Original Article

Match Characteristics of the Incidents in Elite Beach Soccer Tournament

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Objective: This prospective cohort study investigated the characteristics of injury-risk situations during elite beach soccer using video-based football incident analysis [FIA].

Materials and Methods: Videotapes were prospectively collected from the Beach Soccer Tournament at the 4th Asian Beach Games. When a match was stopped because of the injury, the characteristics of the playing situation that caused the incident were collected using FIA and analyzed.

Results: From 27 matches with total of 993 minutes of play, 255 incidents were recorded. The rate of incidents was 4.7 per team per match or equivalent to 1,541 incidents per 1,000 player-hours. Goalkeepers were more susceptible to injury than the other players. Most incidents in playing field, ball procession, team's action, and referee' decision occurred most in the defensive playing field (56.6%), during defensive ball procession (64.7%), resulting from dribbling and tackling (29.0%), and related to foul play (69.0%), respectively. Short pass was the most common form of team action before the incident (34.1%). The most common attack type at the time of incidents was the breakdown attack (42.4%). More incidents occurred involving the opponents unintentionally (95.0%). The lower leg was the most common body part involved in an incident (25.1%, $p<0.05$).

Conclusion: Beach soccer had high rates of the incidents, with unique match characteristics. Strategies to reduce incidents that lead to injury specific to beach soccer are needed.

Keywords: Beach soccer, Football, Incident, Soccer

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Beach soccer started in Brazil in the 1930s[1] and has become a popular sport for both amateur and professional levels in the past 10 years. The first FIFA Beach Soccer World Cup was held in 2006, with 44 participating nations in the qualification rounds. By 2017, the participating nations had increased to 83 in numbers. Despite its growing popularity, only few studies assessed the injuries encountered in beach soccer[2,3].

Beach soccer is a competition between 2 opposing teams (5 players in each) and takes total duration of 36 minutes which is split into three 12-minute periods. The main difference between beach soccer and football (soccer) or futsal is that the game is run on soft sand with the players not allowed to wear shoes or any other foot accessories other than ankle supports and plastic glasses[4,5].

The chances of injury in beach soccer differ from those of football (soccer) due to many reasons. It is a contact sport and is often played in beach areas with high temperatures and high humidity. Thus, The incidence of injuries in beach soccer was found to be 2 to 3 times higher than that found in football (109 to 179 vs. 51 to 81 per 1,000 player-hours)[6]. The injuries in beach soccer were rather comparable to futsal which also has higher rate (168 to 236 per 1,000 player-hours) of injuries than football[7,8]. To prevent or reduce the injuries, a better understanding of the causes and mechanisms, and of the contexts in which they occur is needed[9-12].

Previous studies of injuries were based on information recalled by players and staff. Hence, the

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data were quite subjective and not reliable because some athletes were sometimes unable to recall the exact cause of the injury. The injury prevention plans could not appropriately made from these inaccurate data. Detailed information about potential injury risks and incidents could be improved by a more objective data from a video recording.

Andersen et al developed a video-based football incident analysis [FIA] method[12], which can be applied to analyse the context of incidents during matches, injured players and teams, playing situation and location of the incident on the pitch. Many studies using video-analysis to determine risky actions and mechanisms underlying injuries were conducted in various sports, including football, volleyball and skiing[13-19]. It allowed observation of the mechanisms of anterior cruciate ligament injury in handball and the ankle sprain in volleyball[15,17,18]. Furthermore, a video analysis could also detect of the incidents resulted from foul play[20].

Advantages of the FIA method are that the coaches can utilize the video for match analysis in a faster manner than other methods[13]. A better understanding the causes of incidents can guide to the more appropriate intervention to prevent and reduce the injuries[12,13,21]. To date, no studies have applied video data analysis tools in beach soccer. The aim of the present study was to analyse the context and mechanism of incidents during the Beach Soccer Tournament at the 4th Asian Beach Games using the FIA tool.

Materials and Methods

The tournament

This prospective study was approved by the Ethical Committees of Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Thailand. Data were taken from the VDO files which recorded every match of the Beach Soccer Tournament at the 4th Asian Beach Games, a major international sporting competition hosted by Phuket, Thailand, during 14 to 23 November 2014. The tournament involved 129 international male athletes from 13 countries.

Football incident analysis

Data were collected anonymously after permission from the organizing committees of the tournament. Two physicians (CD, AS) reviewed the video files. The incident was analysed using the FIA video-based method[12]. The incident was defined as a situation in which a match stopped for 15 seconds or more because one or more players lay down on the field and appeared to be in pain or received medical treatment[12]. Each incident was classified according to 19 parameters of playing situations: (1) the exposed player (including the playing position, action with the ball, ball possession, movement direction, individual action with the ball and the player's movement intensity; (2) the injured team (the team's action before the incident, the player's position relative to the immediate opponent and the incident risk action); (3) the opposing team (the degree of defensive team balance); (4) attack characteristics (the attack type and attacking effectiveness); (5) defensive characteristics (duel type, tackling type, ball winning, attention); (6) the playing field (localisation and positioning in one-on-one situations); and (7) foul play (based on the referee's decision). These parameters were described in the previous study[12]. The details and definitions of variables are stated in Table 1.

Interobserver and intraobserver reliability

Two observers (CD, AS) independently identified the incidents from the random matches to determine the reliability of FIA in beach soccer VDO. Interobserver reliability and intraobserver reliability were obtained for each variable and overall assessment. Interobserver reliability was obtained from the percentage of agreement between the assessments of the two observers. Intraobserver reliability was obtained from the percentage of agreement between the first and second assessment (re-assessed the VDO one week later) of one observer (AS).

Statistical analysis

Incident rates were expressed as number per team per match, per player-hours of match exposure and per 1,000 player hours. Player hours were calculated by multiplying the number of incidents by five players by 36/60 h. Reduced numbers of players on the field were not taken into account in this study because the exclusion of a player is an uncommon event. Incidents per 1,000 player hours were calculated by number of incidents multiplied by 1,000 divided by total player hours. For incident rates, 95% CIs were calculated as the incident $\pm$1.96 times the incidence divided by the square root of the number of injuries. Statistical methods applied were frequencies, cross-tabulations and χ^2 test. Significance was accepted at the 5% level.

K correlation coefficients were calculated for interobserver and intraobserver reliability. Coefficients of 0.81 to 1.00 are generally interpreted as very good,

Table 1. Variables used in the football incident analysis, presented with frequency and reliability

Variables	Number (total = 255)	Percentage	Interobserver reliability	Intraobserver reliability
Exposed player				
Playing position			1.00	1.00
Goal keeper	79	31.0		
Defender	65	25.5		
Midfielder	54	21.2		
Striker	57	22.3		
Action with the ball			0.74	0.73
Attack ball possession				
Dribbling	39	15.3[a]		
Shooting	12	4.7		
Flicking	10	3.9		
Screening	10	3.9		
Heading	7	2.7		
Turning	5	2.0		
No action with the ball	3	1.2		
Passing	2	0.8		
Tackling	2	0.8		
Defense ball possession				
Tackling	35	13.7[b]		
Goal action	28	11.0		
No action with the ball	27	10.6		
Screening	19	7.5		
Receiving the ball	17	6.7		
Cleaning	13	5.1		
Ball to body accident	8	3.1		
Flicking	7	2.7		
Heading	6	2.4		
Blocking	5	1.9		
Player role			1.0	1.0
1st defender: pressing defending player on the right side of the ball	167	65.5		
Other defender: all the remaining players of the defending team	9	3.5		
1st attacker: player with the ball on the attacking team	79	31.0		
Other attacker: all the remaining players of the attacking team	0	0		
Movement direction			0.82	0.83
Forward	109	42.8		
Sideward	35	13.7		
Backward	78	30.6		
No move	33	12.9		
Intensity			0.74	1.00
High intensity: including sprinting and moderate intensity running	150	58.8		
Low intensity: including jogging, walking and standing	105	41.2		
Ball possession			1.00	1.00
Attack: a team is in possession	90	35.3[c]		
Defense: the opposing team is in possession	165	64.7		
The injured team				
Attention			0.74	0.84
Duelist: player concentrates on immediate opponent	13	5.1		
On the ground: ball in contact with the playing surface	138	54.1[d]		

Table 1. cont.

Variables	Number (Total = 255)	Percentage	Interobserver reliability	Intraobserver reliability
In the air: ball at head height and upwards	69	27.1		
Ball between head height and playing surface	25	9.8		
Near (in the vicinity of the ball)	0	0		
Further away (not in the vicinity of the ball)	10	3.9		
Team action before incident			0.86	0.86
Long pass	69	27.1		
Short pass	87	34.1		
Flick	30	11.8		
Cross	15	5.9		
Deflection	54	21.1		
Type of incident risk action			0.86	0.86
Against 1st attacker towards: attempt to stop a player with the ball from penetrating a space behind the last defender	66	25.9		
Against 1st attacker elsewhere	57	22.4		
Against 1st defender	90	35.3		
Action away from the ball	42	16.4		
Actions against other players: 2nd and 3rd attackers and defenders	0	0		
Defensive characteristics				
Duel type			1.00	1.00
Heading	18	7.1		
Tackling	78	30.6		
Screening	36	14.1		
Running (pushing, kicking, obstruction, stepping, collision)	72	28.2		
Not in duel: without involving opponent player(s)	51	20.0		
Tackling type			1.00	1.00
Being tackled: involving a player that is being tackled by the opponent	167	65.5		
Not being tackled: involving attacking player that is not being tackled	1	0.4		
Tackling: involving a player that is tackling the opponent	21	8.3		
Not tackling: involving defending player that is not tackling	66	25.8		
Ball winning			0.73	0.87
At the moment of ball winning: attempting to regain possession (1st defender)	138	54.1		
After ball winning (up to 5s): immediately after regaining possession (1st attacker)	48	18.8		
After 2nd ball: regaining ball after deflection from opponent player (1st attacker)	15	5.9		
Not ball winning situations: attempting to maintain possession (1st attacker) and incident away from the ball	54	21.2		
Playing field localization			0.87	1.00
Defensive third: the defending third of the field	144	56.5[e]		
Midfield zone 1: the first half of the middle third, adjacent to the defensive zone	51	20.0		
Midfield zone 2: the second half of the middle third, adjacent to the attacking zone	33	12.9		
Attacking third: the attacking third of the field	27	10.6		

Table 1. cont.

Variables	Number (Total = 255)	Percentage	Interobserver reliability	Intraobserver reliability
Position in situation			0.78	0.78
One on one situation	168	65.9		
Not one on one situation	87	34.1		
Foul play				
Referee's decision			1.00	1.00
Free kick for	123	48.2		
Free kick against	13	5.1		
Yellow card	35	13.7		
Red card	5	2.0		
No foul called	79	31.0		
After 2nd ball: regaining ball after deflection from opponent player (1st attacker)	15	5.9		
Not ball winning situations: attempting to maintain possession (1st attacker) and incident away from the ball)	54	21.2		

[a] *p*-value <0.05, comparing dribbling while attacking ball possession with other action type while attacking ball possession
[b] *p*-value <0.05, comparing tackling while defending ball possession with other action type while defending ball possession
[c] *p*-value <0.05, comparing attack ball possession with defense ball possession type
[d] *p*-value <0.05, comparing on the ground with other attention type
[e] *p*-value <0.05, comparing defensive third with other Localization type

0.61 to 0.80 as good, 0.41 to 0.60 as moderate, 0.21 to 0.40 as fair, and less than 0.20 as poor.

Results

Incidents

There were 27 matches during the tournament and their videos were studied. The total match time was 993 minutes, equivalent to 165.5 player-hours of match exposure. The video analysis identified 255 incidents. The incidents rate was 1,541 per 1,000 player-hours (95% CI 1,352 to 1,730) or 4.7 incidents per team per match (95% CI, 4.2 to 5.3).

Football incident analysis

The interobserver reliability was good for 6 variables and very good for 13 variables. The intraobserver reliability was good for 2 variables and very good for 17 variables. Overall the inter-observer reliability and intra-observer reliability were very good (0.87 and 0.93 respectively).

The player position which incited the injuries in order of frequency was goalkeeper (n = 78 incidents, 31%), followed by defender (n = 65, 25%), midfielder (n = 57, 22%) and striker (n = 55, 21%). The most common player role at the time of an incident was first defender (n = 167, 66%), followed by first attacker (n = 79, 31%). With regard to possession, 165 (65%) incidents occurred while a team was in the defending phase and 90 (35%) in the attacking phase (p<0.001). The results of variables of the FIA and their inter-observer and intra-observer reliability are presented in Table 1.

During the defending phase, tackling was the most common individual action resulting in the incidents (n = 35, 21%), followed by goalkeeping (n = 28, 17%). In the offensive phase, dribbling was the most common action (n = 39, 43%), followed by shooting (n = 14, 15%) (Figure 1). In more than half of the incidents (n = 150, 59%), the player's movement intensity was high-intensity running (as opposed to sprinting or moderate-intensity running).

For the team injury, a short pass was the most common form of action causing the incidents during defensive play (n = 54, 33.0%) and attacking play (n = 33, 36.7%) (Figure 2). The injured player was in a one-on-one situation with the immediate opponent in 168 incidents (66%).

The most common attack type at the time of incidents was breakdown attack (n = 108, 42%), followed by long attack (n = 90, 35%) and set play (n = 57, 22%). A breakdown attack or counterattack occurred when one team lost the ball and the opponent team exploited their numerical and positional advantage by attacking immediately. In most incidents, the attack was unsuccessful (n = 183, 72%).

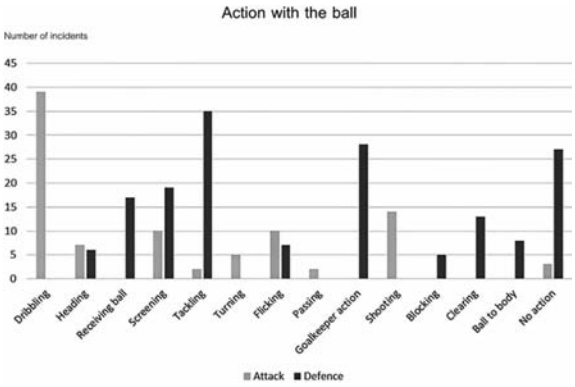

Figure 1. Number of incidents classified according to the individual player action with the ball before the incident-that is, whether this was a dribbling, heading, receiving ball, screening, tackling, turning, flicking, passing, goalkeeper action, shooting, blocking, cleaning, ball to body, or no action (n = 255).

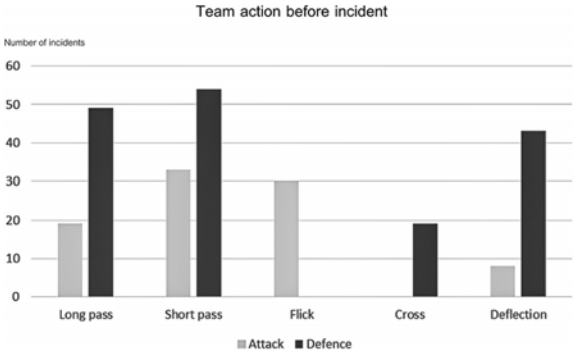

Figure 2. Number of incidents classified according to team action before incident, that is, whether this was a long pass, short pass, flick, cross pass, or a deflection (n = 255).

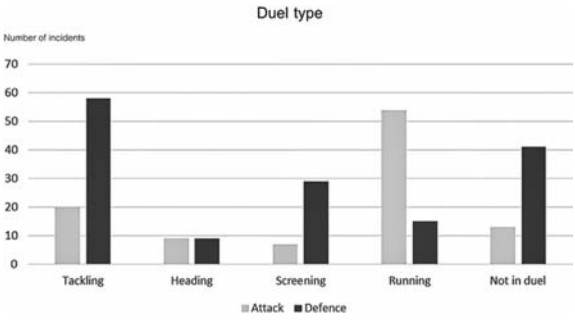

Figure 3. Number of incidents classified according to duel type-that is, whether this was a tackling, heading, screening, running, or not in duel (n = 255).

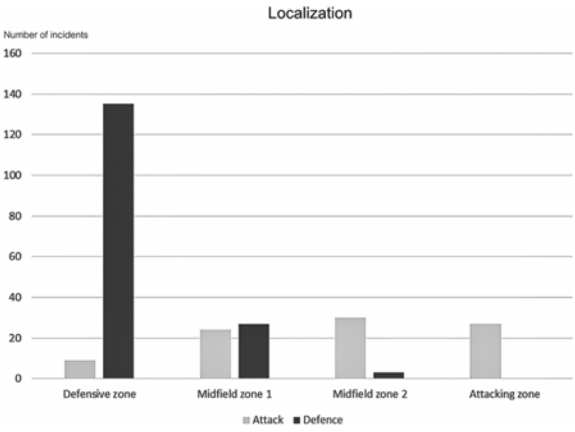

Figure 4. Number of incidents classified according to zones of the playing field - that is, whether this was a defensive zone (the defending third of the field), midfield zone1 (the first half of the middle third, adjacent to the defensive zone), midfield zone2 (the second half of the middle third, adjacent to the attacking zone), attacking zone (the attacking third of the field) (n = 255).

The most common type of duel during an incident was tackling (n = 78, 30%), followed by running duel (n = 69, 28%) and screening (n = 36, 14%) (Figure 3). Most incidents were caused by being tackled (66%) or tackling (8%). The player's attention focused on the immediate opponent was found in only 5% of incidents (n = 13). The player's attention was not on the opponent in the remaining.

Most of the incidents occurred in the injured player's defensive zone (n = 144, 56%), followed by the midfield zone 1 (n = 51, 20%), midfield zone 2 (n = 33, 13%) and the attacking zone (n = 27, 11%) ($p<0.05$) (Figure 4). Most of the incidents related to foul play (n = 176, 69%); most of these resulted in only a free kick awarded by the referee (n = 136, 53%), with a yellow card issued for 35 incidents (14%) and a red card for 5 (2%).

The lower leg was the most common body part that appeared to be in pain or received medical treatment at the time of the incident (n = 64, 25 %), followed by the thoracic/lumbar spine (n = 42, 17 %), foot/toe (n = 28, 11%), head (n = 27, 11%), thigh (n = 25, 10%), trunk (n = 21, 8%), eye (n = 20, 8%) and ankle (n = 15, 6%) ($p = 0.016$).

Discussion

The aim of the present study was to describe

the incidents that could lead to beach soccer injuries with the FIA method. Anderson et al was the first group who created FIA to determine events associated with the risk of injury in the Norwegian professional football league in 2000, using video records of 174 matches, in which 425 incidents were analysed[13].

The present study was the first study to apply the FIA method to high-risk situations in beach soccer. We found a higher rate of incidents during beach soccer than was found for football, with 255 incidents occurring in 27 matches. This was equivalent to 4.7 incidents per team per match, three to four times higher than that reported for football (1.0 to 1.6 incidents per team per match[12,14,21]. There were differences in the characteristics of the incidents between our study of beach soccer and previous studies of football. Most incidents occurred while defending in beach soccer (65%) but during attack in football (57%). The most common part of the pitch for an incident was the defensive zone in beach soccer but the mid-defensive zone in football. The most common player position to incur an injury was goalkeeper (30%) in beach soccer, but striker (30%) in Anderson's study[12] and defender or midfield player in other football studies[13,14]. There is no rule for offside in beach soccer to make the offensive game more effective, which may explain the higher number of incidents during defensive play, in the defensive zone and involving the goalkeeper.

In both beach soccer and football, tackling was the main mechanism involved in incidents during defensive play. During attack, incidents most commonly occurred while dribbling in beach soccer (43%), but with heading in football (20%)[13]. The most common team action before the incident in both beach soccer and football was a short pass (33% and 49%, respectively). Tackling was more commonly associated with incidents than were heading, screening, or running duels. This most common incidents from tackling (30%) was also found in football (46%)[12]. Most incidents were from an unintentional contact to the opponent (95%) which was similar to football (98%).

In beach soccer, the leg, thoracolumbar spine, head, thigh, foot and eye were the most common body parts involved in incidents. This was different from findings in football that knee, ankle, thigh, head, leg and back were more common[12]. It is uncommon in football for a game to stop because of an incident to the foot, eye, or back, the common body parts involved in incidents in beach soccer.

Compared to playing on a grass surface, particulate matter from the sand can easily get into the players eyes during beach soccer. This was the cause of 8.2% of the incidents overall (0.4 incidents per team per match). The most common cause was sand dust in the eyes which has not been reported. However, incidents involving the eyes (n = 20) resulted in only one actual injury (5%). Wearing glasses throughout the match could help reduce this problem. Although back problems are not common in football, they were the second most common cause of an incident in this study. The reason could be playing on sand, in which the player's foot could sink or became jammed. The upper body may then rotate and bend, applying strain to thoracolumbar area.

A limitation of the present study was the relatively small sample size, with 27 matches and 165.5 player-hours. A study that accumulated data from two or three tournaments or from a larger tournament (such as the beach soccer world cup) would allow a greater sample size. The methodology used in this study only described the context of the incident. We were unable to determine the specific mechanism of the injury, such as, joint positioning or the direction of force impact at the time of injury. From previous reports of FIA in other sports, the video analysis identified only one-half of the acute injuries[13,14]. Any non-contact injuries, minor contusions, or actions for which the match was not stopped were not evaluable resulting in an underestimation of the true incidents numbers.

Conclusion

Beach soccer has higher rates of incidents and injuries, and different context of high-risk actions from those found in football. Beach soccer has higher risks associated with the defensive phase, the defensive zone of the field, the goalkeeper player position. Dribbling and tackling were the most common actions at the time of the incident. Unlike football, the most common locations of injuries were the foot, toe, thoracolumbar area and eye. Most of the injuries were not severe.

What is already known on this topic?

Football incident analysis [FIA] is the tool for determining the types of incidents that have the potential to cause injury to the players. No researches have applied video data analysis tools to assess the injuries in beach soccer.

What this study adds?

Beach soccer is a high-incident sport. FIA can objectively analyze beach soccer incidents.

Goalkeepers have more injuries than other players. Most of the incidents occurred in the defensive playing field during defensive ball possession and resulted from dribbling and tackling. Injuries to foot and eye were also common in beach soccer.

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Potential conflict of interest

The authors declare no conflict of interest.

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