Paper : Rugby Football

Injury Characteristics in Japanese Collegiate Rugby Union through One Season

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This study aimed to examine the 'early-season bias' in rugby union in Japan, and to describe the nature and severity of injuries in matches during the 2005 season at the collegiate level. Injury surveillance involved sixty-six rugby union players from one university club. The playing season was divided into three phases; pre-competition phase, specific preparation phase, and main competition phase. The difference of injury incidence among the three phases and the trend of injury incidence in the pre-competition phase and main competition phase were examined statistically. Overall injury incidence was 48.4 injuries/1000 player-hours in matches and there was a significant difference of injury incidence among the three phases (p<0.05). Injury incidence in the pre-competition phase indicated a significant decline (p<0.001), however, in the main competition phase, injury incidence significantly increased toward the end of the season (p<0.001). The current study showed less possibility of the association of 'early-season bias' with ground condition in Japan.

Keywords: rugby union, early-season bias, injury incidence, severity, nature of injuries

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1. Introduction

Epidemiological research is essential to measure the extent of injuries in the sequence of injury prevention (van Mechelen, 1997). To date, there is a huge amount of injury surveillance conducted in rugby union using several definitions of injury (Bathgate, et al., 2002; Bird, et al., 1998; Brooks, et al., 2005a & 2005b; Holtshausen, et al., 2008; Kerr, et al., 2008; Lee and Garraway, 1996 & 2000; Takemura, et al., 2007; Targett, 1998). Most of the recent studies showed injury incidence as a function of exposure time and severity on the basis of 'days lost' from games and training. These studies involve a variety of study populations, however it is pointed out that only one result is available at the collegiate level (Brooks and Kemp, 2008).

Many epidemiological studies for rugby union injuries in Japan have been published in Japanese using the frequency of injury in some populations (Yamamoto, 1990; Ryu, et al., 2000; Fukuda, et al., 2005). Two of these studies were performed retrospectively using a questionnaire with different definitions of injury and methodologies. In another study all injuries were recorded by the team medical personnel during two playing seasons, however the research didn't estimate exposure time which makes interstudy comparisons effortless. On the other hand, a professional soccer team in J-League recorded 16.5 injuries per 1000 player-hours through one season (Shiraishi, et al., 2002).

A long-term playing period is a peculiarity of the rugby season in Japan, which is mainly divided into three phases according to competition cycle; pre-competition phase, specific preparation phase, and main competition phase. The pre-competition phase, which is very specific and covers a long period only in Japan, has many practice matches on weekends and national holidays from early spring to early summer. In addition, vigorous training

sessions are common during the phase and matches are held on a weekly basis. After a short break period between pre-competition and the specific preparation phase, an intensive training session, training camps and intensive pre-season matches are held in the specific preparation phase. The main competition phase starts in late summer and continues until winter, the intensity of training sessions decreases and matches are held on more professional quality pitches once or twice every few weeks.

As for the American football code, the number of injuries was compared in four phases for a one-year playing season; pre-competition phase in spring, competition phase in spring, pre-competition phase in summer, and main competition phase in autumn (Kawamura, et al., 2007). The study clustered several months for comparison of the different number of injuries each phase, and found the least number of injuries/day in the pre-competition phase in summer.

"Early-season bias" has been described as a decline in injury incidence from the early period to the late period of the playing season by Orchard (Orchard, 2002). Overseas epidemiological studies have suggested seasonal bias existed in various football codes (Orchard, 2002) such as Australian football (Orchard, et al., 1999) and rugby union (Alsop, et al., 2000; Lee and Garraway, 2000; Takemura, et al., 2007). One of the reasons for this phenomenon was ground condition, since the change in ground condition according to annual seasons seems to be consistent with the change of injury incidence through the rugby season both in the northern and southern hemispheres (Orchard, 2002). However, it remains unclear which reason can be attributed to seasonal injury bias, even though ground condition is the most plausible reason (Orchard, 2001; Takemura, et al., 2007). Therefore, it is valuable to examine the 'early-season bias' in Japan, which is located in the northern hemisphere and has a different playing season.

The purpose of this study was to examine the 'early-season bias', especially in the pre-competition phase in rugby union in Japan, which has a different season style from other countries where rugby union has developed. In addition, the nature and severity of injuries during a single season were described at the collegiate level.

2. Methods

2.1. Participants and setting

Sixty-six rugby union players were involved in the epidemiological study from one university club in Japan during the 2005 rugby season. The club had three teams at the university level; first grade, second grade, and third grade, and all players from the three teams were included. The three teams had training sessions together during their season from February to December. However, matches were held on different days on weekends in accordance with the team grade.

The pre-competition phase was between February 8th and July 1st, 2005. There was an approximately three-week short break between the pre-competition and specific preparation phases. Intensive training sessions, training camps and intensive pre-season matches were held in the specific preparation phase.

The main competition phase started on August 27th and ended on December 11th, 2005. The first grade team belonged to the provisional university rugby competition league. In the competition league, eight university rugby teams competed in a round-robin and the top five teams were allowed to participate in the highest level competition tournament at the university level in Japan, the University Rugby Football Championship. The second grade team also joined in a round-robin competition which consisted of six teams. The third grade team had several practice matches in the main competition phase.

2.2. Injury surveillance

Injury data collection was undertaken by team trainers or physiotherapists using a questionnaire, which consisted of three parts; demographic data, injury data, and activity data (Takemura, et al., 2007). Injury data included type, body site, previous history of the injury, playing phase, mechanism of the injury, and ball relationship. The team trainers or team physiotherapists joined in all training and game sessions. When they recognized any injury, it was recorded. This was done after injury evaluation by trainers and followed by diagnosis by a doctor.

Exposure time data was collected by one of the members in the club with a record of the training program at each training session. For the matches,

Table 1 Exposure time and number of match injuries in each periodized phase.

	Exposure (hours)	Injuries	Incidence (injuries/1000 player-hours)	95%CI
Pre-competition phase	342.8	11	32.1	16.0-57.4
Specific preparation phase	200.0	7	35.0	14.1-72.1
Main competition phase	387.5	27	69.7	45.9-101.4
Total	930.3	45	48.4	35.3-64.7

Significant difference between the three phases (p<0.05).

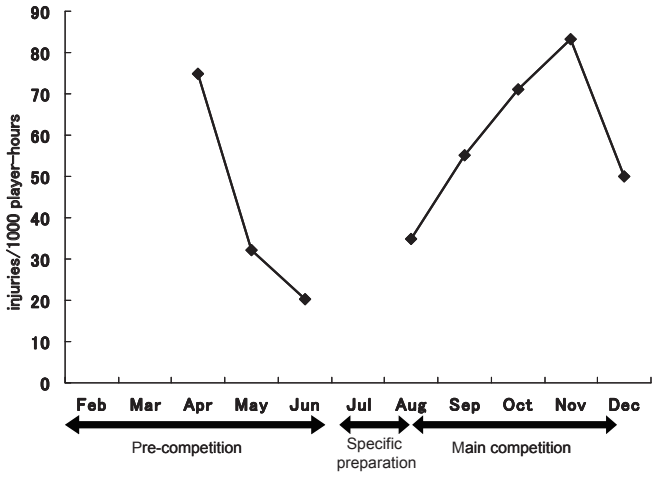

Figure 1 Trend of injury incidence in matches in the pre-competition phase and from the specific preparation phase to the main competition phase. Significant decrease of injury incidence in the pre-competition phase (p<0.001) and significant increase in the main competition phase excluding the last month (p<0.001).

official reports were utilized to calculate exposure time in all games.

2.3. Definition and classification of injury

Injury was defined as any event that prevented a player from joining in the next scheduled training session or match (Brooks, et al., 2005a & 2005b) and classified in accordance with the Orchard Sports Injury Classification System (Orchard, 2004). The date of return to play was regarded as when the injured player was able to fully participate in a training session or match.

2.4. Statistical analysis

Injury incidence was calculated by each periodized phase and then by each month in each phase. A Chi-square test was applied to the difference of injury incidence among the three phases (p<0.05). The Randomization test (Edgington and Onghena, 2007) was applied to examine the trend of injury incidence in the pre-competition phase and main competition phase.

This study was approved by the ethical committee of the Graduate School of Comprehensive Human Sciences in the University of Tsukuba, Japan.

3. Results

3.1. Injury incidence and severity

One hundred ninety-eight training sessions and 48 games were held throughout the 2005 season. Overall exposure time was 56,760 hours including 930.3 hours in matches. A total of 105 injuries occurred with 45 injuries in matches. Therefore, overall injury incidence was 48.4 injuries/1000 player-hours in matches. **Table 1** shows exposure time, number of injuries, and injury incidence in matches in each phase. There was a significant difference of injury incidence among the three phases (p<0.05).

Injury incidence in the pre-competition phase indicated a significant decline from the beginning of the pre-competition phase to its end (p<0.001). However, in the main competition phase, injury incidence significantly increased toward the end of the season excluding the last month of the main competition phase (p<0.001) (**Figure 1**).

The overall severity of injuries was 25.2 days (3-223 days) except two career-ending injuries (**Table 2**). Although the pre-competition phase (58.8 days) had the highest severity of all three phases, injuries in the specific preparation phase (9.0 days) were the least severe.

Table 2 Severity of match injuries in each periodized phase.

	2～3	< 8	< 29	29≦	Career-Ending	Mean (range) (days)
Pre-competition phase	1	0	4	6	0	58.8 (3-223)
Specific preparation phase	3	1	3	0	0	9.0 (3-21)
Main competition phase	1	10	10	4	2	15.0 (3-57)
Total (events)	5	11	17	10	2	25.2
(%)	(11.1)	(24.4)	(37.8)	(22.2)	(4.4)	(100.0)

Table 3 The five highest incidence injuries in matches which occurred during the 2005 season.

	Incidence (injuries/1000 player-hours)	Severity (range) (days)
Ankle ligament injuries and sprains	0.85	25.5 (2-86)
Concussion and facial soft tissue trauma	0.43	6.0 (2-13)
Thigh hematomas	0.38	5.0 (3-8)
Knee ligament injuries and sprains	0.38	79.9 (21-243)
Quadriceps/hamstrings strains	0.24	33.6 (18-56)

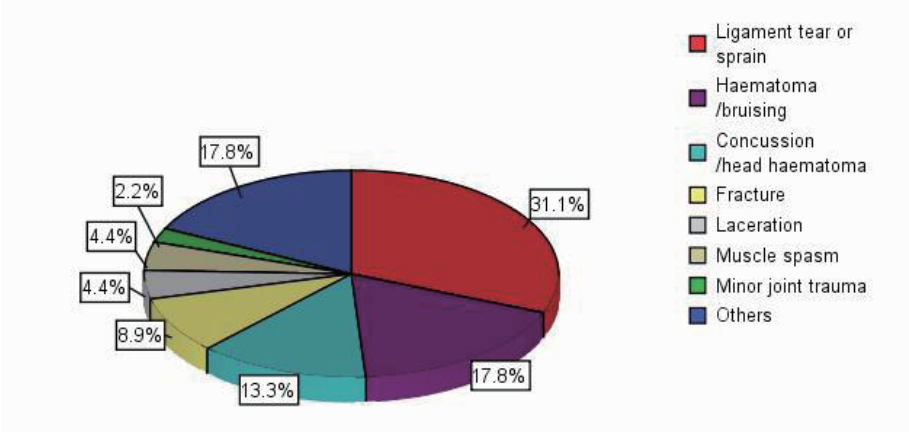

Figure 2 Type of match injuries.

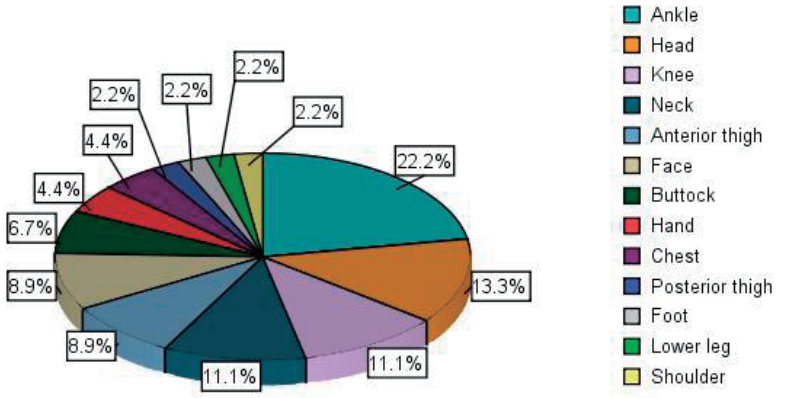

Figure 3 Body site of match injuries.

3.2. Nature of injuries

The most frequent type of injury (**Figure 2**) was ligament injury/sprain (31.1%) and the body site (**Figure 3**) was head/face and ankle (both 22.2%). The worst five injuries are shown in **Table 3**. A percentage of 46.7 of the 45 injuries happened when players were tackled (**Figure 4**), while 51.1% of injured players were the ball carrier (**Figure 5**). Contacting other players was the highest cause of injuries (48.9%) (**Figure 6**).

Twelve of the 45 match injuries occurred repeatedly in this season (26.7%). Recurrent injury incidence was 12.7 injuries/1000 player-hours in matches and severity was lower than that of newly experienced injuries; 12.7 days (3-54 days) compared to 30.1 days (3-223 days).

4. Discussion

In Japan, several studies reported the

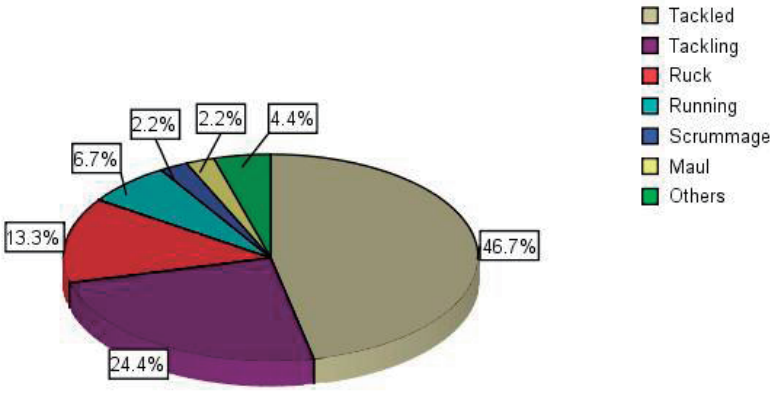

Figure 4 Playing phase of match injuries.

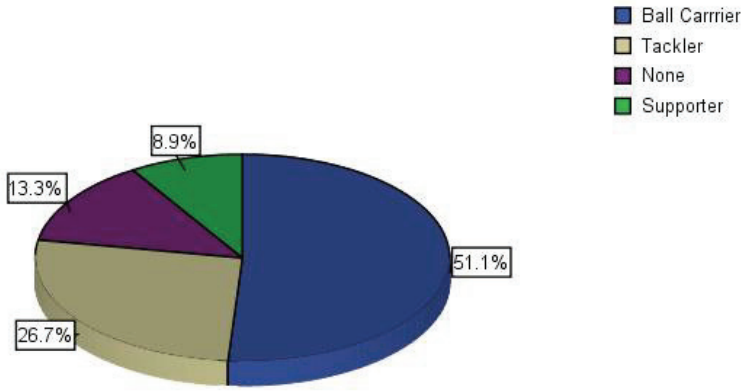

Figure 5 Ball relationship when injuries happened in matches.

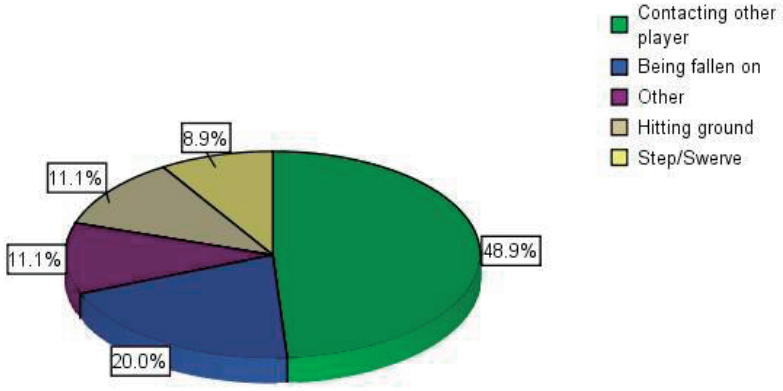

Figure 6 Inciting event in match injuries.

number of injuries in rugby union with wide variations in the definition of injuries and methodologies of the surveillance. Yamamoto (1990) concluded 306 injury events happened in the Kyushu district from 1984 to 1989. Ryu, et al., (2000) investigated injury characteristics of the club teams of medical students, and found that 193 injuries, including 61 severe injuries, occurred during five years. These studies reported both match injuries and training injuries together. Fukuda, et al., (2005) recorded 291 events in the national team for two years including the 2003 Rugby World Cup. Although each study gave a detailed description of rugby injuries within the population, it was not straightforward to make a comparison with other studies.

Injury incidence has been described in the English Premiership (Brooks, et al., 2005a) and the England 2003 Rugby World Cup squad (Brooks, et al., 2005b) under the same definition of injury, 'time-loss injuries', as this current study. This definition is currently world standard for injury surveillance in rugby union (Fuller, et al., 2007). There is only one epidemiological study for collegiate rugby players in the United States (Kerr, et al., 2008), however a different definition of injury and injury surveillance system were used for data collection. Furthermore, periodazation, structure and background of the club, and competition level in rugby union in Japan are unique. Therefore, it is very important to describe injury profile at the collegiate level in Japan.

Injury incidence in the main competition phase was lower (69.7 injuries/1000 player-hours in matches) than two previous studies (Brooks, et al., 2005a & 2005b). Results of the current study were consistent with the findings that injury incidence was higher in more superior grades as skill, fitness, experience and intensity of games were expected to be more advanced (Bird, et al., 1998; Brooks and Kemp, 2008). However, in comparison with the US study at the collegiate level (Kerr, et al., 2008), injury incidence in main competition in the current study was much higher. It is assumed that this discrepancy originates in the dissimilar competitive level of play, various differences of the injury surveillance, and a different definition of injury. It is important to use the same definition of injury, to collect exposure time, and to minimize bias produced by methodological issues such as under-reporting.

Although there are several studies which described

injury profiles for one rugby team (Brooks, et al., 2005b; Bathgate, et al., 2002; Targett, 1998), only one study referred to the difference of injury incidence in each periodized phase. Brooks, et al., (Brooks, et al., 2005b) showed the number of injuries by three phases, divided into 63 weeks for the England squad team and the highest number of injuries in the pre-World Cup phase, but it didn't clarify in which phase injury was the most prevalent.

In American football, injury incidence was the highest in the competition phase in spring (1.68 injuries per day) and the lowest in the pre-competition phase in summer (0.88 injuries per day) (Kawamura, et al., 2007). However, the current study showed the highest incidence in the main competition phase and the lowest in the pre-competition phase. Although the various estimations of exposure time make direct comparison difficult, these differences might reflect the diverse training programs, match regulations, and rules, between the two football codes.

The current study made a first examination of seasonal bias in Japan as well as in the pre-competition phase, which was the most time-consuming period among the three phases. Seasonal bias was examined by several authors (Alsop, et al., 2000; Lee and Garraway, 2000; Takemura, et al., 2007). All research showed that seasonal bias existed from the beginning of the season to the end of the season in rugby with the decline of injury incidence. However, the research was carried out only in the main competition phase, which was typically the longest, and placed after a short preparation phase and pre-competition phase.

While injury incidence decreased toward the end of the phase during the pre-competition phase, from the specific preparation phase to the main competition phase injury incidence tended to increase. These phenomena suggested that the possible causes of seasonal bias, which were proposed by several authors, would be limited. Possible reasons for seasonal bias were ground condition (Orchard, 2001; Takemura, et al., 2007), the lack of enthusiasm in reporting injuries in the late season (Alsop, et al., 2000), inadequate match physical fitness (Lee and Garraway, 1996), more motivation in the early season (Alsop, et al., 2000), and exclusion of a prone cohort member in the late season (Alsop, et al., 2000). The most plausible reason, ground condition, would be ruled out because decreased injury incidence in the pre-competition phase would be consistent with increased ground hardness in the annual season.

Mean severity of injury in the current study (25.2 days) was higher than those in the English Premiership (18 days) (Brooks, et al., 2005a), and in the England 2003 Rugby World Cup squad (16 days) (Brooks, et al., 2005b). It is assumed that the severity of injury might increase, as competition grade becomes lower, due to two reasons; the difference of the type of injury and the team medical supporting system. The type of injury in the current study is different from the previous studies (Brooks, et al., 2005a & 2005b). While in the high-level professional competitions muscle and tendon injuries with less severity were most frequent, in this study joint and ligament injuries had the most frequency. Such joint and ligament injuries cause the longest recovery periods and time absent from play. Moreover, professional rugby players were fully supported by the team doctors/physiotherapists. Diagnosis and examination of injured players could occur without delay, followed by extensive rehabilitation and recovery training. However, it is difficult to compare the difference of frequency by the category of severity because of the various categories of severity in the previous studies (Brooks, et al., 2005a & 2005b; Holtshausen, et al., 2008; Kerr, et al., 2008). Consensus statement may make its comparison possible in the near future (Fuller, et al., 2007).

Among the three periodized phases, severer injuries tended to happen frequently in the pre-competition phase. While this might be affected by the fact that most players lay weight on the main competition, further research is required. Nevertheless, to decrease injury incidence and mean severity of injury through the rugby season, it is necessary to target this phase, which is specific to Japan. As a result of introduction of injury prevention to the phase, the performance of players and teams would increase.

Analysis of recurrence rate is important to estimate the influence of recurrent injury to the injury incidence because previous injury is one of the risk factors for injuries. Brooks, et al., (2005a) described the rate of recurrent injuries and their average severity as 18% and 27 days respectively. In the current study, recurrence rate showed a higher percentage (26.7%) than in the previous studies (Brooks, et al., 2005a). This means that if recurrent injuries were prevented at the collegiate level, overall injury incidence would decline. Criteria of return to

play as well as preventive methods such as training and prophylactic devices should be reconsidered. However, the severity of recurrent injuries in the current study was lower (12.7 days) than in the previous study (Brooks, et al., 2005a).

It might be possible that the type of injury is diverse if competitive level is dissimilar. Joint and ligament injury happens most frequently in collegiate rugby. Although over 45% of all injuries were muscle and tendon injuries, approximately 40% were joint and ligament in high-level competition research using the same definition of injury and injury classification system (Brooks, et al., 2005a). While the body site of injuries is commonly lower limbs, it is unclear which part of the body was most vulnerable in comparison with the previous study. It is important to use the same category and expression even under the same definition and classification for easily comparing the injured body area.

Consensus was almost reached that tackle, including the tackling player and tackled player, was the most frequently encountered cause of injury. Also contacting other players, which included tackle, ruck/maul, set pieces such as scrum and line out, was the top inciting event of all rugby injuries (Brooks and Kemp, 2008; Kaplan, et al., 2008). There was no discrepancy between these consensuses and the current study. This is the reason why tackle and contacting other players, which are essential for rugby, were more time-consuming in matches.

Analysis of tackle injuries from video recordings for top players in New Zealand showed an almost even number of injuries resulted in replacement of the ball carrier and the tackler (Quarrie and Hopkins, 2008). However, in the current study there were twice as many injuries to the ball carrier compared with the tackler. Skills for tackling and being tackled, which depend on experience, are important to prevent tackle related injuries. Analysis of tackle situations using video recordings should be considered for the collegiate rugby players.

Seventy percent of the inciting events were a collision with something such as a player, and the ground. The consensus statement emphasized that injury was "any physical complaint, which was caused by a transfer of energy" (Fuller, et al., 2007), which is produced by body mass and acceleration of a player. Therefore, ground condition which affects speed and acceleration would be an important factor for rugby injuries.

5. Conclusion

'Early-season bias' has indicated that ground condition could be associated with injury occurrence in rugby union. However, the current study which examined only one rugby season showed less possibility of the association in Japan. Measurement of ground condition should be warranted to confirm the association. Also in the current study, incidence, severity, nature, and circumstance of injuries were described in rugby union at the collegiate level. An important first step of injury prevention is to collect injury data using a standardized system.

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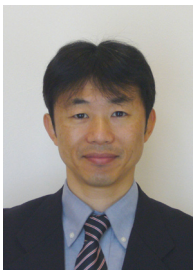

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