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Epidemiology of Collegiate American Football Injuries -Longitudinal Injury Surveillance for 10 Years, 1999 Through 2008-

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American football is an intense contact sport, and a lot of injuries occur in both games and practices. A constructive injury report system has been established within the National Collegiate Athletic Association (NCAA) and many changes and modifications to the NCAA rules on football have been made as a result of these longitudinal data. However, there are few longitudinal studies that include detailed data on American football injuries in Japan. The purpose of this study is to ascertain the characteristics of collegiate American football injuries in both games and practices in Japan based on longitudinal data. The subjects were 523 students who played American football at T University from 1999 to 2008. 790 collegiate American football-related injuries were reported. The game injury rate (GIR: 43.4/1,000 athlete-exposures (A-Es)) was more than 6 times higher than the practice injury rate (PIR: 6.6/1,000A-Es) (χ^2 =25.9, P<0.05), although the PIR was much higher than that for the NCAA. Injuries to the lower extremities such as sprained knees and ankles as well as muscle-tendon strains in both games and practices are very common. In conclusion, we should consider the intensity and quantity of running programs and the change in the guidelines with respect to the contact in scrimmages to reduce the PIR.

Keywords: American football, injury, injury prevention

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1. Background

American football (AF) is one of most exciting collegiate sports in Japan, and many collegiate players here start playing football in their freshman year. However, many collegiate AF players sustain injuries, including brain and head injuries as well as spinal cord injuries (Dick, et al., 2007; Shankar, et al, 2007; Torg, et al., 1979; Matsumoto, et al., 1990). Many studies have been made on AF-related injuries, but it is difficult to compare them due to the different methodologies and injury definitions used (Dick, et al., 2007; Shankar, et al., 2007; Fujiya, et al., 2002; Matsumoto, et al., 1990). The United States, the country of origin of AF, established the National Collegiate Athletic Association (NCAA) in 1906 in order to prevent young athletes, particularly those in football, from suffering numerous injuries and even fatalities. Since then, the NCAA has consistently published reports on injuries sustained in collegiate football. This collection of data amassed over such a long period can help medical associates gain an understanding of the tendencies of football-related injuries. For example, Dick, et al. (2007) reported that the game injury rate (GIR) was 36 injuries per 1000 athlete-exposures (A-Es) from 1988 to 2004, based on a study of 16 years of data on injuries collected by the NCAA over this period, and that the GIR was more than nine times higher than the practice injury rate (PIR). Many changes and modifications to the NCAA rules on football have been made as a result of these longitudinal data (Torg, et al., 1976). However, no such longitudinal studies that include detailed data on injuries sustained in both games and practices

have been made in Japan, although there have been a couple of longitudinal studies that reported on game injuries (Fujiya, et al., 2002; Matsumoto, et al., 1990). What is needed is a long-term source of data on injuries sustained in games and practices that would enable a more accurate understanding of the characteristics of football-related injuries in order to formulate appropriate injury-prevention strategies in Japan. The purpose of this study is to ascertain the characteristics of collegiate AF injuries in both games and practices in Japan based on longitudinal data.

2. Methods

2.1. Subjects

The subjects of this study were 523 students of T University who played AF from 1999 to 2008. The team played in Division I of the Kantoh Collegiate Football Association (KCFA) for 7 years and in Division II for 3 years. The study was approved by the Ethics Committee of the Graduate School of Comprehensive Human Sciences at T University, Japan.

2.2. Injury Surveillance

An injury survey sheet was delivered to players and collected by student trainers by hand. Student trainers asked the players the questions and filled in the answers to guard against players giving incomplete responses. Based upon the results of this survey, we analyzed the injury rates, body parts injured, types of injuries, mechanisms of injury, playing positions in which injuries were sustained, and year of the players sustaining injuries in both games and practices.

2.3. Definitions

2.3.1. Injury

An injury was defined as an incident occurring in a game or practice session that forced the player to sit out a game or practice session for more than one day after the injury was received. The definitions and classifications of injuries were based on those used in the Injury Surveillance System of the NCAA (Dick, et al., 2007). All injuries in this study were diagnosed by orthopedic specialists and neurosurgeons.

2.3.2. Athlete-Exposures (A-Es)

An A-E was defined as the exposure of an athlete to the possibility of injury by participation in a practice or game, regardless of the time spent performing the activity (Dick, et al., 2007). However, in our study we counted the number of players who participated in games and practices during the regular season in 2007 and 2008, as not all players could participate in a game or practice due to various constraints. That is, about 10% of players could not attend daily practices because they had classes at the time of practice. In addition, about 20% of players—mostly freshmen—did not play in actual games because of their lack of football skills. Therefore, game and practice A-Es per year were divided by 0.8 and 0.9, respectively. For example, Game A-Es for 10 years were calculated as follows.

Game A-Es for 10 years
= total number of games for 10 years × average annual number of players × 0.8*
(*Game A-Es were divided by 0.8 because 20% of all players could not participate in games)
= 109 × 52.3 × 0.8
= 4560.6

2.3.3. Injury Rate (IR)

The IR was defined as the ratio of the number of injuries in a particular category divided by the number of A-Es in that category. The calculation of IR by the NCAA is expressed as injuries per 1000A-Es. For example, the GIR for 10 years was calculated as follows.

GIR for 10 years
= total number of game injuries for 10 years ÷ value for Game A-Es × 1000
=198 ÷ 4560.6 × 1000
=43.4/1000A-Es

2.4. Statistics

Data analysis between GIRs and PIRs was conducted by using an χ^2 test calculated using SPSS software (Ver. 19; IBM Inc.) with a 95% Confidence Interval (CI). The data were considered significant when the P-Value was <0.05.

3. Results

3.1. Game and Practice Athlete-Exposures

The game and practice A-Es for 10 years were 4560.6 and 90374.4, respectively (**Table 1**).

3.2. Injury Rates

The total number of injuries for 10 years was 790 (**Table 1**). The number of game and practice injuries was 198 and 592, respectively. Therefore, the GIR for 10 years was 43.4/1,000A-Es and the PIR was 6.6/1,000A-Es. Thus the GIR was more than six times higher than the PIR (χ^2 =25.9, P<0.05).

3.3. Mechanisms of Injury

The most common mechanisms of injury in games were being tackled (8.8/1,000A-Es) (**Table 2**), followed by blocking (6.4/1,000A-Es), tackling (5.7/1,000A-Es), and being blocked (5.5/1,000A-Es). The most common mechanisms of injury in practices were others (0.9/1,000A-Es), followed by sprinting (0.8/1,000A-Es), blocking, tackling, and being tackled (each 0.7/1,000A-Es). The GIR for being tackled was significantly higher than the PIR (χ^2 =6.4, P<0.05). Contact injuries were common in both games and practices, although noncontact injuries were the leading mechanisms of injury in practices.

Table 1 Game and Practice Injury Rates for 10 years

		Game					Practice					
Year	Number of Player	Number	A-Es*1	Number of Injury	GIR	95% CI	Number	A-Es*2	Number of Injury	PIR	95% CI	
1999-2000	60	14	672.0	16	23.8	13.6-38.7	198	10692.0	61	5.7	4.4-7.3	†
2000-2001	55	12	528.0	11	20.8	10.4-37.3	201	9949.5	58	5.8	4.4-7.5	†
2001-2002	53	12	508.8	26	51.1	33.4-74.9	195	9301.5	53	5.7	4.3-7.5	†
2002-2003	55	10	440.0	20	45.5	27.8-70.2	199	9850.5	62	6.3	4.8-8.1	†
2003-2004	53	11	466.4	26	55.7	36.4-81.7	178	8490.6	59	6.9	5.3-9.0	†
2004-2005	52	10	416.0	15	36.1	20.2-59.5	179	8377.2	85	10.1	8.1-12.5	†
2005-2006	51	8	326.4	18	55.1	32.7-87.2	196	8996.4	68	7.6	5.9-9.6	†
2006-2007	50	10	400.0	18	45.0	26.7-71.1	188	8460.0	67	7.9	6.1-10.1	†
2007-2008	52	11	457.6	21	45.9	28.4-70.2	192	8985.6	45	5.0	3.7-6.7	†
2008-2009	42	11	369.6	27	73.1	48.1-106.3	194	7333.2	34	4.6	3.2-6.5	†
1999-2008	523	109	4560.6	198	43.4	37.6-49.9	1920	90374.4	592	6.6	6.0-7.1	†

*1 GAE was divided by 0.8 because 20% of all players could not participate in games

*2 PAE was divided by 0.9 because 10% of all players could not participate in practices

† Statistical significance between GIR and PIR (P<0.05)

A-Es: athlete-exposures, GIR: game injury rate, PIR: practice injury rate, CI: confidence interval

Table 2 Game and Practice Injury Rates by Mechanism of Injury

	Game			Practice			
Mechanism of Injury	Number of Injury	GIR	95% CI	Number of Injury	PIR	95% CI	
Being Tackled	40	8.8	6.3-11.9	59	0.7	0.5-0.8	†
Blocking	29	6.4	4.3-9.1	62	0.7	0.5-0.9	
Tackling	26	5.7	3.7-8.4	61	0.7	0.5-0.9	
Being Blocked	25	5.5	3.6-8.1	51	0.6	0.4-0.7	
Other Contacts	12	2.6	1.4-4.6	39	0.4	0.3-0.6	
Cutting	11	2.4	1.2-4.3	25	0.3	0.2-0.4	
Sprints	7	1.5	0.6-3.2	70	0.8	0.6-1.0	
Gradual	7	1.5	0.6-3.2	57	0.6	0.5-0.8	
Receiving Pass	7	1.5	0.6-3.2	23	0.3	0.2-0.4	
Defensing Pass	5	1.1	0.4-2.6	9	0.1	0.0-0.2	
Unknown	11	2.4	1.2-4.3	52	0.6	0.4-0.8	
Others	18	4.0	2.3-6.2	84	0.9	0.7-1.2	

† Being tackled showed statistical significant between GIR and PIR (P<0.05)

The common mechanism of injury in games was related to contacts such as being tackled, blocking, tackling, being blocked, and other contacts.

GIR: game injury rate, PIR: practice injury rate, CI: confidence interval

3.4. Common Injuries

The most common injuries in both games and practices were sprains (13.9/1,000A-Es and 2.1/1,000A-Es) (**Table 3**), followed by muscle-tendon strains (5.1/1,000A-Es and 1.6/1,000A-Es), concussions (3.9/1,000A-Es and 0.6/1,000A-Es), contusions, fractures, dislocations, and other injuries. The GIR for sprains was significantly higher than the PIR (χ^2 =9.0, P<0.05). The most common types of injuries in both games and practices were the same, in order.

3.5. General Body Parts and Specific Body Parts Injured

The general body parts most commonly injured in both games and practices were the lower extremities (24.3/1,000A-Es and 3.9/1,000A-Es)(**Table 4**), followed by the head/neck (8.3/1,000A-Es and 1.2/1,000A-Es), the upper extremities (8.1/1,000A-Es and 0.9/1,000A-Es), and the trunk/back (2.6/1,000A-Es and 0.6/1,000A-Es). The GIR for the all body parts except the trunk/back was significantly higher than the PIR (the lower extremities:χ^2=14.3, the head/neck:χ^2=5.4, the upper extremities:χ^2=5.4, P<0.05). The specific body parts most commonly injured in games were the ankle (8.1/1,000A-Es) (**Table 5**), followed by the knee (7.5/1,000A-Es), head (5.3/1,000A-Es), and the shoulder (5.0/1,000A-Es). The upper leg (1.0/1,000A-Es) was the most common body part injured in practices, followed closely by the ankle (0.9/1,000A-Es), and the knee (0.9/1,000A-Es).

3.6. Playing Positions in Which Injuries Sustained

The positions in which most injuries were sustained in games were offensive linemen (OL: 68.8/1,000A-Es) (**Table 6**), followed by wide receiver (WR: 40.8/1,000A-Es), and running back (RB: 40.3/1,000A-Es). The positions in which most injuries were sustained in practices were OL (8.5/1,000A-Es), followed by defensive back (DB: 7.6/1,000A-Es), and RB (6.9/1,000A-Es). The GIR for all positions except kicker was significantly higher than the PIR (OL:χ^2=46.2, WR:χ^2=24.1, RB:χ^2=23.2, QB:χ^2=4.3, DL:χ^2=24.4, LB:χ^2=24.2, DB:χ^2=16.1, P<0.05).

Table 3 Game and Practice Injury Rates by Injury Types

	Game			Practice			
Injury Type	Number of Injury	GIR	95% CI	Number of Injury	PIR	95% CI	
Sprain	79	13.9	13.7–21.6	186	2.1	1.8–2.4	†
Muscle–Tendon Strain	29	5.1	4.3–9.1	148	1.6	1.4–1.9	
Concussion	22	3.9	3.0–7.3	50	0.6	0.4–0.7	
Contusion	20	3.5	2.7–6.8	37	0.4	0.3–0.6	
Fracture	15	2.6	1.8–5.4	32	0.4	0.2–0.5	
Dislocation/Subluxation	8	1.4	0.8–3.5	15	0.2	0.1–0.3	
Others	25	4.4	3.5–8.1	124	1.4	1.1–1.6	

† Statistical significance between GIR and PIR (P<0.05)
The most common type of injuries sustained in both games and practices was sprains.
GIR: game injury rate, PIR: practice injury rate, CI: confidence interval

Table 4 Game and Practice Injury Rates by Body Parts

	Game			Practice			
Body Parts	Number of Injury	GIR	95% CI	Number of Injury	PIR	95% CI	
Lower Extremities*	111	24.3	20.0–29.3	351	3.9	3.5–4.3	†
Head & Neck**	38	8.3	5.9–1.1	107	1.2	1.0–1.4	†
Upper Extremities***	37	8.1	5.7–11.2	77	0.9	0.7–1.1	†
Trunk & Back****	12	2.6	1.4–4.6	55	0.6	0.5–0.8	
Others	0	0.0	0	2	0.0	0	

† Statistical significance between GIR and PIR (P<0.05)
* The lower extremities include the foot, ankle, lower leg, knee, upper leg, pelvis, and hip.
** The head and neck include the head, neck, and face.
*** The upper extremities include the finger, hand, elbow, upper arm, and shoulder.
**** The trunk and back include the lower back, upper back, abdomen, and chest.
GIR: game injury rate, PIR: practice injury rate, CI: confidence interval

Table 5 Game and Practice Injury Rates by Specific Body Part

Game				Practice			
Body Part	Number of Injury	GIR	95% CI	Body Part	Number of Injury	PIR	95% CI
Ankle	37	8.1	5.7–11.2	Upper Leg	90	1.0	0.8–1.2
Knee	34	7.5	5.2–10.4	Knee	85	0.9	0.8–1.2
Head	24	5.3	3.4–7.8	Ankle	84	0.9	0.7–1.2
Shoulder	23	5.0	3.2–7.6	Head	67	0.7	0.6–0.9
Upper Leg	21	4.6	2.9–7.0	Shoulder	37	0.4	0.3–0.6
Neck	12	2.6	1.4–4.6	Neck	36	0.4	0.3–0.6
Lower Leg	12	2.6	1.4–4.6	Lower Back	41	0.5	0.3–0.6
Elbow	6	1.3	0.5–2.9	Lower Leg	33	0.4	0.3–0.5
Plevis & Hip	5	1.1	0.4–2.6	Plevis & Hip	35	0.4	0.3–0.5
Finger	5	1.1	0.4–2.6	Foot	24	0.3	0.2–0.4
Chest	5	1.1	0.4–2.6	Finger	13	0.1	0.1–0.2
Lower Back	3	0.7	0.1–1.9	Hand	11	0.1	0.1–0.2
Hand	3	0.7	0.1–1.9	Elbow	12	0.1	0.0–0.2
Foot	2	0.4	0.1–1.6	Chest	6	0.1	0.0–0.1
Face	2	0.4	0.1–1.6	Face	4	0.0	0.0–0.1
Abdomen	1	0.2	0.0–1.2	Abdomen	3	0.0	0.0–0.1
Upper Back	0	0.0	0.0–0.8	Upper Back	5	0.1	0.0–0.1
Upper Arm	0	0.0	0.0–0.8	Upper Arm	3	0.0	0.0–0.1
Others	1	0.2	0.0–1.2	Others	2	0.0	0.0–0.1
Unknown	2	0.4	0.1–1.6	Unknown	1	0.0	0.0–0.1

The common specific body parts injured in both games and practices were the ankle and knee although the upper leg was the leading body part injured in practices.
GIR: game injury rate, PIR: practice injury rate, CI: confidence interval

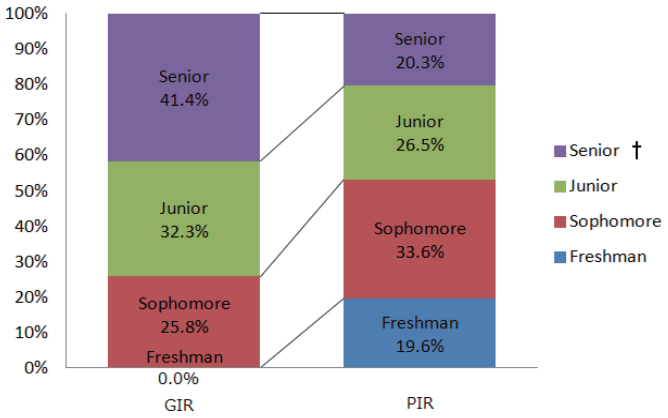
Table 6 Game and Practice Injury Rates by Player's Position

	Game			Practice			
Position (Number of Player)	Number of Injury	GIR	95% CI	Number of Injury	PIR	95% CI	
Offensive Line (80)	48	68.8	50.7–91.2	118	8.5	7.1–10.2	†
Running Back (74)	44	40.3	49.5–91.5	98	6.9	5.6–8.4	†
Wide Receiver (73)	26	40.8	26.7–59.8	85	6.7	5.4–8.3	†
Quarter Back (34)	4	13.5	3.7–34.5	27	4.6	3.0–6.7	†
Defensive Line (75)	24	36.7	23.5–54.6	64	4.9	3.8–6.3	†
Line Backer (74)	25	38.7	25.1–57.2	78	6.1	4.8–7.6	†
Defensive Back (92)	27	33.7	22.2–49.0	120	7.6	6.3–9.0	†
Kicker (5)	0	0	0	2	2.3	0.3–8.4	

† The GIRs in all positions except kicker were significantly higher than the PIR ($P<0.05$).
∗ The playing position sustaining the most injuries in both games and practices was OL.
GIR: game injury rate, PIR: practice injury rate, CI: confidence interval

3.7. Year of Player Injured

Most injuries in games were sustained by seniors (41.4%) (**Figure 1**), followed by juniors (32.3%), sophomores (25.8%), and freshmen (0%). In practices, this was sophomores (33.6%), followed by juniors (26.5%), seniors (20.3%), and freshmen (19.6%). The GIR for seniors was significantly higher than the PIR ($\chi^2 = 7.2$, $P<0.05$).



† The GIR in Senior was significantly higher than the PIR ($P<0.05$).
GIR: game injury rate, PIR: practice injury rate

Figure 1 Game and Practice Injury Rates by Year of Player

4. Discussion

Injury Rates

This study is the first to attempt to clarify in detail the characteristics of collegiate AF injuries in both

games and practices over an extended period. The GIR was six times higher than the PIR ($P<0.05$). Dick et al. (2007) reported that the GIR (36.9/1,000A-Es) was more than nine times higher than the PIR (3.8/1,000A-Es) based on data amassed over 16 years by the NCAA Injury Surveillance System. This is because the higher velocity and higher impact of collisions as well as more opportunities for contact in games resulted in a higher risk of injury (Shankar, et al., 2007). In this study, we found higher injury rates in both games and practices in Japan in comparison with those recorded by the NCAA. This was mainly because players in the United States generally already have a lot of experience gained from playing in high school or junior leagues, whereas almost all the players at T University did not start playing football until their freshman year. Therefore, Japanese players tend to lack the physical fitness and skills needed in football. Fujiya, et al. (2006) and Kuzuhara, et al. (2009) pointed out that most Japanese collegiate football players tend to suffer frequent injuries in practice, and we strongly agree with these results (Fukuda, et al. 2011). One of the characteristics of Japanese collegiate football is that a coach tends to plan a lot of field practices including scrimmages, which are game-simulated practices with full contact, in order to have new players gain experience. However, many players in Japan sustain injuries in scrimmages (Fukuda, et al. 2011; Fujiya, et al. 2006). In comparison, coaches in the United States restrict the number of scrimmages during practices in the regular season. Doing so reduces the chances of injuries, because the more physical contact is increased the more an injury is likely to occur. Therefore, we should consider a change in the guidelines with respect to the intensity and quantity of contact in scrimmages conducted daily. In addition, the average number of field practices per year at T University is 192, compared to an average of 90 to 100 field practices per year in Division I and Division II football teams in the NCAA (Dick, et al., 2007). Moreover, collegiate players in Japan usually do weight training to compensate for comparatively poor physical fitness—except during practices—throughout the entire season. Therefore, Japanese collegiate players may well be suffering from stress from daily field practices as well as regular strength-building programs. As a result, the PIR in this study was much higher than that for the NCAA, although the GIR in this study was similar to that for the NCAA, and thus the GIR/PIR ratio for the NCAA was relatively high.

Mechanisms of Injury

Although only being tackled was statistically significant, blocking, tackling, and being blocked also showed high injury rates. In short, the common mechanism of injury in games was related to contact. Our findings showed a strong agreement with the results of previous longitudinal studies (Dick, et al., 2007; Kuroda et al., 2002; Fujiya, et al., 2006). Most Japanese collegiate AF players may lack the requisite hand skills to control an opponent or prevent themselves from falling when they lose their balance. On the other hand, players may exhibit less caution when being tackled since they tend to practice tackling. Therefore, coaches need to teach proper contact skills including hand skills and how to fall as well as having awareness and proper reaction after being tackled. Moreover, football players, particularly sophomores, at T University tend to lack the appropriate contact skills and therefore they need to practice basic contact drills even during the regular season. Next, the most common mechanisms of injury in practices were “others”, followed by “sprinting.” “Others” includes falling, stepping on someone, pursuing, hitting the ground, and dropping back. In practices, regular running programs are scheduled year round, which could overstress players. On the other hand, it is hard to reduce the intensity of the program as an aggressive program is needed to improve the physical fitness of players. Therefore, a more cautious program should be drawn up and it should be appropriately controlled during practice sessions. In addition, scrimmages and contact drills are regularly scheduled 6 days a week. Thus many players experience minor pain or physical stress to the extent that they need to sit out a practice. However a day off is not enough to fully recover from an exhausted physical condition.

Types of Injury

The most common types of injury sustained in both games and practices were sprains. The results of our study support those of many foreign and domestic reports (Dick, et al., 2007; Powell, et al., 2004; Halpern, et al., 1987; Kurosawa, et al., 1995; Abe, et al., 1995, Fujiya, et al., 2006; Matsumoto, et al., 1990). Although sprains were the most common

types of injury in practices, the percentage of muscle-tendon strains was high and our results agreed with those of Shankar, et al., 2007. Shankar, et al. (2007) reported a higher number of noncontact injuries, and overused muscle-tendon injuries were common in practices. This indicates that football players at T University may well suffer microtraumas to their musculoskeletal system from daily practices. Another point we have to consider is that head injuries were the third most common injury in both games and practices (5.3/1,000A-Es and 0.7/1,000A-Es). These finding supports those of many previous studies (Fukuda, et al., 1999; Kawahara, 1999; Guskiewicz, 2000). Fujiya et al. (2006) that reported that the proportion of concussions had increased during their 13 years of longitudinal research in the KCFA (7.4% from 1991 to 1997 and 11.1% from 1998 to 2003). In addition, recently the guidelines on concussion has been revised in greater detail, and the evaluation of concussions is regarded as severe because AF has a high incidence of head injuries. And recent stricter guidelines to identify concussions may have led to an increase in the number of such injuries being reported. However, the number of concussions recorded by the NCAA is less than that for the KCFA. According to a report by Dick, et al. (2007), the incidence of concussions in the NCAA was 5.5% through 6.8% in games and practices. This is because, as explained above, collegiate players in the NCAA have more experience and better skills compared with players in Japan. Shankar, et al. (2007) stated that high school football players statistically sustained more concussions than collegiate football players. This means that better football skills are a prerequisite to reducing concussion.

Body Parts Injured

The general body parts most commonly injured were the lower extremities in both games and practices, and the specific body parts most commonly injured in games were the ankle, followed by the knee. Many reports state that lower extremity injuries, especially internal derangements of the knee and sprained ankle ligaments, are characteristic football injuries (Dick, et al., 2007; Powell, et al., 2004; Kuroda et al., 2002; Abe, et al., 1995, Shimojyo, et al., 1996; Kurosawa, et al., 1995; Matsumoto, et al., 1990). However, most of these reports only reported injury data for games. In this study, the upper leg (1.0/1,000A-Es) was the most common specific body part injured in practices, followed closely by the knee (0.9/1,000A-Es), and the ankle (0.9/1,000A-Es). As discussed above, noncontact injuries and overused muscle-tendon injuries were common in practices, and often happen during a position drill or a running program (Shankar, et al., 2007). We also reported that a lot of hamstrings strains occurred during running programs in practices (Fukuda, et al, 2011). Therefore, in a future study we should pay more attention to stretching the upper leg and examine what type of stretching is beneficial in reducing muscle-tendon injuries. Overall, we need to focus on strategies to prevent injuries to the lower extremities, such as knee and ankle sprains, in both games and practices as well as strained upper leg muscle tendons in practices.

Playing Position Injured

The playing position in which most injuries was sustained in both games and practices was OL. An OL suffers repeated hard contact in almost all plays. When an OL is blocked from an angled position and has his leg twisted, he might easily strain his knee or ankle because of his heavy weight. Also, other linemen frequently fall on him, causing acute injuries. In particular, we reported that the lower back was the most common injury area for an OL (Fukuda, et al, 2011). An OL usually sets in a three-point stance, bending his back forward as low as he can. Then he must explosively move forward and collide with a defensive player. If he does not have appropriate muscle flexibility and core strength he could suffer repetitive forced hypertension of the lumbar spine at contact. In addition, repetitive movement can cause lower-back injuries, including lumbar sprain, strains, disc injuries or stress fractures known as spondylolysis and spondylolisthesis (Alexander, MJ., 1985). Another factor is that the number of OLs playing at one time is 6, including the tight end (TE), but the average number of OLs on a team per year is only 9.6. This lack of reserve OLs imposes a heavy burden on the number of available OLs, both during games and during practices. Although OL is the position that sees most injuries, WR, RB, and linebacker (LB) also see high injury rates because there are many opportunities for hard contact at high speed. Many studies have reported a high injury rate for these positions (Dick, et al., 2007; Powell, et al.,

2004; Kuroda et al., 2005; Abe, et al., 1995, 2005; Matsumoto, et al., 1990). In particular, we need to pay more attention to head injuries in these positions. Therefore, it is important to consider preventive strategies for individual positions because players in each position have different physical characteristics and roles.

Year of Players Injured

Seniors sustained the most injuries during games. This is because although most players at T University start playing football in their freshman year, the majority of starting players are seniors. On the other hand, sophomores sustain the most injuries during practices because this is the year in which they begin to participate in skilled practices—including full contact—with upper-year players. However, it is hard to gain the physical fitness and football skills needed in competitive collegiate football in a year because AF is a very complicated sport that includes tackling, blocking, passing, and catching. Our findings verified that freshman and sophomore showed a lower force output of a one-repetition maximum in squats and bench presses. According to a report by Matsumoto, et al. (1990), freshmen sustained the most injuries at T University from 1977 to 1988, mainly because they made full contact with upper-year players in each practice session. Based on this finding, a rule change was implemented to prevent freshmen from participating in a full-contact skilled practice. As a result of this rule change, the number of injuries to freshmen decreased.

5. Conclusion

This paper is the first to report data on injuries sustained over a 10-year period in both games and practices in Japan. We will continue to collect such data in order to formulate better injury-prevention strategies. In conclusion, we confirmed the following tendencies in collegiate AF-related injuries: The GIR was six times higher than the PIR, although the PIR was still higher than that in the NCAA. Collegiate football players in Japan tend to spend many hours in field practices and in physical trainings because they have little previous experiences in football. Therefore, coaches have to be careful with respect to the intensity and quantity of daily practices. In addition, they should teach proper contact skills including falling techniques. Injuries to the lower extremities such as sprained knees and ankles as well as muscle-tendon strains are very common. Finally, we need to discuss our findings and formulate a prevention strategy to reduce injuries based on the findings of this study. However, we did not consider total playing time in this study. Also, in the calculation of game and practice A-Es for 10 years, we used the number of players who participated in games and practices during the regular season in 2007 and 2008. In a future study, they should be taken into consideration in order to gain a better understanding of the characteristics of AF injuries.

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