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Negative First-Term Outcomes Associated with Lower Extremity Injury during Recruit Training among Female Marine Corps Graduates

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This study assessed the impact of lower extremity injuries and stress fractures during recruit training on first-term outcomes among female Marine Corps graduates. Injury data were collected from women recruits at Parris Island, South Carolina (1995–1999) and negative first-term outcomes were obtained from the Career History Archival Medical and Personnel System. The three negative outcomes included (1) failure to complete first-term of service, (2) failure to achieve rank of corporal, and (3) failure to reenlist. Overall, 22% did not complete their first-term enlistment and 12% of those who did were not promoted to corporal. After adjustment for demographic characteristics, not completing first term and not being promoted to corporal were both associated with injuries or stress fracture during training. Reenlistment was not associated with training injuries. Our findings indicate lower extremity injuries among women undergoing Marine Corps recruit training are associated with poor first-term outcomes even among those who graduate.

Introduction

Lower extremity musculoskeletal injuries are a significant problem in military populations and have a major impact on operational readiness. In 1999, musculoskeletal conditions, including stress fractures, were responsible for at least 14,000 hospital admissions and almost 4.3 million outpatient visits among active duty personnel in the four U.S. Armed Services.[1] These conditions also account for limited duty rates of 40 to 120 days per 100 soldiers per month.[2] In training populations, the incidence of both musculoskeletal injury and stress fracture is higher among women than among men and accounts for considerable attrition.[3] For male Marine Corps recruit training graduates, the occurrence of a training injury, particularly a stress fracture, is associated with poor long-term military outcomes,[1,3] but little is known about female Marine Corps graduates. This research augments a Center for Naval Analyses report[4] by including injuries sustained during recruit training as a possible determinant of first-term success. There are no articles published in scientific or medical literature on the association between lower extremity injury sustained during recruit training among female Marine Corps recruit graduates and first-term outcomes.

The Chief of Naval Operations' Top Five Readiness Priorities for the Navy[5] emphasize efforts to reduce first-term enlistment attrition. First-term attrition and low first-term reenlistment directly affect manpower, and current and future readiness. First-term attrition and injury prevention are critical to military operational readiness. The General Accounting Office estimated that in fiscal year (FY) 1996 alone, the services lost $390 million due to enlistees who separated before they completed 6 months of service.[6]

This study was designed to examine the impact of musculoskeletal injuries and stress fractures during recruit training on postrecruit training attrition in female Marines, using multiple career outcomes including failure to complete the first-term enlistment, failure to achieve the rank of corporal during the first term, and failure to reenlist after completion of the first term.

Subjects

Subjects were women who attended the U.S. Marine Corps Recruit Depot (MCRD) at Parris Island in Beaufort, South Carolina. The Fourth Battalion at MCRD Parris Island is the only entry-level training site for Marine Corps female recruits; therefore, this sample has the potential to represent the entire population at risk from a single location. After providing informed consent, recruits were enrolled into the study and completed a questionnaire. These volunteers were obtained in two cohorts, the first between June 1995 and September 1996 and the second between June and September 1999. Since data were collected for more than a year, the investigators believe the seasonal variations in recruit accessions are limited.[7]

Methods

Subjects, Recruitment, and Follow-Up

The study design was historical cohort. This design uses an exposure, illness, or injury, about a population, as it was at some time in the past and determines the subsequent status of the population with regard to the outcome of interest. In 1999, the Naval Health Research Center, San Diego, California, completed a study of 3,786 female Marine Corps recruits which formed the historical cohort for the current study. One thousand seventy-one female recruits who did not complete basic training (28%) were not included in the prospective analysis, resulting in a sample size of 2,715 female Marines. The institu-

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tional review board approved the original studies before they were conducted and, at a later date, approved the prospective follow-up of these recruits.

The historical recruits had been followed through the 12 weeks of training or to graduation to ascertain the incidence of stress fracture and other musculoskeletal injury, discovered by self-referral during sick call to the branch medical clinic or battalion aid station. Recruits who reported symptoms of stress fracture or other musculoskeletal injury were examined and diagnosed by a medical doctor; some recruits entered the medical rehabilitation platoon (MRP) for injury rehabilitation, healed, and were reassigned to a new training platoon, eventually graduating longer than 12 weeks on board.

Outcome Data

The Career History Archival Medical and Personnel System (CHAMPS) was used to obtain information on first-term outcomes.[8] Using information codes from the Defense Enrollment Eligibility Reporting System, CHAMPS is able to provide a detailed chronological record of changes in Military Occupational Specialty (MOS), duty station assignments, and medical and career events.[8] First-term was defined as the period after MCRD graduation, and included School of Infantry training and any specialized MOS training before matriculating into the Fleet Marine Force, up to 48 months of service. Failure to complete the first-term enlistment was defined as less than 48 months of completed service in the Marine Corps. Two additional negative first-term outcomes were assessed: failure to achieve the rank of corporal within the first-term enlistment period and failure to reenlist (defined as less than 52 months of active service in the Marine Corps) among those who completed their first-term enlistment.

Injury Data

For analysis purposes, two injury measures were created: "Any musculoskeletal injury" included one or more lower extremity musculoskeletal injury; "Stress fracture" included one or more stress fracture at any body site. The recruits were followed through training to ascertain musculoskeletal injury and stress fracture incidence, discovered by self-referral during sick call to the branch medical clinic or battalion aid station. Recruits who reported symptoms of a musculoskeletal injury or stress fracture were examined and diagnosed by a medical doctor. Stress fracture case diagnoses were based on (1) the clinical presentation of localized pain of insidious onset, without prior acute trauma, aggravated by repetitive weight-bearing activities and relieved with rest; and (2) a confirmatory (+) radiograph or bone scan or both at a site consistent with the clinical presentation. Cases were coded according to the criteria of the International Classification of Diseases (Ninth Revision, Clinical Modification).

Demographic Data

From the survey questionnaire, self-reported age, weight, height, and race/ethnicity were obtained from the trainees. A measure of body mass (BMI) was calculated as weight (in kilograms) divided by the square of height (in meters).

All Marine Corps recruits must have the equivalent of a high school education. In addition, an aptitude test is administered upon entry into the service. The Armed Forces Qualification Test (AFQT) is designed to measure the potential for military success and to screen out individuals who are not likely to complete the initial training program.[4,6,9,10] Furthermore, the higher the AFQT score, the more opportunities for advancement there are within the military.[4] The AFQT score is based on raw scores for 4 out of 10 sections of the Armed Services Vocational Aptitude Battery: word knowledge, paragraph comprehension, arithmetic reasoning, and mathematics knowledge.[10] The raw scores are combined, weighted, and converted to percentiles and categorized into six categories: The highest category (I) consists of those in the 93rd to 99th percentile, category II (65–92%), category IIIA (50–64%), category IIIB (31–49%), category IV (10–30%) and category V (1–9%). No recruit can be in the lowest 10th percentile (category V). Since only a small proportion (6%) of recruits can be within the 10th to 30th percentiles, we combined categories IIIB and IV; therefore, four AFQT groups were used in the analysis.

Statistical Analysis

Descriptive statistics were used to characterize participating recruits. Descriptive data included means, medians, percentages, and ranges. Initially, univariate logistic models were used to identify statistically significant differences between each injury exposure (lower extremity injury and/or stress fracture) and the demographic variables for each of the three attrition outcomes. Adjusted logistic regression models were developed to identify statistically significant differences between injury exposure sustained during recruit training (either any lower extremity overuse injury or stress fracture) and each of the three attrition outcomes while adjusting for all of the demographic variables. In all cases, statistical significance was determined by a $p < 0.05$ or confidence intervals (CIs) that did not include 1.0.

Results

Recruit Characteristics

A total of 2,715 women from the historical sample graduated from Marine Corps basic training. The final sample size was 2,420 women, after omitting subjects with missing follow-up information. The prospective sample included 1,071 women (44%) who incurred a lower extremity injury during training and 87 women (3.6%) who had a confirmed stress fracture during training (Table I). The majority of women were non-Hispanic Caucasian (62%), followed by non-Hispanic African American (18%), and Hispanic (14%). The "non-Hispanic, other" category (6%) consisted of Asian and Pacific Islander and Native American/Native Alaskan. The women had completed a median of 12 years of education, and 96.6% of the women fell within AFQT categories II, IIIA, or IIIB (a score range of 31–92%). (The DoD has established guidelines for recruiting, accession attrition, retention, and reenlistment.[11,12] Recruiters rely on AFQT scores as a primary measure of recruit potential. The distribution of AFQT scores for our study sample (Table I) are comparable to the AFQT scores for fiscal year 1998 non-prior service accessions for Marine Corps women,[9] indicating that this study sample is a strong representation of the Marine Corps women,[9] indicating that this study sample is a strong representation of the Marine Corps-wide female recruit population: category I,

TABLE I

SELECTED CHARACTERISTICS OF 2,240 FEMALE MARINE CORPS GRADUATES, PARRIS ISLAND, 1995–1996, 1999

Characteristic	Mean (SD) or %	*n*
Lower extremity injury during training	44.3	1,071
Lower extremity stress fracture during training	3.6	87
Race/ethnicity		
Caucasian, non-Hispanic	61.7	1,494
African American, non-Hispanic	18.3	444
Hispanic	14.4	349
Other, non-Hispanic[a]	5.5	133
AFQT categories (percentiles)		
I (93–99)	3.3	79
II (65–92)	37.2	901
IIIA (50–64)	31.7	767
IIIB (31–49)	27.7	671
IV (10–30)	0.1	2
Age (years) entering basic training	19.0 (1.96)	
Weight (pounds) entering basic training	127.7 (14.58)	
Height (inches) entering basic training	64.4 (2.56)	
Calculated BMI (kg/m^2)	21.6 (1.92)	

[a] Includes Asian/Native American/Native Alaskan/Native Hawaiian/Pacific Islander.

3.3% vs. 4.7%; category II, 37.2% vs. 33.2%; category IIIA, 31.7% vs. 30.1%; and category IIIB, 27.7% vs. 31.8% for our sample compared with the DoD population report, respectively.[9]) Study participants ranged in age from 17 to 32 years, with an average age of 19 years. At entry to basic training, these women had a mean height of 64.4 inches, mean weight of 127.7 pounds, and mean BMI of 21.6 kg/m^2.

First-Term Outcome Measures

Overall, 22% of the 2,420 women who graduated from basic training were discharged before the end of their first-term service. Among the 1,879 women who completed their first term, 228 (12%) were not promoted to the rank of corporal during the first term and about half (51%) did not reenlist (Table II).

TABLE II

FIRST-TERM OUTCOMES FOR FEMALE MARINE CORPS GRADUATES, PARRIS ISLAND, 1995–1996, 1999

Outcomes	*n*	%	Total Sample
Failure to complete first term[a]	541	22.4	2,420
Not promoted to Corporal rank within first term	228	12.1	1,879
No reenlistment beyond first term[b]	949	50.5	1,879

[a] Defined as less than 48 months of completed service in the Marine Corps according to CHAMPS.

[b] Defined as less than 52 months of active service in the Marine Corps according to CHAMPS.

Failure to Complete First Term

As shown in Table III, after adjusting for race/ethnicity, AFQT categories, age, and BMI, women who had a lower extremity injury during training were less likely to complete their first-term enlistment than women who did not have an injury (adjusted odds ratio (AOR) = 1.7; 95% CI, 1.4–2.1). All race/ethnicity groups were more likely than non-Hispanic Caucasians to complete their first-term enlistment. After adjusting for race/ethnicity, AFQT categories, age, and BMI, women who had a stress fracture during training were less likely than those who did not to complete their first-term enlistment (AOR = 2.4; 95% CI, 1.5–3.8).

Failure to be Promoted to Corporal

After adjusting for race/ethnicity, AFQT categories, age, and BMI (Table IV), women who had a lower extremity injury or a stress fracture during recruit training were less likely to be promoted to corporal during their first-term enlistment than women who did not have an injury (AOR = 1.6; 95% CI, 1.3–2.1; and AOR = 2.1; 95% CI, 1.1–3.9, respectively). In both injury models, Hispanics were more likely than non-Hispanic Caucasians to be promoted to corporal. In addition, women scoring between 10 and 64% on the AFQT (categories IIIA and B) were less likely to be promoted when compared with the highest category (category I). Age had no bearing on the relationship, while BMI was associated with failing to be promoted (as BMI increased, the likelihood of nonpromotion also increased).

Failure to Reenlist

The AORs shown in Table V showed no association between either sustaining a lower extremity injury or stress fracture during recruit training and subsequent reenlistment (Table V). However, women scoring below 65% on the AFQT (categories IIIA, IIIB, and IV) were less likely to reenlist than women scoring 93% or higher (AOR = 2.7; 95% CI, 1.5–4.9 for category IIIA and AOR = 2.9; 95% CI, 1.6–5.2 for categories IIIB and IV).

Figure 1 summarizes the findings for all three attrition outcomes and lower extremity injuries and stress fractures during training. The strongest relation for both lower extremity injury and stress fracture is seen for failure to complete the first term enlistment (AOR = 1.7 and 2.4, respectively). A moderate but still statistically significant association for lower extremity injury and stress fracture is found for not being promoted to corporal during the first term (AOR = 1.6 and 2.1, respectively). The relation for both lower extremity injury and stress fracture and failure to reenlist is no different than the reference group (AOR = 1.1 and 1.2, respectively).

Discussion

Stress fracture rates during Marine Corps recruit training are well documented.[13–16] The stress fracture incidence among Marine Corps women during recruit training has been reported to be 5.7%[13]; in this study, the stress fracture incidence during training was 5.1% (95% CI, 4.4%–5.8%). Medical treatment can also affect recruit training graduation rates. Stress fracture standard of care was followed but taken on a case-by-case basis; metatarsal stress fractures usually heal in 2 to 4 weeks and

TABLE III

AORS FOR FAILURE TO COMPLETE FIRST-TERM ENLISTMENT AND LOWER EXTREMITY INJURY OR STRESS FRACTURE DURING TRAINING, 2,420 FEMALE MARINE CORPS GRADUATES, PARRIS ISLAND, 1995–1996 AND 1999

	Lower Extremity Injury		Stress Fracture	
	AOR[a]	95% CI	AOR[a]	95% CI
Lower extremity injury during training				
No	1.00[b]		1.00[a]	
Yes	1.71	(1.41, 2.08)	2.40	(1.53, 3.75)
Race/ethnicity				
Caucasian, non-Hispanic	1.00[b]		1.00[b]	
African American, non-Hispanic	0.73	(0.56, 0.95)	0.76	(0.58, 0.99)
Hispanic	0.51	(0.37, 0.70)	0.49	(0.36, 0.70)
Other, non-Hispanic[c]	0.52	(0.32, 0.85)	0.53	(0.33, 0.88)
AFQT categories (percentiles)				
I (93–99)	1.00[b]		1.00[b]	
II (65–92)	0.66	(0.39, 1.12)	0.71	(0.42, 1.19)
IIIA (50–64)	0.85	(0.50, 1.44)	0.92	(0.54, 1.56)
IIIB and IV (10–49)	0.85	(0.50, 1.45)	0.90	(0.53, 1.54)
Age (years) entering basic training	1.02	(0.97, 1.07)	1.01	(0.96, 1.06)
Calculated BMI (kg/m^2)	1.04	(0.99, 1.10)	1.04	(0.99, 1.10)

[a] Adjusted for all other variables in Table III.

[b] Indicates reference category.

[c] Includes Asian/Native American/Native Alaskan/Native Hawaiian/Pacific Islander.

femoral shaft or femoral neck stress fractures typically heal in 4 months.[17] A 1-year follow-up of the long-term impact of stress fractures sustained in men undergoing recruit training describes the impact of stress fractures after graduation.[18] In that analysis, 13.6% of male recruits who sustained a stress fracture had a protracted recovery period, experiencing pain at the stress fracture site associated with prolonged activity months after returning to duty,[18] suggesting that some recruits who sustain a stress fracture during recruit training do not fully recover before returning to duty. That study also found that 10.6% had a recurrent stress fracture and only 47% had an uneventful recovery and were asymptomatic after the first period of recovery. Furthermore, recruits who did not sustain a stress fracture during basic training were at a low risk (1.7%) of stress fracture during the 1-year follow-up.[18]

The Naval Health Research Center completed a first-term enlistment follow-up of male Marine Corps recruits using a historical cohort design similar to this one. Among a historical cohort of 1,131 male recruits from MCRD San Diego studied in 1993, those who suffered from a stress fracture during recruit training and still graduated were over two times more likely to be discharged before the end of their first-term enlistment for any reason, and more than six times more likely to be discharged before the end of their first-term enlistment due to a physical

TABLE IV

AORS FOR PERSONNEL NOT PROMOTED TO CORPORAL WITHIN THE FIRST-TERM ENLISTMENT AND LOWER EXTREMITY INJURY AND STRESS FRACTURE DURING TRAINING, 1,879 FEMALE MARINE CORPS GRADUATES, PARRIS ISLAND, 1995–1996, 1999

	Lower Extremity Injury		Stress Fracture	
	AOR[a]	95% CI	AOR[a]	95% CI
Lower extremity injury during training				
No	1.00[b]		1.00[b]	
Yes	1.64	1.28, 2.10	2.06	1.09, 3.90
Race/ethnicity				
Caucasian, non-Hispanic	1.00[b]		1.00[b]	
African American, non-Hispanic	0.90	0.65, 1.24	0.93	0.68, 1.28
Hispanic	0.52	0.35, 0.78	0.51	0.34, 0.76
Other, non-Hispanic[c]	0.87	0.52, 1.46	0.89	0.53, 1.49
AFQT categories (percentiles)				
I (93–99)	1.00[b]		1.00[b]	
II (65–92)	2.64	0.81, 8.66	2.74	0.84, 8.96
IIIA (50–64)	4.27	1.30, 14.03	4.55	1.39, 14.92
IIIB and IV (10–49)	5.14	1.56, 16.93	5.33	1.62, 17.51
Age (years) entering basic training	0.98	0.92, 1.05	0.97	0.91, 1.04
Calculated BMI (kg/m^2)	1.09	1.02, 1.16	1.08	1.02, 1.16

[a] Adjusted for all other variables in Table IV.

[b] Indicates reference category.

[c] Includes Asian/Native American/Native Alaskan/Native Hawaiian/Pacific Islander.

TABLE V

AORS FOR FAILURE TO REENLIST AND LOWER EXTREMITY INJURY OR STRESS FRACTURE DURING TRAINING, 1,879 FEMALE MARINE CORPS GRADUATES, PARRIS ISLAND, 1995–1996, 1999

	Lower Extremity Injury		Stress Fracture	
	AOR[a]	95% CI	AOR[a]	95% CI
Lower extremity injury during training				
No	1.00[b]		1.00[b]	
Yes	1.14	(0.94, 1.37)	1.20	(0.69, 2.09)
Race/ethnicity				
Caucasian, non-Hispanic	1.00[b]		1.00[b]	
African American, non-Hispanic	0.70	(0.54, 0.90)	0.70	(0.55, 0.90)
Hispanic	0.89	(0.69, 1.16)	0.89	(0.68, 1.15)
Other, non-Hispanic[c]	0.88	(0.60, 1.31)	0.89	(0.60, 1.32)
AFQT (percentiles)				
I (93–99)	1.00[b]		1.00[b]	
II (65–92)	1.76	(0.98, 3.14)	1.78	(0.99, 3.18)
IIIA (50–64)	2.71	(1.49, 4.87)	2.76	(1.53, 4.96)
IIIB and IV (10–49)	2.87	(1.58, 5.20)	2.91	(1.60, 5.27)
Age (years) entering basic training	0.97	(0.92, 1.01)	0.96	(0.92, 1.01)
Calculated BMI (kg/m^2)	1.03	(0.98, 1.08)	1.03	(0.64, 2.09)

[a] Adjusted for all other variables in Table V.

[b] Reference category.

[c] Includes Asian/Native American/Native Alaskan/Native Hawaiian/Pacific Islander.

disability.[19] However, these results were not published in the scientific or medical literature and the ORs were not adjusted for demographics and other covariates.

In the last 10 years, recruits who suffered from a stress fracture at MCRD San Diego (males only) or Parris Island (males and females), could have been sent to MRP, healed, then immediately discharged, or rolled back into training. There is no command policy or medical policy regarding stress fractures and retention, and no sex-specific practices. Current medical practice at MCRD Parris Island is to recommend separation for any recruit who experiences two or more stress fractures during recruit training. As a general rule the medical officer will separate recruits with severe stress fractures (pelvis, femoral neck, bilateral tibia) and sacral stress fractures (mostly women) because they take a long time to heal (T. May, unpublished observation).

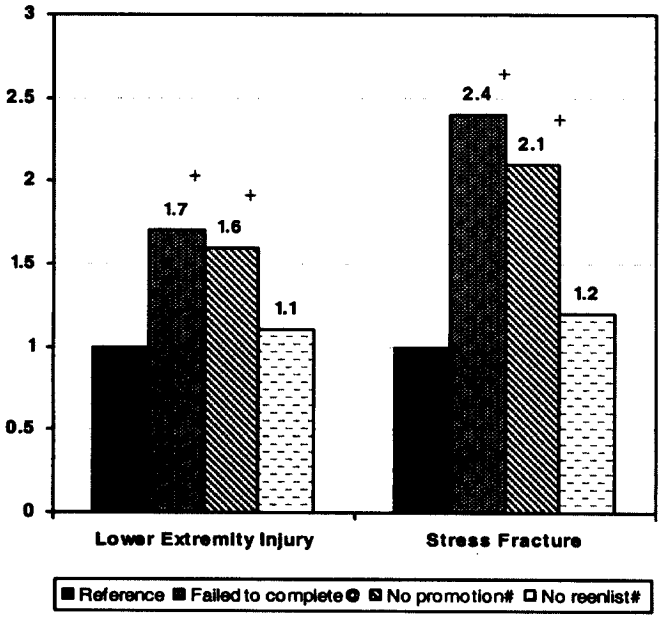

Fig. 1. AORs for first-term outcome indicators and lower extremity injury or stress fracture during training for 2,240 female Marine Corps graduates and 1,879 women who completed their first-term enlistment. AORs adjusted for race/ethnicity, AFQT category, age, and BMI. +, Statistically significant difference ($p < 0.05$) from the reference category.

Current medical practice at MCRD San Diego is to treat all stress fracture recruits on an individual basis. In general, if a recruit is in the MRP for any injury for an extended period of time, he is +less likely to resume training. Multiple metatarsal stress fractures (three or more), bilateral tibia stress fractures, or one femoral neck stress fracture usually means separation (T. May, unpublished observation).

Once a recruit graduates from basic training, efforts to retain qualified personnel focus on job satisfaction, health care, housing, and quality-of-life issues.[12,20,21] The Marine Corps career force requires 25% of the eligible first-term Marines to reenlist.[12] Marines have to be eligible for reenlistment and must request reenlistment within their expiration-of-active service time frame. First-term reenlistment requirements indicate that an eligible candidate must be corporal or higher, have a first class physical fitness test, no history or assignment to a weight-control program, no nonjudicial punishment, court-martial, or civilian convictions, and there must be "boat space" for their MOS,[22] which means that fast-filling MOSs could require command approval for a lateral move to a new MOS to reenlist. In contrast, a qualified Marine in a highly technical MOS may be eligible for a Selective Reenlistment Bonus. The Marine Corps can offer incentives to high-quality personnel to retain, educate, and train the first-term Marine based on career potential. Unplanned attrition in the MOS Corps-wide means the Marine has to be replaced.[22]

Musculoskeletal injuries are a significant problem in military recruit populations where unfit individuals are exposed to sudden increases in the volume and intensity of physical activity. Musculoskeletal injuries during military training are one of the

major causes of medical attrition.[3] Outpatient visits due to injuries are generally the result of musculoskeletal disorders associated with physical training and vigorous operational activities. These injuries have a significant impact on readiness. A fracture can account for >100 lost duty days and a simple sprain can result in several weeks of limited duty, either would restrict deployment. In the Department of the Navy, 58% of medical separations are for musculoskeletal/degenerative disorders.[1] According to Department of Defense (DoD) reports, it costs an average of $11,350 to recruit and train an active duty enlistee through basic training and initial skills training.[23] If in fiscal year 1998, 4,000 sailors and Marines were medically separated (based on trends described elsewhere), the cost could be $45.4 million in recruiting and training costs alone. Not computed in this total are total costs related to disability, hospitalization, prescription medication, and lost man-hours. All told, DoD pays $1.5 billion per year in orthopedic disability costs.[2] Furthermore, in relation to the cost of injuries, a relatively small amount of resources are devoted to prevention, surveillance, best practices program implementation, and research of injury causal factors in the Department of the Navy. The current status of injury surveillance and prevention efforts in the DoD is fragmented.[1]

The Marine Corps Recruiting Commands, in collaboration with the MCRD Recruit Training Regiments, are putting together a physical training program designed for incoming recruits. This program, soon to be administered by recruiters, is a primary prevention strategy whose goal is to change the risk of injury during recruit training and increase the graduation rate by increasing the incoming recruit's physical fitness. The "Poolee Physical Training Manual" and video are in postproduction. However, the recruiter's involvement is limited because there are potential legal ramifications if a recruiter "breaks" a recruit before they ship.

It is clear that training injuries are very costly in terms of health care resources and lost training days during recruit training.[1,2] Injuries can result in temporary and permanent impairments that can interfere with a service member's ability to perform. For example, the estimated fiscal impact of physical disability payments for the U.S. Army was $500 million for 1994 alone.[2] The cost of physical disability in the Marine Corps increased from $10.1 million in 1989 to $28.5 million in 1995.[2] A musculoskeletal injury can result in immediate separation from recruit training; however, for those recruits who suffered a musculoskeletal injury and completed training, the impact of such injuries has not been assessed beyond the training environment, along the accession pathway, and into the Fleet Marine Force.

Musculoskeletal injuries are costly not only because of health care costs but also the financial loss from attrition. The potential long-term impact of musculoskeletal injuries and stress fracture training-related injuries emphasizes the importance of early identification and prevention in training environments. In light of the increased escalation to fight the Global War on Terrorism, emphasis should be made to prevent training-related injuries, not on separating those who sustain an injury and therefore increase the recruit graduation rates for all the military services.

This study has limitations. We did not collect specific separation or reenlistment codes and therefore only analyzed broad-level associations between recruit training injury and the three outcomes of interest. Obstacles to analyzing more specific associations are stated in a General Accounting Office report[24]:

> DoD's current data on attrition is inconsistent and incomplete for two reasons. First, the services interpret DoD's definitions of separation codes differently and therefore place enlistees with identical situations in different discharge categories. Second, DoD's separation codes capture only the officially assigned reason for discharge, when many other factors may result in an enlistee's separation. DoD has not issued guidance for applying these separation codes.

However, it is known that first-term attrition before expiration-of-active service may be due to failure to meet medical, physical fitness or weight-control standards, pregnancy, failure to successfully complete alcohol or drug abuse rehabilitation, or unsatisfactory conduct or job performance.[25] Also not known is how many Marines who sustained an injury during recruit training were affected by first-term enlistment Stop-Loss orders, effectively requiring them to stay beyond the end of their active service, or if Stop-Loss orders affect only career Marines and not first-term enlistees. Not knowing Stop-Loss information may understate the effect of recruit injury on first-term enlistment outcomes.

The recruits who are diagnosed with severe stress fractures (pelvis, femoral neck, bilateral tibia) and sacral stress fractures (mostly women) are usually separated because they take a long time to heal. Therefore, this study does not represent the first-term outcomes of the recruits diagnosed with the most severe stress fractures and cannot infer outcomes to that group. Furthermore, first-term separation, failure to achieve the rank of corporal, or reenlisting might be due to some other trait and not due to the basic training injury, especially stress fracture, and therefore does not confirm or deny a causal relationship.

There were 295 (10.9%) of the 2,715 women from the historical sample who graduated from Marine Corps basic training with missing follow-up information who were excluded from the prospective sample. It is possible that the 295 omitted women could be significantly different than the final sample of 2,420 women.

Comments

These data suggest that a lower extremity injury during recruit training impedes future military success, even among the women who graduate. Several differences by injury status during training were found in three measures of military success (attrition, failure to complete first-term enlistment, and failure to achieve the rank of corporal during the first term). Women who graduated after incurring training injuries and especially stress fractures were less likely to complete their first-term enlistment. Because 44% of the women who graduated had incurred a lower extremity injury during training, this could significantly affect military readiness. This effect is even stronger among female graduates who had a stress fracture during training, but only approximately 4% of women are in this category. In addition, women who graduated after incurring recruit training injuries, especially stress fractures, and completed

their first-term enlistment were less likely to be promoted to corporal during the first-term enlistment than uninjured women. Among women who completed the first-term, there was no effect of injury or stress fracture during training on reenlistment status. Future work needs to be done to compare these rates with rates for male recruits and to explore variables other than age, race, and education that may affect this relation. In addition, follow-up on the efficacy of the Marine Corps Recruiting Commands' Poolee Physical Training Program a few years after its implementation by recruiters would help understand the association between the magnitude of change in fitness before recruit training and injury risk and graduation rates. Too many separations can affect the operational readiness of the Fleet Marine Force. The need for all of the services to write instructions and policy requiring injury prevention during the accession pathway may be warranted.

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