Musculoskeletal Injuries in an Army Airborne Population

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To maintain operational readiness, military personnel engage in vigorous physical and training activities that carry risk for injury. A 1-year prospective cohort study, starting April 1996, was conducted at Fort Bragg, North Carolina among 1,965 members of the 82nd Airborne Division to quantify musculoskeletal injuries. Information collected included type of injury, site, circumstances, and resultant limited duty days. These soldiers suffered 508 overuse injuries (including 38 stress fractures), 1,415 traumatic injuries (including 100 fractures), and 101 unclassified injuries. Injury rates were 6.8% per soldier per month for traumatic injury and 2.4% for overuse injury (totaling 1.2 injuries per soldier per year). Injuries resulted in 22,041 limited duty days, averaging 11 days per injury and 13 days per soldier (4.5% of total workdays). Fractures and stress fractures/reactions produced the most days lost per case. Most of these injuries resulted from military-specific activities.

Introduction

All phases of military training place a strong emphasis on development and maintenance of physical fitness in soldiers to assure combat readiness. Consequently, military personnel routinely engage in physically demanding exercise (i.e., running, calisthenics) and operational training (ruck-marching, field exercises) both during and after basic training. The basic training program itself, much like sports programs, causes a significant number of overuse and traumatic injuries among recruits. Reported risks of injuries during basic military training in the United States and other countries range from 26% to 65% of recruits for training cycles of 6 to 12 weeks in duration.[1-11]

Most military injury studies have focused on basic training. However, after completing basic and advanced training, soldiers continue physical conditioning and operational readiness programs with high risk for injury.[12] For example, musculoskeletal injuries in Army infantry soldiers have been reported to range from 80 to 150 injuries per 100 soldier-years,[13,14] whereas in U.S. Navy SEAL training (special forces 25-week program) there were up to 360 injuries per 100 person-years.[15] Such injuries place a large burden on health care facilities and compromise military readiness.

Injuries impose a high cost in terms of clinic visits, time lost from work, and the dollar costs of medical care, disability, and separation from military service. An Armed Forces Epidemiological Board Work Group estimated the annual cost of injury disability for the three services to be $450 million to $750 million (1991 dollars). Of those personnel reviewed by the Army Physical Evaluation Board during fiscal year 1993, 53% were evaluated for orthopedic complaints and 77% of those were retired or separated with disability compensation.[16,17] In 1994, it was estimated that the average cost of loss of one trainee from basic training was $16,000.[18] Jefferson,[19] in a 1989 review, estimated the financial loss for a soldier discharged after the eighth year to be approximately 150,000 British pounds, excluding the costs of disability pension. Thus, extensive evidence points to injury as generating a large financial burden in addition to its impact on combat readiness.

Injury rates and specific types of injuries are not as well characterized for operational military units as they are for basic training. Thus, this study was conducted to assess the musculoskeletal injury experience of a cohort of Army airborne soldiers. Specifically, the objectives were to (1) determine the rates of traumatic and overuse musculoskeletal injuries, (2) identify types of injuries causing the greatest morbidity, (3) determine the rates of fractures and stress fracture/reaction as sentinel injuries, (4) quantify days lost and limited workdays as a result of injuries, and (5) ascertain leading circumstantial causes of injuries.

Subjects

This 1-year prospective cohort study followed the medical experience of a group of active duty soldiers from the U.S. Army 82nd Airborne Division at Fort Bragg, North Carolina. The study focused special attention on the occurrence of fractures and stress fracture/stress reaction, which are among the more serious and common traumatic and overuse injuries and might be used to reflect total injuries. The observation period was from April 1, 1996 to March 31, 1997.

Cohort eligibility was defined as any active duty soldier from the 82nd Airborne Division whose medical care and records were located at specific medical clinics during the observation period. No clinical visits to the medical facility were required to be included in this cohort; the medical chart's presence indicated that the soldier was currently stationed on base. The medical records thus not only identified injury cases, but also the population at risk. The subjects were never contacted directly and were followed only through their medical records with approval by the appropriate Institutional Review Boards.

The study subjects were members of two infantry battalions (669 men) and three combat support battalions (1,180 men and 116 women), totaling 1,965 subjects (1,849 men and 116 women). Individual soldiers varied substantially in their specific duties, but all were airborne soldiers who were required to perform at least one parachute jump each quarter and participate in

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daily physical training programs and periodic ruck-marching and running requirements. Ruck-marching is hiking in formation a specific distance and pace with a backpack of 20 to 80 pounds.

Methods

The enrollment period preceded the observation period by several months. Once the cohort members were identified during the enrollment period, all medical records were followed for the 1-year observation period whether the subject experienced an injury or not. Study personnel visited the clinics regularly to review medical records of all enrolled subjects. In addition, hospital radiology reports were screened for fractures and stress fractures among the cohort subjects. Study personnel were not involved in the clinical care of the subjects, and the medical records were maintained by clinicians who were unaware of the patient's status as a study subject.

Basic demographic information was collected from the medical records, including race, gender, weight, height, unit, and rank. Extensive medical information was abstracted and coded according to predetermined rules for every clinic visit by a study subject to include dates of visits and dates of record abstraction.

Clinic visits were coded as either new or follow-up visits to calculate rates of injury. Each injury was coded into one of 16 categories, e.g., stress fracture, sprain, or contusion. The circumstantial cause of the injury (self-reported) was coded into one of nine categories, such as motor vehicle accident, sports, running, or parachuting. The anatomical site was recorded into 1 of 16 categories (e.g., head, neck, arm, thigh, calf) as well as its sidedness (right, left, both). The subject's disposition (specific restrictions on physical activity, referral for consultation, or hospitalization) was recorded and coded into 1 of 13 disposition categories. For all coded variables, codes for "other," "unknown," and "not applicable" were included. The number of profile days (days of limited/restricted work activity) and workdays lost (days fully relieved of duty) were recorded for each visit (Table I).

Injuries were classified as overuse, traumatic, other, or unknown. Overuse injuries, which included stress fractures, stress reactions, and tendonitis, among others, were defined as injuries of gradual onset resulting from repetitive motion and/or sustained overloading of tissue. Traumatic injuries, including fractures, sprains, strains, and others, were defined on the basis of sudden onset attributable to an acute event. Injuries that could not be classified as overuse or traumatic were coded as other or unknown. If a particular visit was not for injury, the injury code was "not applicable." For the purposes of this study, stress fractures were defined as clinical cases with appropriate signs and symptoms where the lesion was confirmed on radiograph or bone scan at the affected site. Stress reactions were clinically suspected cases of stress fracture but without definitive radiographic confirmation. Stress fractures/reactions (combination of both stress fractures and stress reactions) represent sentinel overuse injuries (as fractures are sentinel for traumatic injuries) because they are difficult to ignore once they occur and the diagnosis is readily confirmed clinically and radiographically.

Abstraction of subjects' medical charts was continuous throughout the year, hence most subjects had their medical records abstracted several times during the study period. The fact that the chart was found indicated that the subject was still on base. A chart that was "unavailable" suggested that the soldier was probably off base, either temporarily or permanently. If the medical record was found at a later time, then the soldier had returned to base and continued in the cohort with interim medical events abstracted. If the chart was not found again, that subject was assumed to have transitioned to another duty station, and the soldier-months of exposure were calculated according to the last abstraction date.

There was one central full-service radiology facility (at the

TABLE I

INJURY CATEGORIES

Injury Type and Code	Injury Cause	Body Part	Disposition
Stress fracture (1)	Motor vehicle accident	Head/skull	Return to duty
Stress reaction (2)	Fall	Face	Physical training, own pace
Achilles tendonitis (3)	Sports	Neck, cervical spine	No lower body exercise
Other tendonitis (4)	Other recreational	Upper back	No upper body exercise
Bursitis (5)	Running	Lower back	No PT
Fascitis (6)	Other training, exercise	Shoulder, upper arm	Light duty
Other overuse (7)	Marching	Elbow, forearm	Quarters
Pain, not specified (8)	Parachuting	Wrist, hand, fingers	Consult
Strain (9)	Other military operations	Pelvis	Hospitalized
Sprain (10)	Other	Knee	Medical board
Dislocation (11)	Unknown	Ankle	Other
Fracture (12)	Not applicable	Chest wall	Unknown
Blister (13)		Multiple, severe	Not applicable
Abrasion/laceration (14)		Hip, thigh	
Contusion (15)		Leg	
Other trauma (16)		Foot	
Other other (17)		Other	
Unknown (18)		Unknown	
Not applicable (19)		Not applicable	

TABLE II

DISTRIBUTION OF DEMOGRAPHIC CHARACTERISTICS AND INJURY OCCURRENCE BY GENDER, FORT BRAGG 82ND AIRBORNE DIVISION, 1996–1997

Parameters	Men	Women
Number (percent)	1,849 (94)	116 (6)
Mean age (years)	25.6	24.8
Percent Caucasian	70	66
Percent African American	18	22
Percent Hispanic	4	2
Percent Asian	2	4
Total soldier-months (%)	19,666 (94)	1,193 (6)
Mean soldier-months	10.7	10.3
Mean number of overuse injuries per person	0.55	0.50
Mean number of traumatic injuries per person	0.43	0.40
Mean number of total injuries per person	1.03	0.97
Mean number of injury visits per person	1.4	1.3
Mean number of injury profile days per person	11.0	10.4
Mean number of injury days lost per person	0.29	0.14

hospital), where all radiographs taken at the outlying clinics were submitted for radiologist review. A weekly search of the hospital radiology records was performed to capture more detail and identify as many musculoskeletal injuries as possible. A few injuries among cohort members were detected only from these radiology records, and these did not have any information relating to profile days or workdays lost.

The calculation of soldier-months began on April 1, 1996 and ended on March 31, 1997, providing 12 person-months for each subject not lost to follow-up. For subjects lost to follow-up, their last date of participation was the latest valid date of chart abstraction. The data were abstracted from the medical records and directly entered (by double entry) on laptop computers using EpiInfo (CDC, version 6) at the clinic site. Logical checks were performed, and the EpiInfo file was converted to database, spreadsheet, and statistical files (SPSS, Macintosh version 6.04) for analysis. Injury rates were calculated by dividing the number of events of interest (cases, clinic visits, profile days, etc.) by the soldier-months for that group, and then multiplying by 1,000 to give a rate per 1,000 soldier-months. Confidence intervals were calculated at the 95% level using the method of Rothman.[20]

Results

The final cohort consisted of 1,965 soldiers for whom medical record reviews were conducted on at least two occasions: baseline and one or more follow-up chart reviews. This study captured 88% of potential person-years of exposure (1,738 person-years of 1,965 possible person-years), indicating relatively complete follow-up, especially considering the mobility of military personnel. Table II provides a description of the demographic characteristics of the cohort by gender as well as an injury profile in terms of the number of injuries, injury visits, etc. Men comprised 94% of the subjects and contributed 94% of the total soldier-months. Men and women were similar in age and distribution of demographic characteristics and in overall injury occurrence.

Injury Occurrence and Clinic Visits

Members of this cohort experienced 508 overuse injuries, including 38 stress fractures/reactions. Thus, stress injuries to bone accounted for 7.5% of all overuse injuries. Similarly, 1,415 traumatic injuries occurred, of which 100 were fractures. Thus, fractures comprised 7.1% of traumatic injuries. The ratio of total overuse injuries to stress fractures/reactions was 13. Similarly, the ratio of total traumatic injuries to fractures was 14. The ratio for stress fractures/reactions was quite different in women, but their small number makes comparisons difficult to interpret.

Table III presents a summary of the numbers, percents, and rates by gender for overall overuse and traumatic injuries as well as for sentinel overuse (stress fracture/reaction) and traumatic (fracture) injuries. Some subjects suffered multiple injuries; thus, the number of cases may include more than one injury per person. For both genders, traumatic injuries were more common than overuse injuries.

Table IV shows the number of subjects injured, number of injuries, and injury rates by type in the cohort. The most common injury type was strain, which accounted for 40% of traumatic injuries and 28% of all injuries. The most frequent specified overuse injury was tendonitis (83 cases), whereas "other" overuse injuries accounted for 208 cases. The most commonly

TABLE III

SENTINEL OVERUSE AND TRAUMATIC INJURIES BY GENDER, FORT BRAGG 82ND AIRBORNE DIVISION, 1996–1997

	Men (N = 1,849)			Women (N = 116)			Total (N = 1,965)		
	No. of Cases[a]	Percent of All Injuries	Rate[b] (95% CI)	No. of Cases[a]	Percent of All Injuries	Rate[b] (95% CI)	No. of Cases[a]	Percent of All Injuries	Rate[b] (95% CI)
Overuse injuries[c]	478	25	24 (22–27)	30	27	25 (17–36)	508	25	24 (22–27)
Stress fractures[c]	33	1.7	1.7 (1.2–2.4)	5	4.4	4.2 (1.5–10)	38	1.9	1.8 (1.3–2.5)
Traumatic injuries[d]	1,340	70	68 (65–72)	75	66	63 (50–79)	1,415	70	68 (65–71)
Fractures	94	4.9	4.8 (3.9–5.9)	6	5.3	5.0 (2.1–11)	100	4.9	4.8 (3.9–5.8)
Total injuries[e]	1,911	100	97 (93–101)	113	100	95 (79–113)	2,024	100	97 (93–101)

[a] Incident cases only; includes cases detected through medical records and radiology reports.

[b] Per 1,000 soldier-months (example: male stress fractures (33/19,666 × 1,000 = 1.7). CI, confidence interval.

[c] Includes stress fractures and stress reactions.

[d] Includes fractures.

[e] Includes overuse, traumatic, and "other" injuries.

TABLE IV

RATES OF SPECIFIC OVERUSE AND TRAUMATIC INJURIES BY GENDER, FORT BRAGG 82ND AIRBORNE DIVISION, 1996–1997

	Men (N = 1,849)			Women (N = 116)			Total (N = 1,965)		
	No. of Subjects	No. of Injuries	Rate of Injuries[a]	No. of Subjects	No. of Injuries	Rate of Injuries[a]	No. of Subjects	No. of Injuries	Rate of Injuries[a]
Stress fracture	10	10	0.5	1	1	0.8	11	11	0.5
Stress reaction	22	23	1.2	4	4	3.4	26	27	1.3
Achilles tendonitis	18	19	1.0	1	1	0.8	19	20	1.0
Other tendonitis	53	57	2.9	6	6	5.0	59	63	3.0
Bursitis	37	39	2.0	0	0	0.0	37	39	1.9
Fascitis	47	50	2.6	5	6	5.0	52	56	2.7
Pain, not otherwise specified	81	84	4.3	0	0	0.0	81	84	4.0
Other overuse	171	196	10.0	12	12	10.1	183	208	10.0
Total overuse injuries		478	24.3		30	25.1		508	24.3
Fracture	91	94	4.8	6	6	5.0	97	100	4.8
Dislocation	17	18	0.9	0	0	0.0	17	18	0.9
Sprain	220	241	12.3	11	12	10.1	231	253	12.1
Strain	426	545	27.7	23	28	23.5	449	573	27.5
Blister	29	29	1.5	4	4	3.4	33	33	1.6
Abrasion/laceration	93	105	5.4	1	1	0.8	94	106	5.1
Contusion	186	199	10.1	12	15	12.6	198	214	10.3
Other traumatic injuries	103	109	5.6	9	9	7.6	112	118	5.7
Total traumatic injuries		1,340	68.1		75	62.9		1,415	67.8
Other injuries	90	93	4.7	8	8	6.7	98	101	4.9
Total injuries	1,076	1,911	97.2	64	113	94.7	1,140	2,024	97.0

[a] Rate, number of injuries per 1,000 soldier-months.

injured anatomic sites were the knee (15%), lower back (14%), foot (14%), and ankle (12%) (data not shown). For all injuries, 35% were right sided, 33% left sided, 8% bilateral, and the remainder (24%) unknown or unspecified.

Injury Limited Duty Days

In addition to time spent for clinic visits, injuries among soldiers often result in workdays lost and/or days of limited activity (profile days; Table V). As expected, the rate for profile days exceeded the rate for workdays lost in all categories. These data exclude the 27 injuries detected only from radiology records. Figure 1 shows the limited duty days by specific injury type. Limited duty days represent the sum of profile days and workdays lost. Strains, sprains, and fractures accounted for 18%, 16%, and 15%, respectively, of all limited duty days. Stress fractures/reactions accounted for 4.2% of all limited duty days. A total of 22,041 limited duty days were generated by 1,997 injuries for all types combined, an average of 11 limited duty days per injury (plus the day of the clinic visit). Figure 2 gives the mean number of limited duty days on a per case basis for each type of injury, showing that stress fractures/reactions and fractures generated the most limited duty days per injury (28 and 44, respectively).

Causes of Injury

Injury rates by self-reported causes for men and women are shown in Figure 3. Of the specified injury causes, parachute jumping was the leading cause of injury in this population for both genders. Several causes were directly related to other formally organized military activities, such as marching. The category of running could represent either formal military activities or personal off-duty running/jogging. Several of the causes, such as motor vehicle accidents, sports, and recreation, were not related to specific performance of military duties. Figure 3 demonstrates that the activities resulting in the highest injury rates (approximately one-half of all injuries) resulted from formal military-related activities (parachuting, marching, other military training). Compared with men, women suffered more from these types of injuries, whereas men had proportionately more sports injuries.

TABLE V

RATES OF CLINIC VISITS, PROFILE DAYS, WORKDAYS LOST, AND LIMITED DUTY DAYS, BOTH GENDERS COMBINED, FORT BRAGG 82ND AIRBORNE DIVISION, 1996–1997

	Clinic Visit Rate[a]	Profile Day Rate[a]	Lost Workday Rate[a]	Limited Duty Rate[a]
Stress fracture/reaction[b]	2.4	44	0.1	44
Overuse injury	35.6	314	2.4	317
Fracture	7.3	154	8.4	163
Traumatic injury	89.2	641	23.3	664
Total injury	133.3	1,030	26.4	1,057

[a] Rates expressed per 1,000 soldier-months; limited duty days include both profile days and workdays lost.

[b] Includes stress fractures and stress reactions.

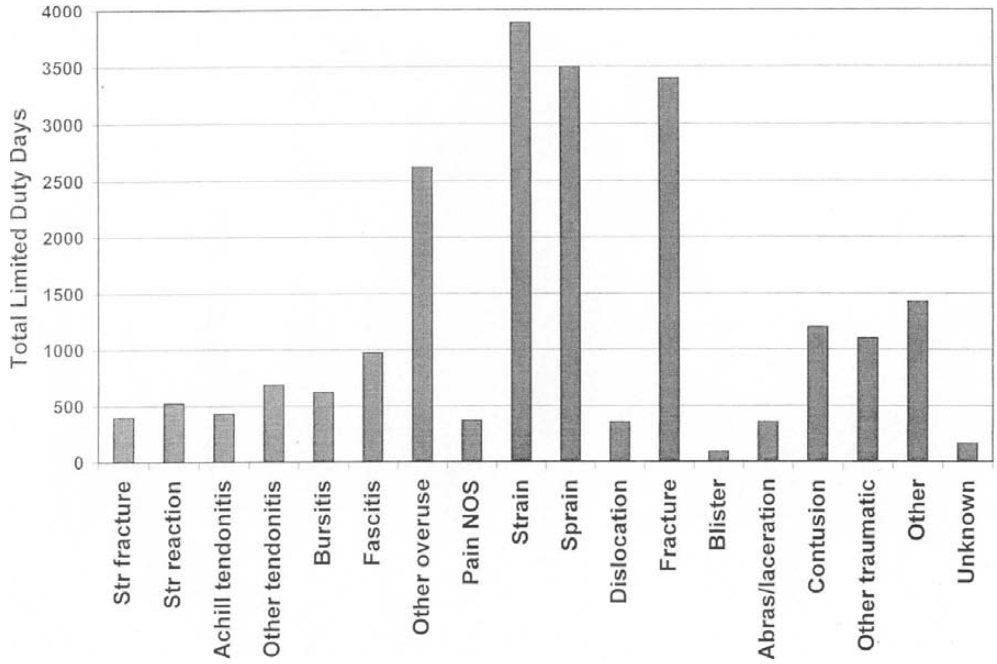

Fig. 1. Total limited duty days by type of injury, Fort Bragg 82nd Airborne Division, 1996–1997 (n = 1997 injuries).

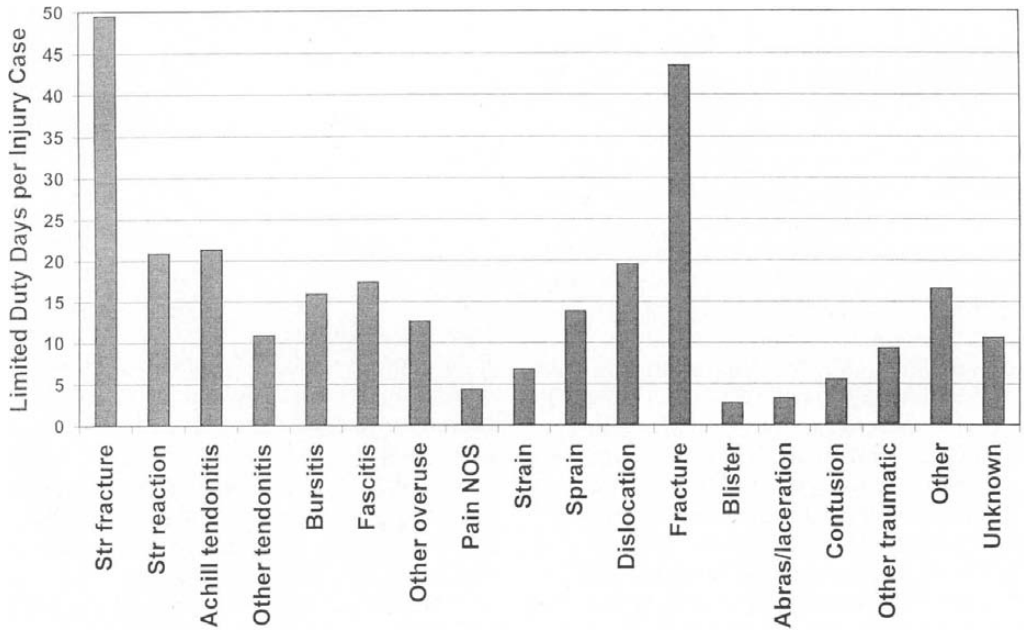

Fig. 2. Average number of limited duty days per injury case, by type of injury, Fort Bragg 82nd Airborne Division, 1996–1997 (n = 1997 injuries).

When looking at specific types of injuries, the "other" and "unknown" causes were often, but not always, the primary contributors. Stress fractures/reactions were caused mostly by running and parachuting (6 and 7 of 33 cases, respectively), but an additional 14 cases were classified as "other" or "unknown" cause. Among the 83 cases of tendonitis, the primary cause (other than "other" and "unknown," with 36 cases) was running (18 cases). For both fascitis and "other overuse" injuries, running was the most important specified cause at approximately one-quarter of each. Approximately 21% of strains were caused by parachuting, whereas sport activities were responsible for 10% of strains. Sprains were caused by parachuting (32%), sports (16%), and running (14%). Thirty-two percent of fractures were caused by parachuting with sports responsible for another 14%. Marching caused 46% of all blisters. Parachuting caused 34% of all contusions but only 21% of the "other traumatic" injuries (the "other" cause was responsible for 47% of "other traumatic" injuries).

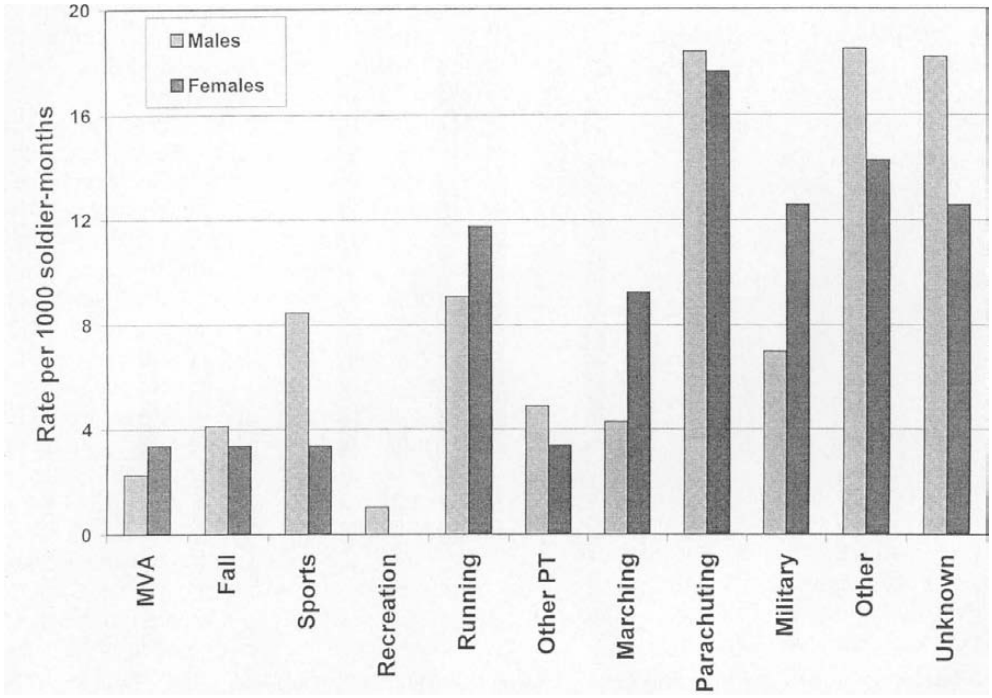

Fig. 3. Injury rate per 1,000 soldier-months, by gender and self-reported cause, Fort Bragg 82nd Airborne Division, 1996–1997 (n = 20, 859 soldier-months).

Discussion

This cohort study provides a comprehensive evaluation of the musculoskeletal injury experiences of 1,965 soldiers over a 1-year period, as determined through abstraction of their medical records. The results of this study indicate that injury detracts substantially from the combat readiness of operational military units, as reflected in extensive limited duty days. Traumatic injury rates were higher than for overuse injury (6.8 versus 2.4 per 100 soldier-months, respectively) with total injuries resulting in an average of 1.1 limited duty days per soldier each month (comprising 4.5% of total workdays).

The airborne soldiers of this study were from a variety of units with approximately one-third as combat troops and the remainder in combat support. The overall injury rate of 97 injuries per 1,000 soldier-months (116 injuries per 100 soldier-years, i.e., average of 1.2 injuries per soldier per year) measured in this study is similar to rates reported in other studies of operational units. For example, one study of Army active duty soldiers found an injury rate of 81 per 100 soldier-years with rates varying from 54 to 223 per 100 soldier-years depending on type of unit.[13] In two studies of Army infantry soldiers, annual injury rates of 142 and 160 injuries per 100 soldier-years were reported.[12,14] A recent review of the British Army's morbidity surveillance system found an injury rate of 62 per 100 soldier-years.[21]

Most military studies have examined injuries in basic training and have found that overuse injuries were more frequent than traumatic injuries. A recent multiservice (Navy and Marine Corps recruits) study found that most musculoskeletal injuries were overuse injuries.[22] Four additional recruit studies found that the proportions of all injuries attributable to overuse were 77%,[1] 78%,[9] 82%,[3] and 86%.[7] High overuse injury rates are expected in basic training populations due to the generally low level of physical fitness of new recruits who are suddenly exposed to intense physical activity.[5,14,23–25] In our Fort Bragg population, only 25% of the injuries were classified as overuse, probably as a result of greater exposure to risks of traumatic injury from parachuting and other operational activities and to having already developed a high level of physical fitness during and after basic training.

There have been several military injury studies that included internal comparison of subjects in high intensity physical activity environments with those in a less physically active setting. In a study of the Norwegian 1-year officer candidate training program, a much higher risk of injury was found during the more physically active initial basic training period of 5 to 6 weeks.[26] In a 1999 study comparing injuries in female trainees in three different settings, the more physically demanding programs resulted in higher injury rates.[22] These studies demonstrate higher risk for injury in training programs where rapid physical conditioning is attempted. Injury rates can generally be reduced through a more gradual approach to achieving the desired fitness level.[8]

Stress fractures are often used as an indicator of both the intensity and magnitude of medical problems associated with military training.[22,27] In our population, the overall stress fracture/reaction rate was 1.8 per 1,000 soldier-months, or an annual incidence of 2.2%. One study measured a similar stress fracture rate,[28] but many studies have reported higher rates among various military populations.[3,7,9,12,25,29–33] The highest rate (70 per 1,000 soldier-months) reported was in a study of female recruits.[1]

Of particular importance with respect to injury is the cost of such injuries. One measure of cost is the number of days lost from duty (workdays lost) and/or days of reduced work activity (profile days). This airborne population lost 4.5% of duty days to injury, either as profile days or workdays lost. A similar rate was

found in a South African recruit population.[3] Of the days lost to injury at Fort Bragg, only 30% were due to overuse injuries, whereas 63% were due to traumatic injuries. Two reports have found that more than 80% of days lost to injury were due to overuse injuries.[3,7] When workdays and profile days for Fort Bragg were combined, overuse injuries claimed 13.0 days per case, and traumatic injuries 9.8 days per case. Three other studies found lower days lost per case,[2,3,7] whereas one found higher average days lost per case.[1] However, comparisons can be difficult to interpret due to differences in the definitions of days lost and types of injury. Regardless of the differences, these lost days are significant when one considers the potential manpower lost and associated economic costs.

All personnel in this airborne population were required to make routine parachute jumps. The act of parachuting poses unique risks[34,35] and could explain some of the differences in injury rates when this population is compared with other nonparachuting military groups. Evidence for high traumatic injury risk is shown in Figure 3, where parachuting resulted in the highest overall injury rate of all known injury causes. In a prior 20-month study of parachuting injuries at Fort Bragg,[34] parachutists suffered 0.5 fractures per 1,000 soldier-months, or 1.0 fractures per 1,000 jump exits. A study of Army Rangers found 1.4 parachuting fractures per 1,000 soldier-months, or 2.0 per 1,000 jump exits.[36] Both of these studies were in operational units. Our study found 25 fractures attributed to parachuting (1.2 per 1,000 soldier-months).

This comprehensive evaluation of injury experience in the 82nd Airborne Division population has several strengths and weaknesses. Strengths of the study include the completeness and detail of information collected on each injury. Injuries were categorized specifically, which allowed for detailed analysis of the types of injuries that occurred in this operational military population. For example, of the 1,997 injuries detected through medical record abstraction, all but 41 listed a specific anatomic location. Also, record abstraction was performed several times each week to capture all clinic visits and establish accurate at-risk person-time data. Another strength of the study was the ability to evaluate several aspects of each injury and clinic visit. Rates were able to be calculated for types of injuries, injury visits, and days of limited duty. Because military populations are very mobile, loss to follow-up was a potential problem, yet 88% of the potential person-time was followed. For those lost to follow-up, the mean soldier-years was 0.51, indicating a uniform loss throughout the 1-year study period.

A weakness of the study is the small number of women followed, which produces unreliable rates for this subset of the population. Another weakness relates to the possible misclassification of some injury types as either a traumatic or overuse. For example, all strains were classified as traumatic injuries. Examination of the medical records showed that some strains could be attributed to chronic activities, better fitting a definition of overuse injury. Consequently, some overuse injuries were misclassified as traumatic injuries. Consistent with our categorization, however, Craig and Morgan [34] found that nearly one-fifth of all acute lower extremity injuries directly related to parachute jumping were diagnosed as strains, as were some parachuting-related upper extremity and neck/lower back injuries. Another weakness of the study was the incompleteness of self-reported data in the medical record concerning the cause of the injury. Whereas 62% of the 1,997 injuries detected through medical record abstraction cited a cause, 38% were coded as other, unknown, or not available.

This study provides a detailed description of injury experience in a cohort of active duty airborne Army personnel over a 1-year period. The study documents the large negative impact of injury on military readiness. Even though strains and sprains resulted in the highest injury rates and the most limited duty days, fractures and stress fractures/reactions produced the most days lost per injury. On average, each soldier experienced more than one injury per year, resulting in over 13 days of limited duty. The implied dollar costs of these injuries are enormous, amounting to thousands of dollars per soldier in lost training, lost salary (i.e., salary paid during recovery), medical care, rehabilitation, disability payments, etc. From a pubic health perspective, the prevention of injury and reduction of severity of injuries in the military directly impacts both cost and readiness to conduct military operations.

These data provide estimated rates of nonfatal injuries in an operational military unit, which indicate the need for prevention as a top priority. Numerous studies have documented the extent of the negative impact of injuries in military training. There is strong evidence that even the routine performance of operational military duties is high risk. This study shows that, in this cohort, approximately one-half of all injuries were occupational (i.e., occurred while on duty). It is important that future studies successfully capture complete data regarding causes of injury. Without knowledge as to cause, there is little possibility for prevention. Clinicians need to routinely query patients about the causes of their injuries and make sure they are recorded and reported. Better prevention strategies need to be developed and implemented by commanders. Furthermore, once prevention programs are in place, their effectiveness in reducing the human and economic costs must be continually evaluated.

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