Mechanisms of Flag-Football Injuries Reported to the HQ Air Force Safety Center

A 10-Year Descriptive Study, 1993–2002

Bruce R. Burnham, DVM, MPH, G. Bruce Copley, PhD, MPH, Matthew J. Shim, PhD, MPH, Philip A. Kemp, MS, Bruce H. Jones, MD, MPH

Background: Flag (touch or intramural) football is a popular sport among the U.S. Air Force (USAF) active duty population and causes a substantial number of lost-workday injuries. The purpose of this study is to describe the mechanisms of flag-football injuries to better identify effective countermeasures.

Methods: The data were derived from safety reports obtained from the USAF Ground Safety Automated System. Flag-football injuries for the years 1993–2002 that resulted in at least one lost workday were included in the study conducted in 2003. Narrative data were systematically reviewed for 32,812 USAF mishap reports; these were then coded in order to categorize and summarize mechanisms associated with flag football and other sports and occupational injuries.

Results: Nine hundred and forty-four mishap reports involving active duty USAF members playing flag football met the criteria for inclusion into this study. Eight mechanisms of injury were identified. The eight mechanisms accounted for 90% of all flag-football injuries. One scenario (contact with another player) accounted for 42% of all flag-football injuries.

Conclusions: The most common mechanisms of injury caused by playing flag football can be identified using the detailed information found in safety reports. These scenarios are essential to developing evidence-based countermeasures. Results for flag football suggest that interventions that prevent player contact injuries deserve further research and evaluation. The broader implications of this study are that military safety data can be used to identify potentially modifiable mechanisms of injury for specific activities such as flag football.

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Introduction

Injuries lead all other health conditions as a cause of morbidity and mortality for the U.S. military.[1–3] In regard to the causes of serious nonfatal injuries among military service members, athletics and sports are consistently among the top three or four.[2–4] Even during deployments for combat, such as Operation Iraqi Freedom (OIF), sports injuries are among the leading causes of serious nonfatal, nonbattle injuries.[5] An army study showed that basketball, football, and softball were the three leading causes of sports hospitalizations in the 1990s.[6] In addition to the military, sports injuries are a leading problem for the U.S., accounting for 16% of all emergency department visits in 2000 to 2001 (about 4.3 million visits per year).[7] Basketball, football, soccer, and baseball were the leading causes of such emergency visits.

Unfortunately the published literature regarding touch or flag football, the focus of this paper, is very limited, and some of the best articles are very dated. In 1969 Kraus examined 9 years of injuries reported to the University of Minnesota Health Service to investigate risk factors associated with touch football, as it was the largest contributor of intramural athletic injuries.[8] A review of quadriceps contusions in West Point cadets found that tackle football was the leading cause of such injury, but touch football was tied for the third leading cause.[9] Of 90 cases followed

From the AFSC (Burnham, Kemp), Analysis and Integration Division, Kirtland AFB, New Mexico; ExxonMobil Biomedical Sciences, Inc. (Copley), Annandale, New Jersey; Air Force Institute for Operational Health (Shim), San Antonio, Texas; and Injury Prevention Program (Jones), U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Maryland

G. Bruce Copley was an employee of HQ AFSC when this research was completed.

Address correspondence and reprint requests to: Bruce R. Burnham, DVM, MPH, HQ, Air Force Safety Center/SEAR, 9700 G Avenue SE, Kirtland AFB NM 87117-5670. E-mail: bruce.burnham@kirtland.af.mil.

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in a prospective longitudinal study of anterior cruciate ligament reconstruction, 18% were caused by touch football, the fourth leading cause.[10] A descriptive study of lost-workday injuries occurring on a U.S. Navy aircraft carrier found that basketball, volleyball, and touch football were the top three recreational activities causing injury.[11] Thus, touch or flag football is an injury problem for young military and civilian populations that deserves attention from sports and safety officials.

Since identifying the mechanism of injury is central to the development of effective countermeasures, this article attempts to fill the current gap in the literature regarding the mechanism of injuries that occur during participation in flag football. This study answered a request for information from a Department of Defense (DoD)–level authority, the Defense Safety Oversight Council's Military Training Task Force that wanted to know if safety data could be used to assist with nonfatal injury prevention activities. While safety data have historically been used to prevent fatalities, this study was conducted to determine the potential for using safety data to develop countermeasures and to define priorities for the prevention of the much more numerous nonfatal injuries.

Methods

The present study is part of a larger descriptive epidemiologic study conducted by the HQ Air Force Safety Center (AFSC) to focus greater attention on, and reduce the number of, lost-workday injuries in the U.S. Air Force (USAF). Detailed methods for identifying and developing mechanisms and hazards are given in a separate paper in this supplement.[12] In summary, in 2003 Ground Safety Automated System (GSAS) data on 32,812 USAF mishap reports from Fiscal Years 1993 through 2002 were analyzed and grouped by activity. This paper specifically examines flag-football injuries. The flag-football and other injuries in the GSAS are all somewhat serious injuries, since at the time of this study only those injuries resulting in at least 1 lost workday were required to be investigated and reported by safety officials. Since a list of mechanisms had not previously been developed in GSAS, a list was formulated using an arduous, iterative process of reading all 32,812 mishap reports, aggregating and categorizing similar types of mishaps together and continually refining the list to capture the greatest number of mishaps into the smallest number of groups.

The GSAS contains safety mishap reports on the USAF active duty population—which is young, predominately male, and physically active. This population has varied in size between 1993 and 2002, from a high of 439,902 in 1993 to a low of 347,782 in 2001. Although descriptive statistics were produced for a wide variety of factors such as fiscal year, age, major command, functional area, injury type, and activity, this article primarily enumerates the mechanisms causing flag-football injuries. In this paper data are presented only for USAF active duty members. Frequencies and percentage distribution of various mechanisms are reported. Also, only aggregate data for men and women combined are described because the USAF is more than 80% male. For this reason some frequencies of mechanisms would be exceedingly small if data were broken out by gender and age. Frequencies and distributions of injury mechanisms are sufficient to determine the most important ones and to begin developing potential prevention strategies, which are the primary purposes of this study.

Results

The top ten activities resulting in mishap reports for the active duty USAF are shown in Table 1. Four of the top ten activities associated with lost workdays were sports and recreation activities. With 944 total lost workday injuries reported, flag football is the third leading producer of injuries in the sports and recreation category, behind basketball and softball. Overall flag football is eighth in both total injuries and total lost workdays among active duty military reports (no USAF civilian reports) as indicated in Table 1. The percentage of these flag-football injuries occurring on-base (74%) as seen in the last column of Table 1 is high. Flag football is second only to basketball in percentage of on-base injuries, which has implications for prevention.

Table 2 summarizes the 944 flag-football injuries reported by specific mechanism. The aggregation methodology was able to group 92% of the injuries into the eight mechanisms identified for flag football. It also gives specific examples of the types of mechanism for injuries found in each mechanism category. Table 2 also gives the frequency and percentage of total flag-football injuries by mechanism. Finally, it describes potential interventions for preventing injuries in a particular mechanism category. Despite the fact that flag football is intended to reduce contact and therefore promote safety, the leading mechanism was contact with another player, which caused 42% of the reported injuries. This is three times that of the second leading mechanism, slips, trips, and falls (14%). Running during flag-football play was the third leading mechanism identified (11%). The remainder of the injuries was evenly distributed among five other mechanisms. Average lost workdays per injury/mishap ranged from a high of 7.2 days for planting the foot and changing direction (cutting) to a low of 3.5 days lost per injury for grabbing the flag. Overall, flag football produces injuries with an average of 5.8 lost workdays per injury reported, the same as for basketball (Table 1).

Table 3 provides data regarding lost-workday injuries, lost workdays, and average lost workdays by injury type,

Table 1. Top ten activities associated with lost workday injuries reported to the AFSC for active duty USAF personnel, 1993–2002[a]

Rank	Activity	Lost workday injuries (*n*)	Total lost workdays (days)	Lost workdays per injury (M/median numbers of days)	Occurrence on base (%)
1	Operation of vehicles or equipment	4,390	46,818	10.7/3	13
2	Basketball	2,165	12,520	5.8/2	78
3	Slips/trips/falls[b]	2,032	14,554	7.2/3	61
4	Lifting/carrying (not slips, trips, or falls)	1,231	3,386	2.8/2	72
5	Softball	1,171	6,843	5.8/3	71
6	Riding in/on vehicles or equipment	1,147	13,023	11.4/4	16
7	Climb/descend stairs or ladder	965	6,902	7.2/3	59
8	Flag football	944	5,406	5.8/3	74
9	Struck/struck by object[c]	932	5,208	5.6/2	73
10	Trail riding—dirtbike/ATV/Quad	454	5,563	12.3/7	8

[a]Excludes categories such as "standing," which convey only incidental activities.
[b]Numerous activities were associated with this category, but specific well-defined activities (e.g., STF due to playing basketball or softball, or climbing a ladder or stairs) were included in those more-specific categories rather than being included under this general STF category. Activity breakdown: general walking (*n*=2363); stepping up or down from/to uneven surfaces such as curbs (*n*=380); entering/exiting buildings or vehicles (*n*=368); carrying items (*n*=254); while handling or carrying items or equipment (*n*=155); running not associated with sports, jogging, or physical training (*n*=138); and dozens of other activities.
[c]Does not include people being struck by objects that they dropped; being struck by a dropped object is categorized here as lift/carry/handle; also does not include being hit by a motor vehicle (pedestrian injuries are included in lower-frequency categories not included in this table).
ATV, all-terrain vehicle; STF, slips, trips, and falls; USAF, U.S. Air Force

body part, and, for fractures, the most common injury type. Fractures represent more injuries than the next two most common injury types, sprains and strains. These data further illustrate that safety reports capture more severe injuries. Ruptured tendons and the foot are the injury type and the body part associated with the highest average of lost workdays; Achilles tendon rupture is the most common simple injury and location. When classifying injuries by body part, the lower extremities (knee, leg, and ankle) account for 45% of all injuries. Legs represent the largest number of fractures and cause the highest average number of lost workdays among the fractures.

Table 4 displays the USAF population by fiscal year for each year of this study from 1993 to 2002. It also shows the frequency of flag-football injuries resulting in mishap reports, along with the rates of these injuries. Unpublished data from the Defense Medical Surveillance System on rates of hospitalization for the USAF and other Services show a steep decline in rates in the early to mid-1990s.

Discussion

This project demonstrates the feasibility of coding existing USAF safety data and aggregating mechanisms of injury for activities such as flag football into meaningful categories with sufficient numbers to guide prevention. This study focused on flag football because it was one of the top ten causes of injury identified by a larger study of lost-workday injuries among active duty personnel by the AFSC (Table 1).[12] This descriptive analysis of safety data identified 944 flag-football injuries, all of which resulted in 1 or more days of lost work. The analysis identified eight mechanisms of injury, the most common of which was contact with other players (42%) followed by slipping, tripping, or falling (14%) and running (11%) as shown in Table 2.

The findings of this study are consistent with those of others in regards to sports. Lauder et al. found that basketball, football, and softball were the top three sports causing hospitalizations of active duty U.S. Army (USA) personnel.[6] A study of navy personnel on a deployed aircraft carrier found that basketball, volleyball, and football were leading causes of injury.[11] National Center for Health Statistics data indicate that basketball, football, and softball were the three leading sports resulting in emergency department care in the U.S. in 1997–1998. Consumer Prudent Safety Commission data from the National Electronic Injury Surveillance System indicated that for men aged 20–24 years in the U.S., the team sports resulting in the most emergency visits were basketball,

Table 2. Frequency and percentage of mechanisms producing flag-football injuries, with possible prevention measures, USAF personnel, 1993–2002 (944 injuries)

Mechanism	Example(s)	Injuries reported (*n* and % total)	Average lost workdays per injury (days)	Prevention
Contact with another player	Tackled, fractured ankle	393 (42)	4.4	Implement and enforce rules to minimize contact
	Kicked in ankle by player			
Slipping, tripping, falling	Fell while running	129 (14)	6.2	Training to improve balance
Running	Heard pop while running	100 (11)	6.7	Shift emphasis from stretching to warm-up Preseason conditioning
	Knee gave out while running			
Planting foot, cutting, changing direction	Knee popped while changing directions	66 (7)	7.2	Brace previously injured or weak knees and ankles
	Cut sharply to catch ball			Wear shortened cleats
Jumping (leg injury)	Jumped to deflect a pass	57 (6)	5.2	Training to improve balance
	Jumped to catch a ball			
Grabbing the flag	Jammed thumb while grabbing flag	43 (5)	3.5	Enforce no pocket rule
	Caught finger on pocket			Improve flag system
Uneven surface, hole, mud	Stepped in a hole while running	36 (4)	5.5	Improve playing field
	Tripped on a dirt pile			Cancel/postpone game if field is too sloppy
Stepping on ball, hit by ball	Stepped on ball, sprained ankle	26 (3)	5.4	
	Hand hit by passed ball			

USAF, U.S. Air Force

football, soccer, and softball.[7] Football is a leading cause of sports injuries for young, athletic military and civilian populations.

Most of the epidemiologic sports injury studies reviewed did not specify whether football was tackle or flag (touch) football.[7,13,14] Nevertheless, it is evident that flag or touch football injuries are not only frequent but can also be serious.[8–10] Lauder's study of active duty USA personnel found that the leading types of sports injury hospitalization overall were fractures (33%), sprains and strains (29%), dislocations (15%), and intercranial injuries (5%).[6] This study of flag football injuries in USAF service members found that fractures accounted for the greatest percentage of injuries (36%), followed by sprains and strains (34%), and dislocations (7%); concussions accounted for 4% (Table 3). The percentage of injuries in this study that were fractures indicate the severity of flag football mishaps reported to the AFSC. The average number of lost workdays reported per injury (5.8 days) is another indicator of severity.

The location of injuries in this study is also similar to that of reports in the literature.[6,15,16] Hootman found that about 54% of collegiate sports injuries were to the lower extremities.[15] Lauder found that 25% to 30% of USA sports injury hospitalizations were for knee injuries and another 12% were for ankle injuries.[6] This study showed that 50% of flag football injuries affected the lower extremities and that 19% were knee injuries and 13% leg injuries (Table 3). Thus, as with most weight-bearing sports, the predominances of flag football injuries occur to the lower extremities, and they can be fairly serious, as the number of fractures suggests.

In order to prevent flag football or other sports injuries, knowledge of the causes and specific mechanisms of injuries is necessary. This study identifies eight mechanisms of flag football injuries (i.e., contact with other players, slips, trips and falls, running, planting feet and cutting moves, jumping for the ball, grabbing the flag, and surface conditions) that should provide good clues about how to approach preventing the most serious flag

Table 3. Flag football lost work injuries, lost workdays, and average number lost workdays per injury by injury type and body part

Flag-football injury type	Lost work injuries (*n*)	Total lost workdays (days)	Average number lost workdays per injury
Concussion	38	90	2.4
Contusion	63	150	2.4
Dislocation (separation/subluxation)	70	341	4.9
Fracture (chipped bones/compression/compound)	337	2548	7.6
Internal injuries, other	12	104	8.7
Laceration (tears/cuts)	29	87	3.0
Rupture (complete organ tears/achilles tendon)	61	815	13.4
Sprain (tear of ligament/joint/cartilage/tendon)	176	795	4.5
Strain (includes muscle injuries/whiplash/spasm)	145	440	3.0
Other	13	89	6.8
Flag-football body part			
Abdomen	11	114	10.4
Ankle	121	685	5.7
Arm	15	101	6.7
Back	37	114	3.1
Elbow	10	49	4.9
Face	40	163	4.1
Finger	96	594	6.2
Foot (to include Achilles tendon)	50	567	11.3
Groin	11	38	3.5
Head	41	98	2.4
Hip	11	59	5.4
Jaw	10	88	8.8
Knee (patella)	179	1090	6.1
Leg	127	855	6.7
Nose	22	74	3.4
Ribs	15	49	3.3
Shoulder/collar bone (clavicle)	84	347	4.1
Wrist	22	135	6.1
Other	42	239	5.7
Flag-football fractures by body part			
Ankle	53	485	9.2
Arm	14	100	7.1
Face	18	130	7.2
Finger	67	391	5.8
Jaw	10	88	8.8
Leg	56	689	12.3
Nose	20	68	3.4
Shoulder/collar bone (clavicle)	31	142	4.6
Wrist	21	133	6.3
Other	47	332	7.1

football injuries. It is noteworthy that Hootman et al. found that 42%–58% of collegiate sports injuries were due to contact with another player across 15 sports including noncontact sports, such as basketball, baseball, and volleyball.[15] This study, as stated earlier, found that 42% of flag football injuries reported to the AFSC resulted from player contact. As with this study, Hootman et al. advocate enforcement of rules and policies aimed at preventing dangerous or rough play that results in injurious player contact.[15] For each of the eight mechanisms of injury identified in this paper, Table 2 provides an example of a plausible prevention strategy. Most of these prevention strategies require further research or evaluation. This is consistent with the conclusion of Hootman et al.[15] and Gotsch et al.[14] who both note that there are few proven prevention strategies or countermeasures for sports injuries, and suggest that more research is needed to identify causes and mechanisms of injury and to implement and evaluate interventions or countermeasures.

The large percentage of football injuries that occur on-base (74%) as shown in Table 1 is an important factor, as the cir-

Table 4. USAF population numbers, and flag football lost workday injuries and rates per 10,000 active duty service members

Fiscal year	Population (*n*)	Frequency (*n*)	Rate (*n*/10,000 service member)
1993	439,902	140	3.2
1994	422,024	126	3.0
1995	396,102	107	2.7
1996	384,719	102	2.7
1997	373,082	71	1.9
1998	363,206	83	2.3
1999	356,214	85	2.4
2000	351,104	87	2.5
2001	347,782	63	1.8
2002	363,787	80	2.2

cumstances surrounding those mishaps are under military control and allow countermeasures to be implemented without coordination with outside agencies.

The finding that flag football injuries rates have gone down from 1993 to 2002 as shown in Table 4 should be interpreted with caution, as all other USAF sports and occupational injuries documented in the safety records have gone down as well. Also, there have been no specific flag football mishap or injury prevention programs during this time. A change that may explain some of the decrease in flag football and other safety mishap reports is that in the early and mid-1990s, DoD hospitalization policies changed so that more injuries and diseases were treated on an outpatient basis, thus reducing the number of lost workday-injuries due to hospitalization (personal communications, unpublished data). It is interesting that over the last 15–20 years collegiate sports injury rates have not appreciably changed.[15] Also, collegiate football injury rates have not substantially changed either.[17] While trend data such as these may be disheartening for some, they highlight the challenge posed by flag football and other sports injuries. Such data indicate the need for detailed sports injury data on mechanisms of injury such as this paper provides as a basis for development of effective prevention strategies.

This paper illustrates, for epidemiologists and others, the richness of detail provided by safety data, detail not available from medical records or medical surveillance data. This paper also may provide the foundation for future studies to include calculation of rates, trends, and multivariate analyses. It may also provide more-specific data for creation of improved external cause coding for sports and recreation activities. Safety data such as this paper utilized could be linked with medical surveillance data to provide missing detail on injuries treated in military treatment facilities, such as was recently done by a DoD working group.[18]

The principle limitation of this study is probable under-reporting of injuries to safety officials. The reporting process relies on a chain of events with a number of weak links: the injured player notifying the supervisor, the supervisor notifying safety, the safety office investigating the mishap and finally reporting to the AFSC. Various internal and external estimates of under-reporting have varied from 50% to 90% under-reporting (unpublished data). Some of the under-reporting may be due to the fact that these data contain only those injuries causing at least 1 lost workday, and they should not be viewed as the total number of injuries. Many injuries do not preclude return to work and are therefore not included in this study. Although not random, safety reports may be an important sample of the more severe and important injuries. Another limitation is the lack of accurate denominator data. Estimating football participation is far different than other activities such as driving, where one can assume nearly universal participation by USAF personnel.

This paper does not provide a definitive list of proven interventions that may apply to the targets identified by this paper. The list of potential prevention modalities was provided only to stimulate further thought and research. Further research and systematic reviews of the sports medicine literature should be conducted to identify effective prevention strategies for flag football and other sports and occupational injuries documented in safety data.

Conclusion

The study shows that USAF safety mishap reports contain enough information to determine not only the activities causing injuries to military personnel, but also the specific mechanisms of injury for activities such as flag football. The fact that 74% of flag football injuries occur on USAF bases means that military commanders have a good chance of influencing their prevention. This paper also provides a list of potential targets for prevention and possible interventions. Some initial priority prevention targets would be fractures, lower-extremity injuries, and enforcement of rules and policies to prevent player-contact injuries. Process objectives might include better or more complete capture of information on flag football and other sports, and occupational injuries, by

safety data systems. Also, more optimal use and coding of safety data on activities and mechanisms of injury would be beneficial to prevention activities.

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