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The Epidemiology of Injuries in Contact Flag Football

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Abstract

Objective: To characterize the epidemiology of injuries in post–high school male and female athletes in the rapidly growing international sport of contact flag football.

Design: Prospective injury-observational study.

Setting: Kraft Stadium, Jerusalem, Israel.

Participants: A total of 1492 players, consisting of men (n = 1252, mean age, 20.49 ± 5.11) and women (n = 240, mean age, 21.32 ± 8.95 years), participated in 1028 games over a 2-season period (2007-2009).

Main Outcome Measures: All time-loss injuries sustained in game sessions were recorded by the off-the-field medical personnel and followed up by a more detailed phone injury surveillance questionnaire.

Results: One hundred sixty-three injuries were reported, comprising 1 533 776 athletic exposures (AEs). The incidence rate was 0.11 [95% confidence interval (CI), 0.09-0.12] per 1000 AEs, and incidence proportion was 10.66% (95% CI, 9.10-12.22). Seventy-six percent of the injuries were extrinsic in nature. Thirty percent of the injuries were to the fingers, thumb, and wrist, 17% to the knee, 17% to the head/face, 13% to the ankle, and 11% to the shoulder.

Conclusions: Contact flag football results in a significant amount of moderate to severe injuries. These data may be used in the development of a formal American flag football injury database and in the development and implementation of a high-quality, randomized, prospective injury prevention study. This study should include the enforcement of the no-pocket rule, appropriate headgear, self-fitting mouth guards, the use of ankle braces, and changing the blocking rules of the game.

INTRODUCTION

American Flag football (AFF) is a version of American football that has become very popular worldwide, and is now played in the United States, Canada, Mexico, several leading European countries, Korea, Dubai and Israel. The sport has a strong amateur following and hosts several national and international competitions. The basic rules of the game are similar to those of the mainstream football game (often called "tackle football" for contrast), but instead of tackling players to the ground, the defensive team must remove a flag or flag belt from the ball carrier ("deflagging") to end a down.[1]

Primarily because there is no dominant sanctioning organization for the sport, the game has mutated into many variations and may also be divided into "contact" or "non-contact", depending on whether or not blocking is allowed.[2]

The AFF league in Israel (AFI) was established 21 years ago in Jerusalem and has rapidly expanded to a national league consisting of more than 90 teams (with over 1000 players), including a men's, women's, high school and mixed league. The annual season runs from October to February.

The aim of this study was two-fold: I. To conduct a two-season, prospective injury-observational study. II. To recommend ideas for a future, prospective injury prevention study.

METHODS

The authors undertook a multiple database electronic search of Medline, EMBase, CINAHL and the Musculoskeletal Injuries Group's specialized register up to December 2011, using medical subject headings and free-text words. Subject-specific search was based on the terms ″American flag football″ in conjunction with ″epidemiology″. The search was restricted to studies published in English.

Post-high school male and female AFI players, who had registered to play in the AFI league over the 2007-2009 seasons, participated in the study. The attending paramedic, who had completed a full paramedic's course through the Magen David Adom organization in Israel, conducted a quick off-the-field assessment following each injury. The appropriate first-aid care was then administered. Injured players were either referred to their local physician or sent to the emergency unit of the local hospital.

All time-loss injuries were recorded on the standard league injury chart. A time-loss injury was defined as an injury that resulted in a player being unable to return to future training or match play. The term “future” referred to any time after the onset of injury, including the day of injury.[3] The charts were collected manually by the principal author (YK). A telephonic, in depth injury-surveillance questionnaire was then conducted by the same author (YK) (Fig 1.). The injury assessment questionnaire was based on the internationally accepted consensus injury surveillance questionnaire recommendations of Fuller[3] and was designed more specifically for AFF. The questionnaire was administered within a day or two following the injury. Physicians were requested to provide a specific written diagnosis or to use a sport specific injury coding system, such as the Orchard system.[4] This was done in

order to reduce the possible risk of injury misclassification. It was not possible to collect any pre-season baseline measures, since the player registration process was done via the AFI website, to which the authors had no access.

The ethics committee of the Meir Hospital, Kfar Saba, Israel gave ethics approval for the study and all players were requested to sign a consent form prior to participation. During the 2007-2009 playing seasons, data was collected, statistically analysed, results discussed and appropriate conclusions were drawn.

STATISTICAL ANALYSIS

In order to compare the differences between the injured and non-injured, as well as the male and female players, the t-test for equality of variances was employed. For the purposes of cross tabulation, the Pearson Chi-Square test was used to determine whether there was a statistically significant correlation between the variables tested (Figs. 3-5). Statistical analysis was undertaken via the use of IBM® SPSS® predictive analytics software package (version 18.0). The p-value of statistical significance was 5% or less.

RESULTS

Most players were American and Canadian pre-college students studying in Israel. They were all of similar age, socio-economic background and all played a similar number of games.

A total of 1412 players (94%) agreed to participate in the study and underwent informed consent. Nine athletes refused to participate. The remaining 71 players, although registered to play, were unable to be contacted either due to the fact that their contact details were incorrect, or that they had decided not to play in the league at all. The cohort physical characteristics, as well as injury risks and rates are represented in Table 1.

Males had statistically significant higher values than the females with regards to average weight and height ($p<0.001$). There was no statistically significant difference between the injured players and a random sample of uninjured players with respect to age, height, weight, level of play, gender and number of games played. ($p<0.001$). There were a total of 159 players injured, of which, 8 were lost to follow-up.

This study revealed that 88% of the injuries occurred in 5 anatomical regions (Fig.2). The remaining 12% ("other" in the body part list) included the ribs, neck, lower back, lower arm, pelvis, hip, thigh, foot and groin area.

Eighty-seven percent of the injuries were extrinsic in nature (environment-related)[7], whereas 13% were intrinsic (player-related).[7] Of the extrinsic injuries, 11% were due to fingers being caught in the belt/pocket or flag of the opposing player. Fifty percent were due to contact with another player, 18%, contact with the ground and 8% contact with an object (Fig.3). The term "other" in the injury type list, refers to other pathologies, including muscle

strain/rupture, tendonopathy, bursitis and meniscal tear. There was a highly significant correlation between injury type vs. injury mechanism (Fig.3) (p value < 0.001).

There was a highly significant correlation observed between body part vs. injury mechanism (Fig. 4) (p value < 0.001). In the shoulder for example, the majority of the injuries were caused by the player being knocked into or knocked by another player (Fig.4). The term "other" in the injury type list, refers to other the same pathologies as described previously. More than half of the pathologies were dislocations (Fig.5).

One-third of the knee injuries involved the knee ligaments, 83% being extrinsic in nature, and 50% were contusions and hematomas (Fig.5). There was a highly significant correlation between body part vs. injury type (Fig.5) (p value < 0.001).

Despite the fact that most of the injuries (81%) resulted from either direct contact with the ground, another player or with an object, very few players (19%) used any form of protective equipment. This was especially pertinent regarding injuries to the wrist and hand. Although more than one-third of all the injuries involved the wrist and hand, only 2 players (0.07%) had taken measures related to injury prevention in this anatomical location, and both only post-injury.

Player-position-injuries were distributed as follows: Thirty-one percent involved the defensive linemen, 24% the receiver, 15% the quarterback, 21% the offensive line (tight end and centre positions), 7% the cornerback and 2% the safety position. There was no significant correlation between injured body part vs. field position, nor between injury type vs. field position. A low correlation was observed between injury mechanism vs. field position (p=0.05). More than 70% of the injuries reported were either described as moderate (8-28 days before returning to playing) or severe (> 28 days before returning to playing).[3]

DISCUSSION

This is the first prospective study evaluating the epidemiology of both male and female sport injuries in AFF. The published literature regarding flag football was found to be very limited, despite the sport's growing popularity in so many countries. There have been no published studies that presented specific flag football mishap or injury prevention programs. There were however, two published articles related to injuries in flag football and both were epidemiological studies.[5,6]

The first was a prospective observational study of female flag football injuries, in which there were 114 reported injuries.[5] Thirty-nine percent occurred in three anatomical regions: The fingers/wrist, 16% the knee and 8% the ankle. Collisions with other players and objects resulted in 64% of these injuries. Offensive ball handlers (running backs and receivers) had the greatest probability of being injured. The authors did not make any recommendations for the prevention of injuries.

Although some of the injury statistics were similar to the authors' observational study, the study results may not necessarily be representative of AFF, as female flag football is known to be less aggressive than the male version.[8] An additional difference between male and female leagues is that blocking is not permitted in the latter, which significantly reduces

player-on-player contact and therefore, may have a significant impact on the epidemiology of the injuries.

The second and most recent article was a retrospective, descriptive report consisting of data that was derived from safety reports obtained from the USAF (United States Air Force) Ground Safety Automated System. The authors suggested strategies to prevent possible injuries for some of the eight mechanisms of injury identified in their manuscript. The criterion used to define an injury was based on one lost workday, as opposed to the more widely accepted criterion, which was the inability to continue to play for at least one game.[3] Nonetheless, some of their data (anatomical regions injured and percentage of injuries related to contact with another player and/or the ground), were very similar to the results of the authors' observational cohort.

The incidence rate in the present observational cohort was significantly lower than in other high-contact sports. In basketball for example, the injury rate has been reported to be 1.94 per 1000 athletic exposures (AEs) in high school leagues[9], whereas it was found to be 2.39 per 1000 AEs in high school soccer.[10] This may be explained by the fact that AFF is a non-tackle sport, with less contact between players than other sports.

As the game of AFF involves "deflagging" and blocking is permitted with the hands, the anatomical distribution of injuries is very different from other upper limb, ball-playing sports. In the present study, the hand and wrist comprised 30% of the injuries while 13% were ankle injuries. In basketball for example, arm/hand injuries comprised only 9% of the injuries, while ankle/foot injuries comprised 40% of reported injuries.[9]

Nearly 40% of all hand/finger injuries (which made up 30% of all total injuries) were a direct result of fingers being caught in the opposing player's pants pockets. This information was extracted directly from the detailed injury questionnaire. Most players in this study wore pants with pockets, even though this violates International Flag Football Rules[2]. The authors therefore recommend, as do both previously cited studies in this article[5,6], that coaches, team captains, referees and management of AFF take a more active and aggressive role in enforcing the no-pocket rule.

Seventy-four percent of the head/face injuries were contusion-type injuries. Recent investigations have suggested that a protective, but not preventive, effect may be afforded by mouth guard use in rugby players and customized mandibular orthotic use in football players.[11] Mouth guards in particular have been shown to prevent oral and tongue injuries and may reduce the severity of concussions.[12,13] Very few players in the study cohort used them, despite the fact that their usage is an obligation according to International Flag Football Rules.[2] It is imperative that coaches, team captains, referees and management of AFF take a greater role in ensuring that all players use an intra-oral mouthpiece of a visible colour.[2] It has been suggested that the use of headgear in soccer players may reduce the incidence of concussions.[13] Following discussion with coaches and players in the AFI, it was evident/decided the use of headgear in flag football would more than likely be unsuccessful, despite its potential for reducing head injuries. The view is that flag football is a non-tackle sport and therefore players choose this sport in order to avoid wearing protective headgear.

There is some debate in the literature whether knee braces play a significant role in preventing knee injuries. The prophylactic use of knee braces in sports to prevent knee ligament injury remains controversial. Rishiraj and colleagues[14] have suggested that this inconsistency in the literature may be related in part to a fear of performance hindrance that has led to poor knee-brace compliance. Conversely, neuromuscular preventative programs have been shown to reduce the incidence of non-contact knee injuries.[15,16,17,18] In this study, 76% of the knee injuries were as a result of direct contact with the ground or with another player (Fig.4.) Neuromuscular preventative programs would therefore not be highly effective in injury reduction in this cohort.

Fourteen percent of all the injuries in the study cohort were to the ankle. Ninety-five percent of them were ligamentous in nature and 5% of them were fractures (Fig.5). Ankle braces have proven to be successful in significantly reducing ankle injuries in sport, primarily in those players with recurrent sprains.[19,20,21] Very few players in the study cohort used them. All AFF players, and especially those with recurrent sprains, should consider the use of ankle braces in order to reduce the incidence of ankle sprains. It is additionally advisable for them to and to undergo rehabilitation following previous injuries.

As reported previously, most of the shoulder injuries were a result of player-on-player contact. In a recent study, [22] very similar percentages to this study were reported. The authors concluded that although dislocation/separation injuries represent a relatively small proportion of all injuries sustained by high school student-athletes, the severity of these injuries indicates a need for enhanced injury prevention efforts. Other than changing game rules to reduce the incidence of player-on-player contact, previous attempts to reduce the impact of shoulder injuries by the use of pads, have proven unsuccessful. The pads appear to "bottom out" under higher-impact loads and therefore offer little protection when the athlete may need it most[23].

Four (2.6%) of the observed injuries were concussions. There have been very little data published describing how and by whom sport-related concussions are diagnosed and managed. Traditionally, on-field signs and symptoms included confusion, loss of consciousness, posttraumatic amnesia, retrograde amnesia, imbalance, dizziness, visual problems, personality changes, fatigue, sensitivity to light/noise, numbness, and vomiting.[24]

In this study, any of these symptoms, that prevented the player from returning to the same game, was defined as a concussion.

The highest prevalence of injuries involved players at the positions of the defensive line (26%) and wide receiver (30%). This may be due to the fact that these positions involve a higher level of physical contact than others. The objective of the defensive lineman position is to reach the quarterback (QB) as quickly as possible, to prevent or obstruct a pass. The wide receiver's objective is to get past the defensive cornerback, in order to be open to receive a pass. The cornerback is allowed to push the wide receiver only within the first 4.5 metres past the line of scrimmage. This puts the wide receiver on the receiving end of physical contact.

Although AFF is not a tackle sport (rather a contact sport), certain types of blocking are allowed. While blocking to the back, face or holding is prohibited, blocking to the body and to the hands is permissible.[2]

The high number of moderate to severe type-injuries, as well as their high injury incidence rate, reflects the high degree of physical contact in this allegedly "non-tackle", yet contact sport.

Limitations of the study included the possibility of underreporting of injuries by the players themselves, as well as the refusal of some to comply with the questionnaire. The study included a specific-age population (pre-college male and female students) and therefore the possibility exists that the injury rate may be higher in an older athletic population. Although a telephonic, in-depth questionnaire was conducted by the same author within a day or two following the injury, there were cases where the player's condition necessitated a follow-up medical investigation, and therefore a final diagnosis was only made 7-14 days post-injury. Although the authors felt that this time period was short enough that players would not suffer from recall bias, the possibility still existed. Previous injury information was collected; however, the side of the body that the injury occurred on was not recorded, leaving the possibility that a previous injury could confound the results.

CONCLUSION

Contact flag football results in a significant amount of moderate to severe injuries. The high incidence of injuries to the hand, head and face, differentiate injuries in contact flag football from other contact sports. These data may be used in the development of a formal AFF injury database, as well as in the development and implementation of a high-quality, randomized, prospective injury prevention study. This study should include the enforcement of the no-pocket rule, appropriate head gear, self-fitting mouth guards, the use of ankle braces, and changing the blocking rules of the game.

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Injury Date: _____ **Player Code:** _____

1. Mechanism of Injury:

□ knocked into another player	□ contact with ground	□ hit by object	□ intrinsic
□ hand/finger caught	□ knocked by another player		

2. Cause of Injury: □ Overuse □ Trauma

3. Type of Injury:

□ concussion	□ Meniscus/ cartilage	□ haematoma/ contusion	□ fracture
□ dislocation	□ tendon in jury/rupture	□ nerve injury	□ ligament
□ abrasion/ laceration	□ dental/ tongue injury	□ muscle strain/rupture	□ bursitis

4. Injured body part:

□ head/ face/ lips/tongue	□ shoulder / clavicle	□ hip / groin	□ neck/ cervical spine	□ upper arm
□ thigh	□ sternum/rib	□ upper back	□ elbow	□ knee
□ abdomen	□ LB/ sacrum/pelvis	□ wrist	□ ankle	□ fingers
□ thumb	□ foot/heel/ toe	□ lower leg/ Achilles	□ lower arm	
Final diagnosis:				

5. Affected side: □ L □ R □ N/A **6. Dominant side:** □ L □ R

7. Recurrence: □no

□ Re-injury □ Recurrent < 2 months) Late recurrence (2-12 months)

□ Exacerbation of current injury □ Recurrent (< 2 months) □ Late recurrence (2-12 months) □ Delayed recurrence (> 12 months)

8. Severity: □ Slight □ Minimal □ Mild □ Moderate □Severe □Career ending

(Days) (0) (1-3) (4-7) (8-28) 28)

10. Field position: □ wide receiver □ tight-end □ quarter back □ center □defensive line □ safety □ corner-back

11. Game: Game practice **12. League Type:** □ Mens □ Womens

13. Injury period: First Half (0-25) Second Half (25-50)

14. By Game rules: **No** **Yes**

15. Penalty? **No** **Yes**

16. Was player suspended **No**

17. Field conditions: □ Dry □ Wet

18. Match sessions per wk:__ _____ **19. Practice sessions per wk:** _____

20. Football hours per wk:___ **21.Years playing football:**_____

22. Previous Injuries

	□ concussion	□ Meniscus/ cartilage	□ haematoma/ contusion	□ fracture
□ N/A	□ dislocation	□ tendon in jury/rupture	□ nerve injury	□ ligament
	□ abrasion/ laceration	□ dental/ tongue injury	□ muscle strain/rupture	□ bursitis

23. Previous Injured body part

□ head/ face/ lips/tongue	□ shoulder / clavicle	□ hip / groin	□ neck/ cervical spine
□ thigh	□ sternum/rib	□ upper back	□ elbow
□ abdomen	□ LB/ sacrum/pelvis	□ wrist	□ ankle
□ thumb	□ foot/heel/ toe	□ lower leg/ Achilles	□ lower arm

24. Protective equipment: □ yes □ no What type?_____

Figure 1. Injury-surveillance questionnaire

League	Males	Females	Group Total
No. of games played	**846 (84%)**	**182 (16%)**	**1028**
No. of teams	**116 (81%)**	**28 (19%)**	**144**
No. players	**1252 (84%)**	**240 (16%)**	**1492**
Age Average (yrs) **SD**	**20.49** **4.89**	**22.44** **7.58**	**20.71** **5.27**
Height Average (m) **SD**	**1.76** **0.96**	**1.65** **0.89**	**1.75** **0.10**
Weight Average (kg) **SD**	**80.67** **16.89**	**62.59** **9.21**	**78.87** **17.15**

Table.1 Baseline demographic data

League	Males	Females	Group Total
No. of injured players	**141 (89%)**	**18 (11%)**	**159**
No. of injuries	**145 (90%)**	**19 (10%)**	**164**
Athlete Exposures	**1,059,192**	**43,680**	**1, 533,776**
Incidence Rate per 1000 athlete exposures	**0.14** **(95% CI: 0.12, 0.16)**	**0.39** **(95% CI:0.20,0.57)**	**0.11** **(95% CI: 0.09, 0.12)**
Incidence Proportion	**11.26** **(95% CI:9.5, 13)**	**7.5%** **(95% CI:4.2,10.8)**	**10.66%** **(95% CI: 9.1, 12.22)**

Table.2 injury result data