining a preseason injury than those players not injured while. None of these risk factors (baseline injury, age, playing position) presented a statistically significant association with injury.

4. Discussion

Our study aimed to prospectively determine the epidemiology, clinical characteristics, and associated risk factors for injuries in professional male junior provincial South African rugby players over a 14-week preseason period. To our knowledge, studies in South Africa have yet to investigate risk factors for injuries during preseason among junior provincial rugby players aged 18–21 years. Overall; 1) 53 participants suffered 84 injuries, 2) injury prevalence was 75.5% overall and higher for u19 (62.5%), 3) injuries during match play (149.26 injuries per 1000 h) were higher than training (23.32 injuries per 1000 h), 4) the lower limb (48.8%) was the most commonly reported injury by anatomical region, 5) Muscle/tendon (48.2%) tissue-type injuries were the most common during the preseason, 6) participants reported more contact-related injuries (48.8%), 7) severity of injuries was mostly moderate (8–28 days, 38.1%), 9) an injury at baseline was associated with a higher risk for subsequent injury.

4.1. Injury incidence and prevalence

The overall injury incidence in this study was 30.73 injuries per 1000 h during preseason. This figure is higher than reported in professional senior rugby (2.5 injuries per 1000 h) during preseason [22]. In this case, the lower injury incidence in professional senior rugby could be attributed to players' technical ability and skill level [5].

Training and match injuries during the preseason accounted for 23.32 and 149.26 per 1000 h, respectively. Ball et al. reported findings on an age group similar to this study but varied in level of play (first, second, and third-grade university rugby teams), with the incidence of injury reported as 9.2 training injuries per 1000 h and 107.3 injuries per 1000 h for matches [9]. The higher injury incidence for professional junior provincial rugby in comparison to first-, second- and third-grade university rugby teams is in keeping with the overall injury trend in rugby, for example, an increase in injury incidence is seen in higher levels of play [18].

Table 7. The odds ratio estimate (%; 95% CI) and p-value for all participants that incurred a medical attention injury during preseason by baseline injury, age, and playing position.

Characteristics	Odds ratio estimate	95%CI	p-value
Baseline Injury	3.388	0.759 – 15.130	0.110
Age	0.579	0.209 – 1.604	0.294
Playing Position (Forwards)	3.046	0.789 – 11.760	0.106

Abbreviation: CI: confidence interval.

4.2. Anatomical region and body area

We reported the lower limb (48.8%) as the most commonly injured anatomical area during preseason, consistent with the evidence in senior professional and adolescent university rugby [9,22,23]. Injuries to the upper limb by anatomical area were the second most commonly reported during matches, highlighting findings similar to those in senior professional rugby [23]. However, in adolescent university rugby, the head/neck was highlighted as the second most common reported injury by anatomical area during preseason matches [9]. Since injuries to the head/neck area commonly occur during contact situations [24], the difference seen in adolescent university rugby may be associated with a lower contact skill level in comparison to senior professional rugby [5], resulting in a higher proportion of head/neck injuries.

4.3. Tissue and pathology type

Muscle/Tendon tissue-type injuries were reported most during preseason training (51.7%) and match play (39.1%) in this study. Ligament/joint capsule tissue-type injuries (specifically joint sprains) followed these. The preseason phase consists primarily of running and condition-type activities in preparation for the demands of the in-competition phase [25,26]. The exposure to the types of preseason activities on players mentioned earlier, and the reported number of lower limb injuries may have a plausible link to the increased proportion of muscle/tendon and ligament/capsule tissue-type injuries we reported in this study.

4.4. Severity of injury

Of all the injuries sustained during preseason, our results show that the severity of injuries mainly was moderate (8–28 days), accounting for 38.1% [median of 14 days (IQR = 9 days)]. Preseason training injuries (41.7%) had a higher proportion of injuries categorized as moderate in severity (8–28 days) than injuries sustained during preseason match-play (30.4%). Although we reported preseason injuries, the trend is similar to previous studies where injury severity during match play was less than for training [22].

The preseason phase of the competition includes a conditioning period for participants in preparation for the in-competition phase [11]. The conditioning period typically

includes higher training volumes, possibly related to increased injury incidence and severity, especially during training [27].

4.5. New and recurrent injury

Evidence suggests that new injuries occur more often than recurrent injuries [18]. Our study correlates with existing literature as we reported the frequency of new injuries (91.7%) occurring significantly more often than recurring injuries (8.3%). The evidence in rugby links this trend to the type of injury events commonly occurring in rugby (contact/collision), exposing participants to a greater propensity for new injuries [5].

4.6. Injury event

In this study, during preseason, we reported higher contact-related injuries (48.8%) than non-contact-related injuries (36.9%), possibly pointing to the higher number of contact-related events occurring in rugby, commonly the tackle event. Tackle events accounted for 53.6% (tackled and tackling) of all contact-related injuries reported in this study. The high number of preseason injuries during the tackle event is consistent with those seen in the literature when reviewing the evidence in both professional and school-level rugby [24,28], though the same cannot be said for unspecified injury events reported in this study. Interestingly, non-contact training injuries (45.0%) were higher than contact training injuries (38.3%). The higher number of non-contact training injuries during preseason provides insight into the conditioning demands of the preparatory phase of competition, namely, preseason [22]. It is worth noting that some participants (13.1%) could not recall a specific mechanism of injury, most of which occurred during training (11.9%).

4.7. Period of play

Limited supporting staff during match days and poor player injury recall for the time of injury influenced the effective capturing of injuries during specific match play periods. Of the data reported, injuries during the second quarter (13.0%) occurred most often, which is seen in studies reporting on male u20 international [29] and provincial youth rugby players [30].

4.8. Risk factors

Controlling for age and playing position, participants with baseline injuries had higher odds of sustaining a preseason injury in our study. Studies reporting injury risk related to previous injury history or baseline injury are limited and conflicting in rugby. A similarity in community-level rugby is observed, where a previous injury presents a plausible risk factor for a subsequent injury [31]. However, another study found no association between injury history and the risk of sustaining an injury during the season [14]. The findings of our study showed no statistical significance.

4.9. Limitations and recommendations

This study reported injuries in male junior provincial rugby players contracted to a professional rugby club in South Africa. Therefore, care should be taken in generalizing our results to broader populations. Our study highlighted the injury trends related to the clinical characteristics of injury among junior provincial rugby players during the preseason period, which may help guide clinicians for future preseasons in implementing injury prevention strategies specifically in a South African context. Based on our findings on injury prevalence, junior provincial rugby players are likely to have a high prevalence of injury. Therefore, considerations for player treatment and rehabilitation by strength and conditioning coaches should be considered when designing conditioning schedules and rugby programming during the preseason period. Our study recorded injuries as an all-inclusive injury definition of medical attention irrespective of time loss. While this method may provide improved evidence related to injury burden (especially in smaller cohorts), there is the potential that the reporting of injuries may have been inflated. Future studies should consider using both injury definitions to allow for more consistent in-between study comparisons. Results related to injury risk do not show statistical significance and may suggest a reduced confidence toward our injury risk findings. Future studies should include a larger cohort over a multi-seasonal period. Larger cohorts would enable the inclusion of more predictors in a risk factor model, facilitate the potential for a multivariate model in risk factor analysis, and allow for the investigation of more subgroup-specific risk factors. Other risk factors for injuries related to rugby exist in the literature, for example, body mass index (BMI), levels of play, level of competition, physical performance levels, training loads and match exposure [9,18,28,29,32,33]. These variations in the reporting of probable injury risk show the complexities surrounding injuries in rugby. Bittencourt et al. acknowledged the complexities of sports injuries and proposed a non-linear model for injury risk [34]. Therefore, when interpreting the findings of this study, the complexity of injury should be noted since our methodology limited our ability to do so.

5. Conclusion

This study is the first to report on preseason injury epidemiology in elite male u19 and u21 South African rugby players. We reported an overall injury prevalence of 75.5% during preseason, with a higher prevalence and match injury incidence reported for u19 participants. Matches had a higher injury incidence. Lower limb and contact injuries were most commonly reported. Injuries were moderately severe, and injuries affecting muscles were most common. Participants having a baseline injury are associated with a higher risk of sustaining another injury. Further research is needed in preseason rugby before implementing our findings in injury risk management strategies.

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Data availability

All datarelated to this study are available upon reasonable request.

Ethics approval

The institution where the study was performed granted ethics approval for dataanalysis and data collection. Informed consent was obtained from allparticipants.

Declaration of generative Artificial Intelligence (AI) and AI-assistedtechnologies in the writing process

The authors declare that no AI or AI-assisted technologies were used throughout theresearch and writing process.

Author contributions

Conceptualization,K.M. and C.V.; search and search strategy, K.M.; acquisition of data, K.M.;statistical analysis, L.F.; composition of results and conclusions, K.M.; reviewof results and article, K.M., C.V., D.G., and C.Jv.R. All authors have read andagreed to the published version of the manuscript.

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