Incidence, Severity, and Burden of Ankle Sprain in Male Collegiate Rugby Union

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Abstract

Background: Rugby is a high risk of injury to the ankle, but epidemiological data on ankle injury is limited to specific competition levels and generations. This study aimed to clarify the epidemiological characteristics of ankle sprain by longitudinally investigating the incidence, severity and burden of ankle sprains in men's collegiate rugby players.

Methods: The study recorded ankle sprains in rugby matches and training across three seasons from 2017 to 2019, investigating 128 male collegiate rugby players.

Results: The incidence of ankle sprain was 1.21 injuries/1000 Player-hours (1000 PHs), and the risk of occurrence during matches (18.18 injuries/1000 PHs) was 25.6 times higher than during training (0.71 injuries/1000 PHs). Thus, it was thought that reducing the incidence of ankle sprains during matches would contribute greatly to reducing the loss of competition time due to injury of team members. The results suggested that the main injury mechanism was related to contact play and steps, and that contact skills and physical fitness characteristics were also involved in the risk of sprains. The incidence of ankle sprains in collegiate rugby players was higher than that reported in a previous study on professional-level players, and the rate of initial sprains was high in this study.

Conclusions: This suggests that prevention of ankle sprains is important in university age rugby players.

Background

It is well known that the ankle joint is the joint that is most prone to injury in sports. Previous studies have estimated that approximately 25% of sports injuries are ankle injuries (Fong et al., 2007). Even in rugby, which has a higher risk of injury than other sports, the ankle joint is cited as one of the sites with a high incidence of injury (Kaux et al., 2015; Yeomans et al., 2018). It was also reported that 17.5% of all injuries sustained by Japanese collegiate rugby players affected the ankle joint (Ogaki et al., 2020). According to epidemiological data on professional rugby players, the incidence of an ankle injury during a match was 10.0 injuries/1000 player-hours (1000 PHs), and lateral ligament injury due to ankle sprain was the most common injury with 4.7 injuries/1000 PHs. It has been suggested that it is vital to focus on the prevention and treatment of injuries (Sankey et al., 2008).

Ankle sprains are characterized by both a high incidence and high recurrence rate. A medical history of sprain is a significant risk factor for an ankle sprain. Repeated sprains may cause chronic ankle instability, resulting in various dysfunctions of the ankle joint (Hertel 2002). To reduce the incidence of this problematic injury, it is essential to first clarify the epidemiological features of the injury, including the incidence, severity, and mechanism of injury through epidemiological studies (Finch 2006).

Descriptive epidemiologic studies are useful for ascertaining the incidence, severity, and mechanism of injury in sports. A prospective study using an epidemiological survey enables calculation of the injury rate per hour of exposure by recording the exposure time of athletes (Fuller 2007). Ascertaining the incidence of injury per time of exposure makes it possible to compare different populations (based on sex, age, and competition level). The severity of the injury is based on the time loss during practice or competition due to injury (Fuller 2007). The value obtained by multiplying the injury rate and the severity is called the Burden (Quarrie 2008), and this calculation makes it possible to evaluate the time lost by the team due to injury.

Although ankle sprains are problematic in rugby, the only available epidemiological data on ankle sprains is limited to professional level players (Sankey et al., 2008). In rugby, the risk of injury differs depending on the player’s age and the level of competition (Bathgate et al., 2002; Haseler et al., 2010). Therefore, the incidence and factors of injury may differ depending on the players. Furthermore, given the high recurrence rate of ankle sprains, it is important to work on injury prevention in the generations before the professional level, especially inexperienced young.

Therefore, this study aimed to clarify the epidemiological characteristics of ankle sprains through longitudinal investigation of the incidence, severity and burden of ankle sprains in men's collegiate rugby players.

Methods

Subjects

The subjects comprised 128 male collegiate rugby players who belonged to competitive level teams and participated in the All-Japan University Rugby Championship for three years between 2017 and 2019. The number of participants was 90 in 2017, 87 in 2018, and 86 in 2019. Players who were unable to ever participate in team practice due to rehabilitation throughout the season and players who joined or left the team partway through the season were excluded from the subjects.

The subjects' field positions of the were 66 forwards (n = 66: 28 front row, and 18-second row, 20 back row), and 62 backs (n = 62: 10 halves, 33 inside backs, and 19 outside backs). Table 1 shows the physical characteristics of the subjects. We explained the purpose and method of the study to the subjects beforehand and surveyed once consent was obtained. This study was implemented with the approval of the Research Ethics Committee established by the Faculty of Health and Sport Sciences, University of Tsukuba (Approval number: 30–48).

Table 1
Physical characteristics of players

	Age (years)	Stature (cm)	Body mass (kg)	Rugby experience (years)
Forwards (n = 66)	19.5 ± 1.4	177.9 ± 6.1	93.3 ± 9.9	9.6 ± 4.7
Backs (n = 62)	19.2 ± 1.3	172.1 ± 5.4	76.5 ± 6.5	11.4 ± 3.8
Total players (n = 128)	19.3 ± 1.3	175.1 ± 6.4	85.2 ± 11.9	10.5 ± 4.4

Injury Surveillance

The survey period covered three years from 2017 to 2019, and it was divided into three competition seasons (January to December 2017, January to December 2018, January to December 2019). Ankle sprains that occurred during rugby match and training during the survey period, and the exposure time of all players were recorded by the athletic trainer belonging to the team. Ankle sprains were defined as injuries that resulted in the player being unable to participate in a match or practice for at least 24 hours after injury (Fuller et al., 2007), and the injury had received an orthopedic diagnosis.

Information was recorded on the site where tenderness was observed immediately after the injury, whether the injury was new or recurrent, the mechanism of injury, and the number of days until the player could return to competition. Recurrence was defined as an injury at the same site as a previous injury, which occurred after the athlete had completely recovered from the previous injury. Mechanisms of injury were classified as contact play: "tackled," "tackling," "ruck," "other player collision," "scrum," "line out," and "maul," and as non-contact play: "stepping" and "kicking." The infrequent non-contact play was classified as "other," and unknown mechanisms of injury were classified as "unknown." The day of return to competition was defined as the day when the player fully participated in all training sessions, or as the day when the player was ready to participate in a match.

Statistical Analysis

The incidence of ankle sprains was calculated as the incidence per 1000 player-hours (1000 PHs), calculated based on the value obtained by dividing the number of occurrences (No.) by the Exposure time (h) and multiplying the value by 1000. The 95% Confidence Interval (95% CI) was also calculated for the incidence. Incidence were compared by match/training,

field position, new/recurrent, and injury mechanism. A chi¯squared test was performed first as a statistical test for the number of occurrences. The Rate ratio and its 95% CI were calculated for injury by match/training, field position, and new/recurrent, and it was regarded as a significant difference when the 95% CI did not exceed 1.

Severity was defined as the number of days from injury to return to competition and was compared by match/training and field position. An unpaired t-test was used for comparison. The ratio per site was calculated for each site that was tender, and the chi¯squared test was performed. Burden (days/1000 PHs) was calculated by multiplying the incidence by the mean severity, and the data was shown by month. For these calculations, the Preparatory period was set from January to March and from July to August when there were no matches, while the Competition period was set from April to June and from September to December, when the players competed in matches.

IBM SPSS version 25.0 (IBM Japan Inc., Tokyo, Japan) was used for statistical processing, and the level of significance was set as 5%.

Results

Over the three seasons, there were 121 matches and 763 training sessions. The match exposure time was 2420.0 hours, the training exposure time was 81,720.4 hours, and the total exposure time was 84,140.4 hours (Table 2). Table 3 shows the number and rate of ankle sprains and the rate ratio. There were 102 ankle sprains during the three seasons, 44 of which were during matches, and 58 occurred during training, showing a significant difference between the incidence during matches and during training ($p < 0.05$). The incidence of ankle sprain was 1.21 injuries/1000 PHs, and the risk of occurrence during matches (18.18 injuries/1000 PHs) was 25.6 times higher than during training (0.71 injuries/1000 PHs) ($p < 0.05$).

Table 2
Match and training exposure during three rugby playing seasons

	Forwards	Backs	Total
No. of trainings (n)	763	763	763
No. of matches (n)	121	121	121
Training exposure time (h)	42,669.0	39,051.4	81,720.4
Match exposure time (h)	1,290.7	1,129.3	2,420.0
Total exposure time (h)	43,959.7	40,180.7	84,140.4

Table 3
Incidence of ankle sprain during three playing seasons

	Match		Training			Total	
	No. (%)	Incidence/1000 PHs (95% CI)	No. (%)	Incidence/1000 PHs (95% CI)	Rate ratio (95% CI)	No.	Incidence/1000 PHs (95% CI)
Total ankle sprain	44 (43.1)	18.18 (12.81 to 23.55)	58 (56.9)	0.71 (0.53 to 0.89)	25.62 (17.31 to 37.91) *	102	1.21 (0.98 to 1.45)

PHs, player hours; CI, Confidence interval; rate ratio = matches/training; *$p < 0.05$.

Table 4 shows the number of ankle sprains, the rate of occurrence, and the rate ratio by field position. During matches, there was no significant difference between positions in the number of ankle sprains and the rate ratio. There was a significant difference in the number of ankle sprains during training ($p < 0.05$), but there was no noticeable difference in the rate ratio. Similarly, there was a significant difference in the numbers of ankle sprains overall ($p < 0.05$), but there was no significant difference in the rate ratio.

Table 4
Incidence of ankle sprain during match and training by field positions

	Forwards		**Backs**		
	No. (%)	Incidence/1000 PHs (95% CI)	No. (%)	Incidence/1000 PHs (95% CI)	Rate ratio (95% CI)
Match	24 (40.0)	18.59 (11.16 to 26.03)	20 (47.6)	17.71 (9.95 to 25.47)	1.05 (0.58 to 1.90)
Training	36 (60.0)	0.84 (0.57 to 1.12)	22 (52.4)	0.56 (0.33 to 0.80)	1.50 (0.88 to 2.55)
Total	60	1.36 (1.02 to 1.71)	42	1.05 (0.73 to 1.36)	1.31 (0.88 to 1.94)

PHs, player hours; CI, Confidence interval; rate ratio = forwards/backs.

Table 5 shows the number, the incidence, and the rate ratio of new and recurrent injuries. New injuries accounted for 62 (60.8%) of all ankle sprains, while 40 (39.2%) were recurrent, indicating a significant difference in the incidence of new and recurrent injuries ($p < 0.05$). The rate ratio was significant at 1.55 (95% CI, 1.04 to 2.31) ($p < 0.05$).

Table 5
Incidence of new and recurrent ankle sprain

	New		**Recurrent**		
	No. (%)	Incidence/1000 PHs (95% CI)	No. (%)	Incidence/1000 PHs (95% CI)	Rate ratio (95% CI)
Total ankle sprain	62 (60.8)	0.74 (0.55 to 0.92)	40 (39.2)	0.48 (0.33 to 0.62)	1.55 (1.04 to 2.31) *

PHs, player hours; CI, Confidence interval; rate ratio = new/recurrent; *$p < 0.05$.

Table 6 shows the number of ankle sprains, the incidence, and the rate ratio according to the mechanism of injury. The most common mechanism of injury was “unknown” in 21 cases (35.0%), followed by “tackled” in 17 cases (28.3%) and “stepping” in 14 cases (23.3%) ($p < 0.05$). Similarly, “unknown” was the most common mechanism of injury for forwards with 12 cases (20.0%), followed by 10 cases of “tackled” (16.7%), and 7 cases each of “stepping” and “lineout” (11.7%) ($p < 0.05$). There were 9 cases of “unknown” (15.0%) for backs, followed by 7 cases each of “tackled,” “ruck,” and “stepping” (11.7%) ($p < 0.05$). There was no significant difference in the rate ratio of mechanisms of injury between different field positions.

Table 6
Incidence of ankle sprain by injury mechanisms

	Forwards		Backs			Total	
	No. (%)	Incidence/1000 PHs (95% CI)	No. (%)	Incidence/1000 PHs (95% CI)	Rate ratio (95% CI)	No.	Incidence/1000 PHs (95% CI)
Tackled	10 (16.7)	0.23 (0.09 to 0.37)	7 (11.7)	0.17 (0.05 to 0.30)	1.31 (0.50 to 3.43)	17 (28.3)	0.20 (0.11 to 0.30)
Tackling	4 (6.7)	0.09 (0.00 to 0.18)	1 (1.7)	0.02 (0.00 to 0.07)	0.23 (0.03 to 2.04)	5 (8.3)	0.06 (0.01 to 0.11)
Ruck	6 (10.0)	0.14 (0.03 to 0.25)	7 (11.7)	0.17 (0.05 to 0.30)	1.07 (0.36 to 3.17)	13 (21.7)	0.15 (0.07 to 0.24)
Other player collision	4 (6.7)	0.09 (0.00 to 0.18)	5 (8.3)	0.12 (0.02 to 0.23)	1.14 (0.31 to 4.25)	9 (15.0)	0.11 (0.04 to 0.18)
Scrum	3 (5.0)	0.07 (0.00 to 0.15)	0 (0.0)	0.00	0.00	3 (5.0)	0.04 (0.00 to 0.08)
Lineout	7 (11.7)	0.16 (0.04 to 0.28)	0 (0.0)	0.00	0.00	7 (11.7)	0.08 (0.02 to 0.14)
Maul	4 (6.7)	0.09 (0.00 to 0.18)	0 (0.0)	0.00	0.00	4 (6.7)	0.05 (0.00 to 0.09)
Stepping	7 (11.7)	0.16 (0.04 to 0.28)	7 (11.7)	0.17 (0.05 to 0.30)	0.91 (0.32 to 2.61)	14 (23.3)	0.17 (0.08 to 0.25)
Kicking	0 (0.0)	0.00	3 (5.0)	0.07 (0.00 to 0.16)	0.00	3 (5.0)	0.04 (0.00 to 0.08)
Other non-contact play	3 (5.0)	0.07 (0.00 to 0.15)	3 (5.0)	0.07 (0.00 to 0.16)	0.91 (0.18 to 4.53)	6 (10.0)	0.07 (0.01 to 0.13)
Unknown	12 (20.0)	0.27 (0.12 to 0.43)	9 (15.0)	0.22 (0.08 to 0.37)	0.69 (0.29 to 1.63)	21 (35.0)	0.25 (0.14 to 0.36)

PHs, player hours; CI, Confidence interval; rate ratio = forwards/backs.

Table 7 shows the severity of ankle sprains. Overall severity was 24.7 days, 25.8 days for injuries sustained during matches, and 23.8 days for injuries sustained during practice, showing no significant difference between matches and training. There was also no considerable difference in severity between different field positions.

Table 7
Severity of injury during match and training by field positions

	Forwards (days)	Backs (days)	Total (days)
Match	28.7 ± 24.1	22.4 ± 21.1	25.8 ± 22.8
Training	25.9 ± 20.1	20.3 ± 18.9	23.8 ± 19.7
Total	27.1 ± 21.6	21.3 ± 19.7	24.7 ± 21.0
Data above shows average value ± standard deviation.			

Figure 1 shows the proportion of sites where tenderness was observed after ankle sprain injury. The most common site of tenderness immediately after injury was the anterior talofibular ligament with 35.5%, the deltoid ligament was 20.9%, the anterior tibiofibular ligament was 17.3%, the calcaneofibular ligament was 12.7%, the posterior talofibular ligament was 5.5%, the Lisfranc joint was 1.8%, and other areas made up 6.4% ($p < 0.05$).

The number of sprains by calendar month was 2 in January (2.0%), 5 in February (4.9%), 3 in March (2.9%), 13 in April (12.7%), 15 in May (14.7%), 12 in June (11.8%), 4 in July (3.9%), 11 in August (10.8%), 12 in September (11.8%), 9 in October (8.8%), 12 in November (11.8%), and 4 in December (3.9%). The results of a chi-squared test revealed a significant difference. The Burden calculated based on incidence by calendar month and severity is shown in Fig. 2.

Discussion

This study conducted a longitudinal investigation into ankle sprain occurrence over three seasons in male collegiate rugby players. The incidence of ankle sprains was higher during competition than during training, with a 25.6 times greater risk of occurrence. It has been previously clarified that the injury rate in rugby is higher during matches than during training, not only for injuries involving sprained ankles (Brooks et al., 2005a; Brooks et al., 2005b). The reasons for this include the high number of full-contact plays and the large quantity of high-intensity running; thus, the high exercise intensity affects the occurrence factors. This survey also found that the most common mechanism of injury other than “unknown” was “tackled,” followed by “stepping.” It is assumed that the risk of an ankle sprain is increased because matches have greater contact play intensity and more chance of high intensity running play than training.

The incidence of ankle sprain in this study was 18.18 injuries/1000 PHs (95% CI, 12.81 to 23.55) during matches and 0.71 injuries/1000 PHs (95% CI, 0.53 to 0.89) during training, which is higher than the incidence seen in professional-level rugby reported in previous studies (Sankey 2009). Sankey et al. investigated ankle injuries over two seasons in professional rugby players belonging to English Premiership Rugby Clubs, and reported that the incidence of ankle injuries during matches was 10.0 injuries/1000 PHs (95% CI, 8.6 to 11.6), and 0.16 injuries/1000 PHs (0.23 to 0.38) during training. Although Sankey et al. included ankle trauma other than ankle sprains, the incidence of ankle sprains in this study is nonetheless higher than that reported for professional-level ankle trauma. This suggests that the risk of sprained ankles may be higher in college-aged players than in professional level players.

Previous studies on rugby injury epidemiology have often reported that the incidence of injury increases as the competition level and player’s age increases (Bathgate et al., 2002; Haseler et al., 2010). The reason for this is assumed to be due to the increased number and intensity of physical contact during play. However, the results of this study indicated a higher level of injury than that reported at the professional level. Therefore, although the overall injury rate increases with higher competition levels and older players, the injury risk may differ when limiting the site or type of injury.

University students are expected to have inferior skills and physical strength compared to professional athletes, but considering that many ankle sprains occur during contact play, contact skills and body control skills during contact play may affect the rate of injury. Alternatively, differences in physical strength such as leg muscle strength, dynamic balance, and muscle strength around the ankle joint may also be related to the outcome. Although we cannot elaborate on the involvement of these factors, it must be emphasized that efforts to prevent injury from younger generations of players are important either way. Furthermore, given the high rate of new ankle sprains in this study, adopting preventive measures from the generations of players younger than the professional level will reduce the chance of players having a history of sprain, which could reduce the rate of injury.

It is necessary to identify athletes with risk factors to prevent ankle sprains and recurrence of sprains. Important risk factors include a history of ankle sprains, reduced muscle strength around the ankle joint, and limited range of motion (Fousekis et al., 2012; Ogaki et al., 2013; Willems et al., 2005). A history of ankle sprain is an uncorrectable risk factor; thus, it is essential to check the muscle strength and range of motion of the ankle joint during the preseason, and make improvements if muscle weakness or restricted range of motion are discovered.

However, as ankle sprains often occur during physical contact situations, it is assumed that risk factors involved in sprains are not only internal risk factors such as muscle strength and range of motion of the ankle but also external risk factors such as other players and problems with the playing surface. Therefore, it would be difficult to reduce the occurrence of ankle sprains in rugby simply by improving the muscle strength and range of motion of the ankle joint. There is room for further study on the involvement of internal and external risk factors in ankle sprain.

The incidence of ankle sprain did not differ by field position. Also, in terms of injury mechanism, “tackled” and “stepping” were the main injury mechanisms, and these did not differ with different field positions. However, with the forwards, 11.7% of injuries occurred during the lineout. This is a play unique to forwards, and it is assumed that the risk of sprains is high when landing after jumping in a lineout. With the backs, although some sprains occurred with position-specific play such as kicking, it only contributes a small proportion of the injuries. As the major injury mechanism of an ankle sprain is common to both field positions during play, such as tackled and stepping, this suggests that a preventive effect can be expected even when using a uniform sprain prevention strategy that does not consider the field position.

Previous studies have reported that before starting regular training, pre-activity movement training is useful for lower limb injury prevention (Attwood et al., 2018; Hislop et al., 2017). It is necessary to verify whether this kind of preventive training intervention can reduce the incidence of ankle sprains.

The overall mean severity was 24.7 days, and there was no difference between matches/training and field positions. This number of days may be indicative of the period of athletic rehabilitation after ankle sprain. However, the standard deviation of the mean severity of all sprains is 21 days, so the number of rehabilitation days may vary. In addition, the most common site with tenderness immediately after the injury was the anterior talofibular ligament, but tenderness was observed in various sites, including the deltoid ligament, accounting for 20.9%, while the anterior tibiofibular ligament made up 17.3%. Therefore, injury to various areas is suspected. It is necessary to consider that the pathology of ankle sprain and the duration of athletic rehabilitation may vary widely in rugby players.

Looking at the trends of ankle sprains during the season and the degree of their impact, the Burden was particularly high during matches. Although the severity of sprains did not differ between matches and training, there was a higher incidence during matches, which is assumed to be the reason that the Burden was higher during matches than during training. However, it tended to be high in the first competition season of April, May, and June and low in the second competition season. Usually, the official match in Fall is the main game in the university competition season, and this game determines the results. So, in the second competition period, the athlete rehabilitation time may be shortened to enable the players to participate in matches and return to the competition early. Therefore, factors such as the season and team status may

also affect the Burden. However, considering the 12-month season, as the Burden is higher in the first half of the season than in the second half of the season, this indicates that preventive intervention for sprains is required from an early stage in the preseason.

This study presents epidemiological data on ankle sprains in male collegiate rugby players. This study investigated a single team; therefore, the epidemiological characteristics may differ depending on other competition levels, the age, and gender of the players. Moreover, none of the sprains were evaluated using MRI images or ultrasound, which means the study has not considered the severity of ligament injury, the details of treatment immediately after injury, and the details of athletic rehabilitation. A limitation of this study is that physical strength characteristics such as muscle strength and flexibility of the subjects were not considered. Future studies must clarify the epidemiological characteristics of ankle sprains targeting other competition levels and generations of players in Japan, conduct preventive training for athletes with risk factors, and verify the preventive effect of this training.

Conclusion

This study conducted a longitudinal study on the incidence, severity, and injury mechanism of ankle sprains in male collegiate rugby players. The incidence of ankle sprains over the three seasons was 1.21 injuries/1000 PHs, and the risk was 25.6 times higher during matches (18.18 injuries/1000 PHs) than during training (0.71 injuries/1000 PHs). Reducing the incidence of ankle sprain during matches would contribute greatly to reducing the loss of competition time due to the injury of team members. The study results suggested that the main injury mechanism was related to contact play and stepping, and that contact skill and physical fitness were involved in the risk of sprain. Moreover, the rate of new sprains was higher than that of recurrent sprains, suggesting the importance of preventing ankle sprains in players of university student age.

Abbreviations

PHs
player-hours; CI:Confidence Interval; IBM:International Business Machines; SPSS:Statistical Package for the Social Sciences

Declarations

Ethics approval and consent to participate

This study was implemented with the approval of the Research Ethics Committee established by the Faculty of Health and Sport Sciences, University of Tsukuba (Approval number: 30-48).

Consent for publication

Not applicable: No data from any individual person included in manuscript.

Availability of data and material

The dataset supporting the conclusions of this article is not available.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

RO and MT conceptualized study design and protocol, and determined the study institutions. RO, GO, AO, and TM collected and assembled the data. RO and MN carried out the analysis and interpretation of data, and drafted the manuscript. All authors have critically reviewed, revised and approved the manuscript.

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Figures

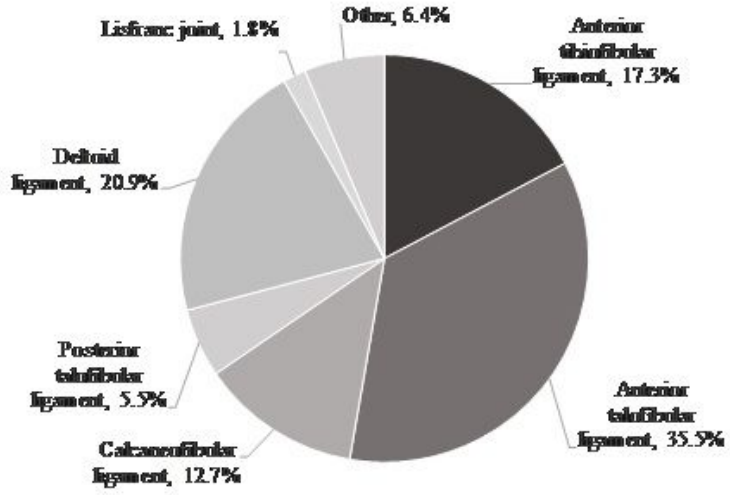

Figure 1

The proportion of tenderness site when injures

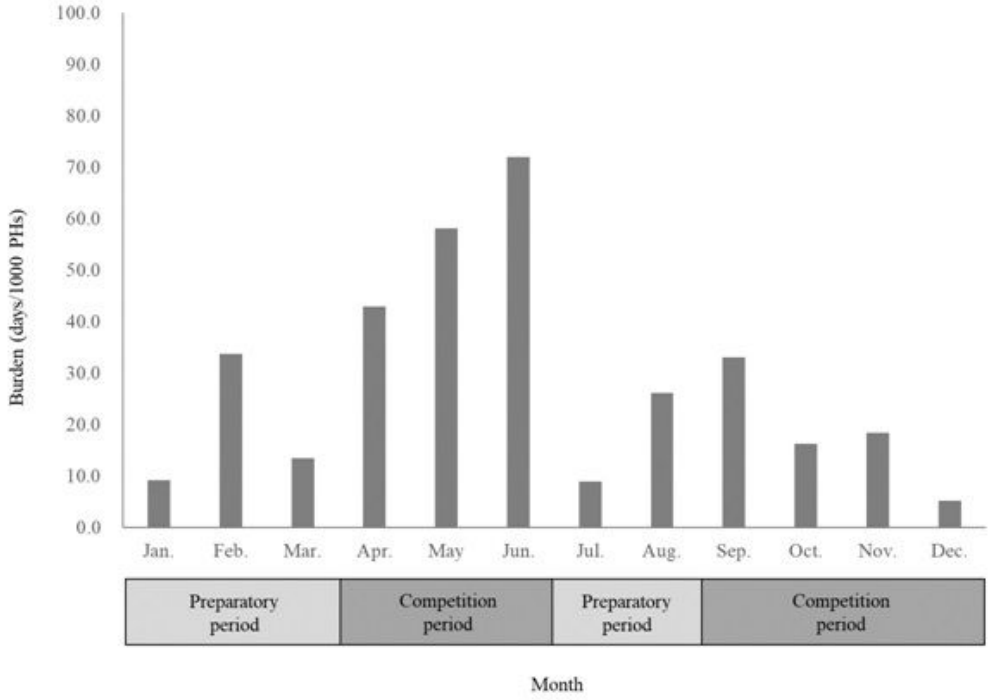

Figure 2

Burden of injury by months