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Beach Soccer Injuries During the Japanese National Championships

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Investigation performed at Urasoe General Hospital, Okinawa, Japan

Background: The frequency and severity of injury in beach soccer are unknown.

Purpose: To estimate the incidence rates, characteristics, and risk factors for injuries associated with beach soccer.

Study Design: Cohort study; Level of evidence, 3.

Methods: The same sports physician examined and recorded injuries incurred during the Japanese National Beach Soccer Championships in 2013 and 2014. Posttournament follow-up was made for all injuries. Match exposure for each player was recorded through video review to examine individual risk factors.

Results: A total of 58 injuries were recorded during 54 matches. The overall injury rate was 179.0 (95% CI, 138.4-231.6), and the time-loss injury rate was 28.2 (95% CI, 14.7-54.1) per 1000 player-hours. The foot/toe (34.9%) was the most frequently injured area, followed by the lower leg (22.2%) and thigh (11.1%). There was only 1 ankle injury (1.6%). The most frequent injury type was contusions (60.3%), followed by lacerations/abrasions (14.3%) and sprains/ligament injuries (6.3%). Only 4 injuries resulted in ≥ 30 days of time-loss (7.4%). After adjusting for age, a previous history of severe injury and longer experience of beach soccer were significantly associated with injury risk.

Conclusion: The time-loss injury rate in this study was comparable to the rates reported during the matches of soccer or futsal tournaments. However, a greater incidence of foot/toe injury and lacerations/abrasions as well as a lower incidence of ankle injury distinguished beach soccer from soccer and futsal, possibly related to the specific playing conditions of being barefoot on a sand surface.

Keywords: football; soccer; epidemiology; athletic injuries; beach soccer; Japan

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Beach soccer is a variant of soccer and a relatively new sport that started in Brazil in 1995.⁷ Matches are played by 2 teams, each consisting of 5 players including a goal-keeper (Table 1). A match consists of 3 equal periods of 12 minutes, and the game stops once the ball is out of bounds. Beach soccer differs from soccer or futsal in its playing surface; the sand surface enables players to perform acrobatic moves. In addition, shoes are not allowed in beach soccer; however, elastic binding around the ankles or feet and plastic eyewear may be permitted for protection.⁸⁻¹⁰

Following the first Fédération Internationale de Football Association (FIFA) Beach Soccer World Cup (Rio de Janeiro, Brazil) in 2005, the sport has gained popularity worldwide. However, little is known about the frequency and characteristics of injuries during beach soccer games. To date, only 2 studies have reported the incidence rate of injuries in beach soccer games: Mina et al¹⁸ described the characteristics of injuries during Iranian Women Beach Soccer Premier League in 2010-2011, and Al-Shaqsi et al¹ reported the incidence of injury during the second Asian Beach Games. However, neither study followed injured

TABLE 1
Soccer, Futsal, and Beach Soccer Rules⁸⁻¹⁰

	Soccer	Futsal	Beach Soccer
Ball weight, g	410-450	400-440	400-440
Ball size, cm	68-70	62-64	68-70
Pitch dimensions, m	90-120 × 45-90	38-42 × 18-25	35-37 × 26-28
Surface	Natural or artificial surface	Artificial turf	Sand, at least 40 cm deep
Goal dimensions, m	7.32 × 2.44	3.0 × 2.0	5.5 × 2.2
Footwear	Allowed	Allowed	Not allowed
Shin guards	Allowed	Allowed	Not allowed
Players per team	11	5	5
Substitute players ^a	3	9	5
Match duration	2 periods of 45 min, running time	2 periods of 20 min, playing time	3 periods of 12 min, playing time

^aFor official competitions organized under the auspices of FIFA.

players posttournament and therefore could not estimate time-loss injury rates or injury severity.

The goals of this study were to describe the incidence and pattern of injuries in beach soccer as well as to explore individual risk factors associated with injury during the Japanese National Championships in 2013 and 2014.

METHODS

Study Population

The Japanese Football Association started the Men's National Beach Soccer Championship in 2006. The teams that win the regional championship are invited to participate in the national championship, and there is no restriction whether a player is amateur or professional. This is a prospective cohort study assessing the frequency of injuries during the 8th and 9th Japanese National Beach Soccer Championships at Tropical Beach in Okinawa (October 18-20, 2013) and Shibukawa beach in Okayama (September 13-15, 2014), respectively. All players registered for the tournament were eligible for the study. At the prematch meeting, we explained the study purposes to coaches and players of all teams. After written informed consent, we administered a standardized baseline questionnaire to all players. The questionnaire included age, playing position, dominant leg, height, weight, experience in soccer/futsal/beach soccer, amount of training during the previous week, and past history of injuries. The study was approved by the ethics committee at the Urasoe General Hospital, Okinawa, Japan, as well as by the Japan Football Association, and conducted according to the guidelines of the Declaration of Helsinki.

Injury Reports

A medical team from the Urasoe General Hospital and Rokuto Orthopaedics Clinic consisting of 1 sports physician, 1 junior resident, 6 sports physical therapists, and 5 sports trainers assisted all games throughout the tournaments from an on-site aid station. Whenever a player visited the aid station with an injury, the same sports

physician examined and recorded the injury using the standard FIFA report form.¹¹ An injury was defined as any physical complaint sustained by a player that resulted from a beach soccer match.¹¹ Injuries incurred during training, illness such as heat injuries, or mental complaints other than physical complaints were also recorded, although these were not considered injuries.

Match Exposure Time

To investigate associations between individual risk factors and incidence of injuries, match exposure needs to be recorded on an individual basis.¹¹ However, as the number of substitutions is unlimited in beach soccer, there is no official record of playing time for each player. Therefore, the games were recorded using handheld video cameras (HDR-CX180; Sony), and subsequently, 1 physical therapist and 1 sports trainer independently counted the exposure of each player through video review. Any discrepancy was resolved by reviewing the video again by both study staff. Foul-related injuries were established as such if they occurred as a result of a foul as defined by the match referee.

Injury Follow-up

One week after the tournament, all players with injuries were contacted by phone by the sports physical therapists. We recorded the number of days that had elapsed from the injury date to the date of full participation in team training as *injury severity*.¹¹ We also recorded the diagnosis of the injury if the participant visited an orthopaedic clinic after the competition. If the player was still not cleared for training due to the index injury after 1 week, contact was repeated 4 weeks after the tournament and then every 3 months until the player could return to full participation.

Statistical Analysis

Baseline characteristics of the players were presented as proportions for categorical variables and medians and ranges for continuous variables. Incidence rates of overall injury and traumatic, overuse, and time-loss injuries were calculated by dividing the number of events by total match

exposure time in 1000 player-hours. A *traumatic injury* was defined as “an injury resulting from a specific, identifiable event.”¹¹ When there was no identifiable event responsible for an injury, this was categorized as an overuse injury. A *time-loss injury* was defined as “an injury that resulted in a player being unable to take a full part in future training or match play.”¹¹ Those lost to follow-up were excluded from the total exposure time of the time-loss injury rate. The incidence of illness other than physical complaints was also reported. Circumstances (time during the match and location in the field of play) and characteristics of injuries (body part, type, mechanisms, and severity) were described. Multiple injuries sustained by a player in a single event were recorded as 1 injury with multiple diagnoses. The associations between individual factors (age, position, previous experience of beach soccer and soccer, amount of training, history of injuries) and the incidence of injuries were assessed by fitting Poisson regression models. To account for the multiple events within the same individual, generalized estimating equations with an exchangeable correlation structure were computed. Factors associated with the injuries in a crude analysis ($P < .05$) were adjusted for age. All analyses were conducted using STATA 11.0 (Stata Corp).

RESULTS

Baseline Characteristics

A total of 341 players (170 players from 16 teams in 2013 and 171 players from 16 teams in 2014) were registered for the tournaments, and all agreed to take part in the study (Figure 1). The baseline characteristics of the players are presented in Table 2. Age ranged between 13 and 48 years (median, 28 years) and the median length of beach soccer, soccer, and futsal experience was 3, 15, and 2 years, respectively. Of the 341 players, 36% reported having had a severe injury resulting in hospital admission or surgical repair (knee, 31.8%; foot/toe, 10.8%; ankle, 8.9%), and 39% reported at least 1 time-loss injury in the preceding year (foot/toe, 28.9%; ankle, 17.3%; knee, 15.7%). Fifty-two players (15%) had a history of concussion.

Injury Incidence

A total of 54 games were played during 6 days, corresponding to 324 player-hours of match exposure, during which 54 players made 66 visits to the aid station (Figure 1). After excluding 7 injuries occurring during training between matches and 1 episode of heat exhaustion, 58 injuries were recorded in 53 athletes, resulting in an injury incidence of 179.0 (95% CI, 138.4-231.6) per 1000 player-hours.

Location and Type of Injuries

Table 3 describes 63 diagnoses of 58 injuries, which included 4 injuries with multiple diagnoses (3 had 2 diagnoses and 1 injury had 3 diagnoses). The foot/toe (34.9%) was the most common location of injury, followed by the lower leg (22.2%) and thigh (11.1%). Of the foot/toe injuries,

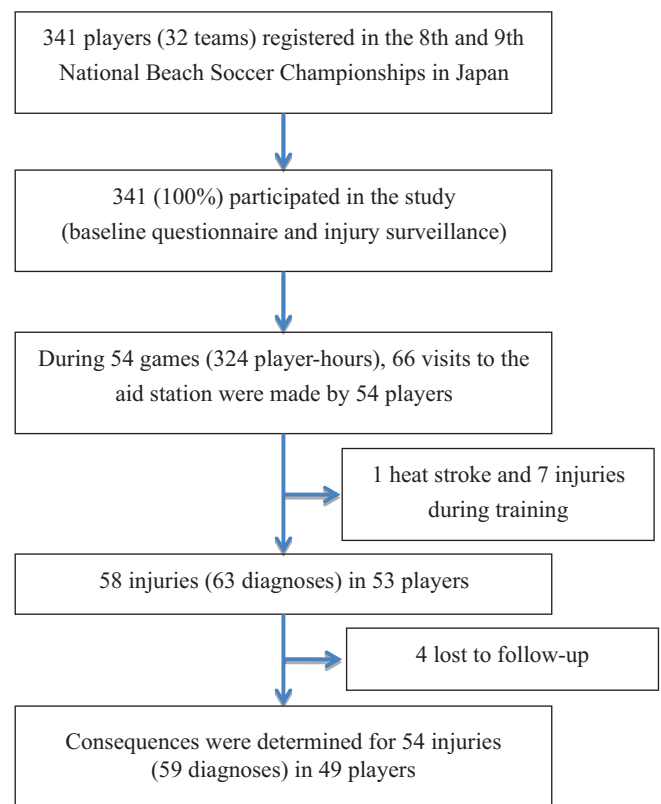


Figure 1. Flow diagram of study participants.

54.5% were to the foot, 27.3% to the hallux, and 18.2% to other toes. The most frequent type of injury was contusions (60.3%), followed by lacerations/abrasions (14.3%) and sprains/ligament injuries (6.3%). The type of injury according to the playing position is presented in Table 4.

Mechanism of Injury

Most injuries were due to trauma ($n = 53$, 91.4%), while 5 were overuse injuries (8.6%). Of the 53 traumatic injuries, the most common mechanism was contact with another player (75.5%), followed by contact with the ball (13.2%), contact with other objects (7.5%; 1 contact with the ground and 2 contact with an unknown object), and no contact (3.8%). The diagnoses of 5 overuse injuries were cartilage injuries ($n = 3$), muscle strain ($n = 1$), and lumbar disc herniation ($n = 1$). Two traumatic injuries without any contact were due to muscle strain of the thigh (1 hamstrings and 1 quadriceps). There were only 4 injuries (6.9%) related to foul play. Of the 53 traumatic injuries, 18.9% occurred in the first period of the match, 50.9% in the second, and 22.6% in the third (7.5% were unknown). Twenty-six percent (15/58) of injuries occurred in front of the goal.

Time-Loss Injuries

As 4 players were lost to follow-up (7.5%), the injury consequences were determined in 59 diagnoses of 54 injuries among 49 players (Figure 1). There were 9 time-loss

TABLE 2
Baseline Characteristics of Players and Factors Associated With Injuries

	Players (N = 341), n (%)	Injuries (N = 58), n	Incidence Rate (per 1000 Player-Hours)	Univariable Analysis			Multivariable Analysis (Adjusted for Age)		
				Rate Ratio	95% CI	P	Rate Ratio	95% CI	P
Age, y									
13-24	95 (27.9)	16	200.0	1.00		.9 ^a			
25-30	133 (39.0)	22	164.7	0.98	0.51-1.88				
31-48	113 (33.1)	20	181.2	1.05	0.53-2.07				
Position									
Pivo	73 (21.7)	15	275.6	1.00		.5			
Ala	127 (37.7)	16	146.3	0.61	0.31-1.23				
Beque	55 (16.3)	12	212.8	1.06	0.50-2.27				
Goleiro	45 (13.3)	7	112.3	0.76	0.29-1.95				
Multiple	37 (11.0)	8	202.7	1.05	0.43-2.53				
Years playing beach soccer									
<1	47 (14)	4	117.1	1.00		.04 ^a	1.00		.02 ^a
1-4	174 (51)	27	176.4	1.82	0.54-6.22		1.88	0.55-6.36	
≥5	120 (35)	27	197.5	2.64	0.78-9.00		3.03	0.90-10.2	
Years playing soccer									
1-4	17 (5)	2	134.2	1.00		.5			
5-14	131 (38)	21	181.3	1.36	0.35-5.35				
≥15	193 (57)	35	181.1	1.54	0.40-5.93				
Training in the previous week, h									
<5	93 (28)	17	210.9	1.00		.8			
5-9	105 (31)	16	199.9	0.83	0.42-1.65				
≥10	139 (41)	23	143.3	0.91	0.47-1.75				
History of injuries resulting in hospital admission or surgical repair									
0	218 (64)	33	166.0	1.00		.04 ^a	1.00		.04 ^a
1	93 (27)	13	137.8	0.92	0.50-1.70		0.92	0.50-1.70	
≥2	30 (9)	12	388.6	2.64	1.38-5.05		2.65	1.39-5.04	
History of concussion									
No	287 (85)	45	166.8	1.00		.1			
Yes	52 (15)	13	248.4	1.59	0.85-2.99				

^aTest for linear trend.

injuries (incidence, 28.2/1000 player-years; 95% CI, 14.7-54.1). Length of days lost ranged from 3 to 240 days (<1 week, n = 1; 1-4 weeks, n = 3; 1-3 months, n = 4; >3 months, n = 1). Of 9 time-loss injuries, 4 were at the foot/toe (3 contusions and 1 navicular bone fracture), 3 at the thigh (2 contusions and 1 muscle strain of rectus femoris), 1 at the knee (medial collateral ligament [MCL] injury), and 1 at the lower leg (contusion) (Table 3). The most severe injury (240 days of time-loss) was an MCL injury that occurred in a player who had rupture of the anterior cruciate ligament (ACL) on the same knee 2 months before the tournament. He did not have surgical treatment for the ACL injury; however, he protected the knee with taping. A participant with a concussion during the tournament was told to not return to play for at least 7 days; however, he participated in the game on the next day against medical advice.

Factors Associated With Injury

Multivariable analysis identified that longer experience of beach soccer and previous history of severe injury that

resulted in hospital admission or surgical repair were associated with increased rate of injuries during the tournaments after controlling for age (Table 2). Using <1 year of experience of beach soccer as the reference, the adjusted rate ratios were 1.88 (95% CI, 0.55-6.36) in participants with 1 to 4 years of experience and 3.03 (95% CI, 0.90-10.20) in those with ≥5 years of experience (test for linear trend, $P = .02$). Similarly, using no history of severe injury as the reference, the adjusted rate ratios were 0.92 (95% CI, 0.50-1.70) in players with 1 previous episode of the severe injury and 2.65 (95% CI, 1.39-5.04) in those with ≥2 episodes ($P = .04$). The following variables were not associated with injuries in the univariable analysis: age, playing position, the length of experience of soccer, the amount of training in the previous week, and the history of concussion (Table 2).

DISCUSSION

This is the first prospective study describing injury rates, risk factors, and injury severity during beach soccer

TABLE 3
Consequence of Injuries by Location and Type (n = 63)^a

Location and Type	All Injuries	Time-Loss Injuries	Location and Type	All Injuries	Time-Loss Injuries
Head/neck			Thigh		
Total	4 (6.4)	0 (0)	Total	7 (11.1)	3 (33.3)
Concussion	1	0	Strain	2	1
Strain	1	0	Contusion	5	2
Laceration	1	0	Knee		
Dental injury	1	0	Total	4 (6.3)	1 (11.1)
Rib			Ligament	2	1
Total	1 (1.6)	0 (0)	Cartilage	1	0
Contusion	1	0	Contusion	1	0
Low back			Lower leg		
Total	5 (7.9)	0 (0)	Total	14 (22.2)	1 (11.1) ^b
Strain	2	0	Contusion	11	1 ^b
Contusion	2	0	Abrasion	3	0
Other	1	0	Ankle		
Shoulder			Total	1 (1.6)	0 (0)
Total	1 (1.6)	0 (0)	Sprain	1	0
Subluxation	1	0	Foot/toe		
Elbow			Total	22 (34.9)	4 (44.4)
Total	1 (1.6)	0 (0)	Fracture	1	1
Ligament	1	0	Cartilage	2	0
Forearm			Contusion	14	3
Total	1 (1.6)	0 (0)	Abrasion	3	0
Contusion	1	0	Laceration	2	0
Hand/finger					
Total	2 (3.2)	0 (0)			
Contusion	2	0			

^aResults are reported as n (%).

^bIncluding 1 injury lost to follow-up.

TABLE 4
Type of Injuries by Playing Position (n = 63)^a

	Pivo (n = 16)	Ala (n = 17)	Beque (n = 15)	Goleiro (n = 7)	Multiple (n = 8)
Concussion	0	0	0	1 (14.3)	0
Fracture	0	0	0	1 (14.3)	0
Subluxation	0	1 (5.9)	0	0	0
Ligament	1 (6.2)	1 (5.9)	0	1 (14.3)	0
Sprain	0	0	0	1 (14.3)	0
Cartilage	0	1 (5.9)	1 (6.7)	0	1 (12.5)
Strain	0	1 (5.9)	2 (13.3)	0	2 (25.0)
Contusion	13 (81.3)	11 (64.6)	6 (40.0)	2 (28.5)	5 (62.5)
Abrasion	1 (6.2)	1 (5.9)	3 (20.0)	1 (14.3)	0
Laceration	1 (6.2)	0	2 (13.3)	0	0
Dental	0	0	1 (6.7)	0	0
Other	0	1 (5.9)	0	0	0

^aResults are reported as n (%).

games. Two previous studies that have reported the incidence rate of injuries in beach soccer games did not provide any follow-up of the injured players posttournament and therefore could not estimate time-loss injury rates or injury severity.^{1,18} Moreover, we also measured individual exposure using video recordings, which enabled us to examine associations between individual risk factors and incidence of injuries.

To elucidate characteristics of injuries associated with beach soccer tournaments, we compared injuries during the beach soccer tournaments with those during soccer or futsal tournaments in adult men (Table 5).^{1,13,14,23} The incidence of foot/toe injuries in beach soccer (45.8-67.9/1000 player-hours) was high compared with that in soccer (3.8-8.4) or futsal (10.7) (Table 5). Hallux injuries were a particular problem noted in our study, probably related to

TABLE 5
Injury Rates in Adult Men During Soccer, Futsal, and Beach Soccer Tournaments^a

	Soccer			Futsal	Beach Soccer	
	Junge and Dvorak ¹⁴	Junge and Dvorak ¹⁴	Yoon et al ²³	Junge and Dvorak ¹³	Al-Shaqsi et al ¹	Current study
Tournament	World Cup	Olympic Games	Asian Cup	World Cup	Asian Games	Japanese Championships
Year	1998-2010	2000-2012	2000	2000-2008	2010	2013-2014
Overall	69.8	68.9	139.5	195.6	109.4	179.0
Incidence of injuries ^b						
Incidence of time-loss injuries ^b	45.1	31.3	49.3	79.4	Not reported	28.2
Three most frequent locations of injury (%)	Thigh (19.9) Lower leg (15.5) Ankle (14.2)	Head/neck (17.2) Lower leg (16.6) Thigh (15.9)	Ankle (20.3) Knee (18.8) Lower leg (16.5)	Knee (15.8) Thigh (13.9) Head/neck (12.7)	Foot/toe (37.8) Thigh (24.3) Trunk (13.5)	Foot/toe (34.9) Lower leg (22.2) Thigh (11.1)
Incidence of foot/toe injuries ^b	3.8	4.0	8.4	10.7	45.8	67.9
Incidence of ankle injuries ^b	9.1	8.5	28.3	23.7	3.3	3.1
Most frequent type of injury (%)	Contusion (47.0)	Contusion (58.0)	Contusion (62.4)	Contusion (43.6)	Strain (21.6)	Contusion (60.3)
Incidence of laceration/abrasion ^b	3.9	7.1	6.3	4.7	16.3	27.8
Foul-related injury, %	31.4	41.6	Not reported	29.5	0	6.9

^aData on soccer, futsal, and Asian Games beach soccer were extracted from the previous literature.

^bAll injury incidence data are presented per 1000 player-hours.

striking the ball while barefoot.² Similarly, the frequency of lacerations/abrasions in beach soccer (16.3-27.8/1000 player-hours) was higher than that in soccer (3.9-7.1) or futsal (4.7) (Table 5). The majority (88.9%) of skin lesions in the current study occurred in the lower leg or foot/toe, suggesting that the absence of footwear might have increased the risk of lacerations/abrasions.²¹ In contrast, ankle injury—one of the most frequent locations of team sports injury^{15,19,22}—was found to be uncommon in beach soccer (3.1-3.3/1000 player-hours) compared with soccer (8.5-28.3) or futsal (23.7) (Table 5). A similar difference in the frequency of ankle injury has been observed between beach volleyball and indoor volleyball.³ The lower rate of ankle injury, especially ankle sprains, in barefoot beach sports may be explained by its specific playing condition, not wearing shoes, and landing in soft sand.³

Only 4 injuries (6.9%) occurred as a result of a foul play in this study. In the Asian Beach Games, none of the beach soccer injuries was secondary to a foul.¹ In contrast, a substantial number of injuries resulted from foul plays in soccer (31.4%-41.6%) or futsal (29.5%) (Table 5). The average number of fouls per match during the tournaments in this study (11 fouls/match) was lower than the number reported in the soccer World Cup (35 fouls/match).²⁰ Based on these observations, however, we cannot provide a robust conclusion that beach soccer is a safe and fair sport with few foul-

related injuries as we do not know whether the decisions made by the referees in the current study were made according to the laws of the game.

Not surprisingly, a previous history of severe injury was associated with a greater risk of injury during the current tournaments, as has been reported by Dvorak et al.⁵ We also found that longer experience of beach soccer was associated with higher injury risk. We do not know why, but it may be speculated that players with more experience perform more acrobatic moves or are simply more involved during games and therefore are at greater risk.¹⁸ Skill level is closely related to injury risk; however, its direction (high-level player has higher risk or vice versa) has been controversial in soccer studies.^{4,12,19}

Although we used standardized data collection procedures by FIFA,¹¹ the reporting system in this study (ie, through a study physician at the aid station) differed from that often used in other studies (ie, through a team physician).^{6,16,17} This might have resulted in overestimation of injury risk compared with other studies. The sample size in this study was relatively small, and the participants may not be representative of all beach soccer players in Japan. We made a comparison between beach soccer and soccer or futsal to understand the characteristics of beach soccer injuries. However, we acknowledge that care must be taken with interpretation because not only playing condition but also rules and refereeing differ between these.

The time-loss injury rate in this study was comparable to the rates reported during the soccer matches or futsal tournaments. However, we found that the incidences of foot/toe injury and lacerations/abrasions are particularly high during beach soccer tournaments. The high risk of lacerations/abrasions in the current study adds emphasis to the importance of keeping the ground surface in good condition and respecting the FIFA beach soccer laws⁸: “The surface must be sifted until suitable for play, must not be rough or contain pebbles or any other dangerous elements.” Given the growing popularity of beach soccer, more research is needed to deepen our understanding of beach soccer injuries, which may serve as a basis to develop injury prevention programs.

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