Factors Associated with Discharge During Marine Corps Basic Training

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This prospective study assessed risk factors for discharge from basic training (BT) among 2,137 male Marine Corps recruits between February and April 2003. Physical and demographic characteristics, exercise, and previous lower extremity injuries before arrival at Marine Corps Recruit Depot were assessed by questionnaire during intake processing. Stress fractures were confirmed by x-ray, triple-phase bone scan, or magnetic resonance imaging. Overall, 223 (10.4%) participants were discharged from training. In addition to the occurrence of a stress fracture during BT, older age (>23 years), non-Hispanic race, poor incoming self-rated physical fitness, no history of competitive exercise, and an incoming lower extremity injury with incomplete recovery were independent risk factors for discharge. Strategies to identify and allow the proper healing time for pre-BT lower extremity injuries, including interventions to improve the physical fitness of recruits before BT and reduce stress fractures during BT, may be indicated to lower attrition.

Introduction

Recruits entering Marine Corps basic training (BT) face a wide array of physical and psychological stressors that increase their likelihood of discharge. Although BT discharge rates have been shown to vary by time and service, and to be higher in women, estimates for the Marine Corps during the 1990s have suggested that 11 to 15% of men and 20 to 25% of women were discharged from BT.[1] The reasons for discharge are numerous and include a physical injury that is unlikely to heal sufficiently during training, psychological unsuitability, substance abuse, performance problems, a physical or psychological limitation that was not revealed before reporting to BT, or a combination of these factors. Discharged recruits place a financial strain on the military budget since the costs of recruitment, transportation, food, clothing, accommodations, training, wages, and medical care cannot be recouped once a recruit is separated. According to the Department of Defense, these costs of BT were estimated to be between $9,400 and $13,500 per recruit in fiscal year 1996.[2] Assessing independent risk factors for attrition is an important first step in identifying recruits who are at an increased risk for discharge. In addition, the knowledge gained from these risk factor studies can provide evidence-based information for designing future interventions to minimize BT attrition.

Attrition from BT is a vital concern for the U.S. military as evidenced by the number of previous investigations designed to identify risk factors. Studies on the demographic and physical characteristics of recruits associated with an increased risk for discharge have been numerous, likely due to the personal information contained in readily available databases. Results of these studies have shown that women,[3-5] those who are younger (<19 years) or older (>23 years),[6,7] those who are of Caucasian race/ethnicity,[3-5,8,9] and those with a history of psychiatric problems[10,11] are at an increased risk for discharge. The body composition of recruits has also been studied as a potential risk factor for attrition from BT[3,4,12,13]; however, due to the lack of variability from current military screening procedures, body composition is unlikely to be a major predictor of attrition. A low level of exercise before BT has been a consistent predictor of discharge,[5,14,15] whereas physical fitness assessed more objectively via exercise testing (e.g., 2.0-mile run time, number of push-ups completed in 2 minutes) has been shown to predict BT discharge in most,[4,15-17] but not all, studies.[13,18] Preservice injuries have also been associated with an increased risk of military attrition.[10,11] However, few studies have been able to isolate injuries that significantly affect the recruit's ability to successfully complete BT from those that have healed sufficiently and thus pose little risk of influencing attrition. The occurrence of an injury during training has also been reported as a strong determinant of whether a recruit will be discharged[4]; however, we are unaware of previous studies that have documented the impact of stress fracture injuries on the probability of discharge specifically among male Marine Corps recruits.

Despite reports citing predictors of attrition during military BT, few studies have been conducted among Marine Corps recruits. Additionally, few have examined a large number of risk factors in a single investigation to determine their independent effect and relative importance. The purpose of the current study was to evaluate the independent and combined effects of demographics, physical characteristics, exercise/fitness, and injuries before BT, and stress fractures during BT, on discharge among male U.S. Marine Corps recruits.

Methods

Study Population

The population for this study consisted of male U.S. Marine Corps recruits from the Marine Corps Recruit Depot (MRCD)

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San Diego, California. MCRD San Diego trains male Marine Corps recruits who enlist from states west of the Mississippi River. Marine Corps BT is an intensive and highly regimented 12-week program of physical conditioning and military skills training. All recruits, encompassing eight consecutive companies (four or five platoons), who entered MCRD San Diego from February to April 2003 were asked to participate in the current study during the second day of platoon formation, 3 days before the start of BT (N = 2,515). Of these, 2,146 (85.3%) agreed to participate and completed the baseline questionnaire. All participants were then followed until the date of graduation or discharge from BT, with the exception of 9 (0.4%) participants whose graduation/discharge status could not be located. These participants were excluded, leaving a final analytic sample of 2,137. All participants received the Privacy Act statement and signed a consent form in accordance with the guidelines of the Naval Health Research Center (NHRC) Institutional Review Board (protocol number NHRC.2002.0020) before completing the baseline questionnaire.

Baseline Questionnaire

Each entering company was administered the baseline questionnaire at the same time in an assembly fashion. Each questionnaire item was read aloud and NHRC study personnel circulated among the group to answer additional questions about the questionnaire items or procedure. Official Marine Corps personnel not associated with the study were not present during the administration of the questionnaire to ensure participant confidentiality.

The questionnaire included items to assess each participant's age, height, weight, race/ethnicity (non-Hispanic Caucasian, non-Hispanic African American, Hispanic, Asian, Pacific Islander, Native American), and marital status (married, separate/divorced/widowed, single/never married). Due to the low number of participants in some categories, three groups were formed for race/ethnicity (non-Hispanic Caucasian, Hispanic, other) and two for marital status (married, not married). Body mass index (BMI) was calculated as self-reported weight in kilograms divided by the square of self-reported height in meters. Other questionnaire items were designed to assess each participant's current physical fitness level (poor, fair, good, very good, excellent) and exercise participation during the 2 months before arrival at MCRD, including exercise frequency (times per week), level of sweating during exercise (never, occasionally, fairly often, quite a lot, most or all of the time), and participation in competitive exercise such as sports or marathons (yes/no). The frequency of running or jogging (times per week), lower body weight training (times per week), and participation in lower body stretching (yes/no) and pull-ups (yes/no) during the 2 months before arrival at MCRD for BT were also queried. In addition, participants were asked to report any previous lower extremity musculoskeletal injury that occurred before BT. A musculoskeletal injury was defined as any injury of the bone, muscle, tendon, ligament, and/or cartilage of the lower extremity. Participants who reported a history of one or more musculoskeletal injuries were then asked whether they were capable of returning to 100% of their "normal" physical activity following their injury.

Stress Fracture

All participants were followed through BT for the occurrence of a stress fracture injury. Suspected stress fracture injuries were first assessed by a corpsman, physician's assistant, or physician at the MCRD Branch Medical Clinic–Sports Medicine and Reconditioning Team Center. Participants with a suspected stress fracture were then referred by the clinic's licensed medical staff to the radiology department at the Naval Medical Center San Diego for confirmation by x-ray, triple-phase bone scan, or magnetic resonance imaging scan. A diagnosis of a stress fracture or stress reaction was confirmed by the senior staff radiologist. A stress fracture was defined as one or more partial or complete hairline fractures caused by repetitive loading on any lower extremity, nondiseased bone. A stress reaction was defined as an early stress fracture that did not disrupt the structure of the bone and therefore did not meet the definition of a stress fracture, but if left untreated would likely progress to an eventual stress fracture. For the purposes of the current study, a stress fracture or stress reaction were combined into a single category, hereafter referred to as a stress fracture.

The incidence of a stress fracture during BT was expressed as an incidence rate and an incidence density rate. The incidence rate was calculated as the number of participating recruits who suffered at least one stress fracture during BT divided by the total sample size, multiplied by 100. The person-time stress fracture injury incidence density rate was calculated as the number of persons who incurred at least one stress fracture during BT divided by the number of training day exposures (TDEs) accumulated by the sample population at risk, multiplied by 1,000. TDEs are a means of defining the person-time at risk when calculating an incidence rate and are defined as the summation of the total number of days each participant was injury free and participating in BT, therefore at risk of incurring a stress fracture. A participant was considered at risk of a stress fracture commencing the first day of BT and ending at the occurrence of the injury for those participants who suffered a stress fracture, or the date of graduation or discharge from BT for those who did not incur a stress fracture.

Graduation or Discharge Status

Training records at MCRD were searched to obtain the graduation or discharge status for all participants. Information abstracted included the event (graduation or discharge), date of event, and the reason assigned for those who were discharged. For the purposes of the current study, reasons for discharge were grouped into three categories, including behavioral, medical, or administrative. A behavioral discharge included personality disorders, substandard performance, misconduct, drug use, failure to adapt to the military training environment, or fraudulent entry. Medical discharges included participants who were separated due to physical problems. The sole administrative discharge included a declined waiver for excessive dependents.

Statistical Analyses

Discharge incidence according to each risk factor was calculated by dividing the number of participants who were discharged from BT by the number of participants within each risk factor category. Potential risk factors included demographic and

physical characteristics, self-reported exercise participation and lower extremity injuries before BT, and the occurrence of a stress fracture during BT. Age was categorized into three groups based on distributions shown in previous studies to be important thresholds associated with discharge. The remaining continuous risk factors (height, weight, and BMI) were categorized into approximately equal groups (quartiles) based on the distribution of the risk factor in the total population. The univariate association between each risk factor and the incidence of discharge was evaluated using the χ^2 test.

To evaluate independent risk factors of discharge from BT, all potential risk factors displayed in Tables I and II, regardless of their level of statistical significance, were entered into an automated backward elimination logistic regression model. The backward elimination model selection procedure began with all factors in a saturated model and removed each factor with the lowest level of statistical significance based on the Wald χ^2 test, with a reassessment of the model after the removal of each factor. The selection procedure ended when all factors in the multivariate model were associated with discharge from training at the $p < 0.05$ level. The adjusted odds ratios and 95% confidence intervals were reported for presentation from the final multivariate model. SAS version 9.1 (SAS Institute, Inc., Cary, North Carolina) was used to perform all analyses.

TABLE I

UNIVARIATE RELATIONS OF SOCIODEMOGRAPHIC AND PHYSICAL CHARACTERISTICS WITH DISCHARGE

	Total No.[a]	Discharge Incidence (%)	χ^2 (*df*)	*p*
Age (years)			11.3 (2)	0.004
<19	564	11.7		
19–23	1,363	9.0		
>23	210	16.2		
Height (inches)			1.2 (3)	0.8
<68	446	11.2		
68–69	472	10.0		
70–71	538	9.5		
>71	677	11.1		
Weight (pounds)			4.5 (3)	0.2
<149.7	537	11.7		
149.7–168.7	532	10.2		
168.8–187.6	522	8.2		
>187.6	542	11.6		
BMI (kg/m^2)			3.6 (3)	0.3
<22.0	533	12.4		
22.0–24.2	527	9.7		
24.3–26.9	541	9.1		
>26.9	530	10.8		
Race/ethnicity			14.4 (2)	0.0007
Hispanic	437	5.5		
Other	298	12.1		
Non-Hispanic Caucasian	1,401	11.6		
Marital status			7.1 (1)	0.008
Married	163	16.6		
Not married	1,974	9.9		

[a] N = 2,137. Categories may not sum to the total sample size due to missing data.

Results

Of the 2,137 male participants, 10.4% (n = 223) were discharged from training. The most common reason for attrition included a medical-related event (53.4%, n = 119), followed by a behavioral discharge (43.5%, n = 97). The remaining discharges included 1 (0.4%) administrative discharge and 6 (2.7%) discharges for whom we could not locate an assigned reason.

Table I displays the univariate associations between the physical and demographic characteristics of participants and discharge from BT. Age, race/ethnicity, and marital status were each significantly associated with discharge during BT, while height, weight, and BMI were each nonsignificant predictors of discharge.

The univariate associations of exercise and lower extremity injury before BT and the occurrence of a stress fracture during training with the incidence of discharge are shown in Table II. Several measures of exercise performed before arrival at BT were significantly associated with discharge, including physical fitness, sweating during exercise, competitive exercise, running/jogging frequency, and lower body weight training. In addition, lower extremity injuries before BT and the occurrence of a stress fracture during training were significantly associated with discharge. Exercise frequency, lower body stretching, and the practice of pull-ups before BT were not associated with discharge.

In our sample of 2,137 participants, 6.0% (n = 128) suffered at least one stress fracture during BT. When expressing the incidence of a stress fracture during training as a function of the TDEs for the entire population (173,726 TDEs), the incidence density rate was 0.74 per 1000 TDEs. Among those who were discharged from BT (n = 223), 38 suffered at least one stress fracture during 10,997 TDEs, for an incidence rate of 17.0% and an incidence density rate of 3.46 per 1000 TDEs. Ninety of those who graduated from BT (n = 1,914) suffered at least one stress fracture over 162,729 TDEs, for an incidence rate of 4.7% and an incidence density rate of 0.55 per 1000 TDEs.

Table III shows the final multivariate model, including independent risk factors for discharge during BT. The oldest participants (>23 years) were 57% more likely to be discharged compared with those aged 19 to 23 years. Those who were non-Hispanic were also more likely to be discharged. Compared to those with a self-reported fitness level of excellent or good, those with a poor or fair fitness level were nearly three times more likely to be discharged during training. Nonparticipation in competitive exercise before BT increased the risk of discharge by 45%. Interestingly, only those who suffered a lower extremity musculoskeletal injury without complete recovery before BT were more likely to be discharged, with no increase in risk for those who reported a previous injury with complete recovery. The occurrence of a stress fracture during BT was the most powerful predictor of discharge, with those who suffered a stress fracture more than four times more likely to be discharged than those who did not suffer a stress fracture.

Discussion

The primary purpose of the current prospective study was to evaluate potential risk factors for attrition from Marine Corps BT in male recruits. The risk factors studied included items from previous research considered to be important predictors of at-

TABLE II

UNIVARIATE RELATIONS OF EXERCISE HISTORY AND INJURY WITH DISCHARGE

	Total No.[a]	Discharge Incidence (%)	χ^2 (df)	p
Self-rated physical fitness			37.1 (2)	<0.0001
Poor/fair	643	16.3		
Good	1081	8.8		
Very good/excellent	409	5.6		
Exercise frequency (time/week)			6.3 (2)	0.05
≤2	553	13.0		
3	493	10.8		
≥4	1,086	9.0		
Sweating during exercise			22.9 (2)	<0.0001
Never/occasionally	496	16.1		
Fairly often	823	9.4		
Quite a lot/most or all of the time	813	8.1		
Competitive exercise			11.7 (1)	0.0006
No	902	13.1		
Yes	1,225	8.5		
Run/jog frequency (times/week)			10.7 (3)	0.01
None	101	12.9		
1–2	774	12.7		
3	481	10.6		
≥4	774	7.8		
Lower body weight training (times/week)			7.3 (2)	0.03
≤2	1,313	11.8		
3	373	8.0		
≥4	429	8.2		
Lower body stretching			2.2 (1)	0.1
No	428	12.4		
Yes	1,678	10.0		
Practiced pull-ups			0.8 (1)	0.4
No	506	11.5		
Yes	1,609	10.1		
Previous lower extremity injury			8.2 (2)	0.02
Injury with incomplete recovery	42	23.8		
Injury with complete recovery	391	10.0		
No injury	1,634	10.2		
Stress fracture during training			54.0 (1)	<0.0001
No	2,009	9.2		
Yes	128	29.7		

[a] $N = 2,137$. Categories may not sum to the total sample size due to missing data.

trition from military recruit training. However, a limitation of these previous studies has been the inability to evaluate multiple factors concurrently to assess their relative importance in predicting the risk for discharge. Our study extends these findings by simultaneously controlling for each risk factor in a multivariate statistical model to assess the relative strength and independence of each factor in one study population.

Of the six independent risk factors for discharge from BT highlighted in the current study (Table III), all but three are nonmodifiable: age, race/ethnicity, and participation in competitive exercise before BT. Thus, before their official start of BT, recruits with an incoming poor/fair level of physical fitness can be placed within a comprehensive training program designed to increase their cardiorespiratory fitness, muscular strength, and endurance to minimize their likelihood of discharge. In fact, in a recently published report, Knapik et al.[19] described the effectiveness of a fitness assessment program for Army recruits who failed an entry-level physical fitness test before basic combat training. Three groups of recruits were studied: (1) those who passed or (2) failed the entry-level test and entered directly into basic combat training, and (3) those who failed the test, but instead were assigned to a preconditioning program of running, weight training, road marching, and stretching before training. They found that those recruits who failed the initial fitness test and completed the preconditioning program had lower rates of attrition and injury during basic combat training compared with those who also failed the entry-level fitness test but did not complete the preconditioning program. The MCRD physical conditioning platoon trains substandard recruits to physical standards; however, we are unaware of the effectiveness of this program with respect to discharge and/or injury. Commanders, recruiters, and trainers should advocate for a conservative, comprehensive, and progressively increasing program of preconditioning to enhance the physical fitness of low-fit recruits before the start of BT.

Using hospital medical records to verify diagnoses, we described the incidence of stress fractures, a major cause of attrition from military recruit training.[20–23] We calculated the incidence rate and the incidence density rate. The incidence density rate is preferred when attempting to compare two or more

TABLE III

INDEPENDENT RISK FACTORS FOR DISCHARGE FROM MARINE CORPS BT

	AOR	95% CI	p^a
Age (years)			0.05
<19	1.39	(0.99, 1.95)	
19–23	1.00	ref	
>23	1.57	(1.01, 2.44)	
Race/ethnicity			0.001
Non-Hispanic Caucasian	2.28	(1.43, 3.63)	
Other	2.55	(1.44, 4.51)	
Hispanic	1.00	ref	
Self-rated physical fitness			<0.0001
Poor/fair	2.95	(1.80, 4.85)	
Good	1.56	(0.96, 2.54)	
Very good/excellent	1.00	ref	
Competitive exercise			0.02
No	1.45	(1.07, 1.97)	
Yes	1.00	ref	
Previous lower extremity injury			0.01
Injury with incomplete recovery	3.25	(1.49, 7.09)	
Injury with complete recovery	1.07	(0.73, 1.57)	
No injury	1.00	ref	
Stress fracture during training			<0.0001
Yes	4.19	(2.73, 6.45)	
No	1.00	ref	

N = 2,137. AOR, adjusted odds ratio; CI, confidence interval; ref, referent level.

[a] From the Wald χ^2.

incidence rates across populations that differ in the duration of time the sample populations were considered to be at risk. This is particularly important when comparing stress fracture incidence rates across the services, since the duration of recruit training is dependent upon the branch of service. Results of the current study suggest that participants who suffered a stress fracture were over four times more likely to be discharged during training. Interventions designed to reduce the incidence of stress fractures during recruit training, as well as programs aimed at early detection and management, are indicated.

In the current study, male recruits with a lower extremity injury that did not heal completely before BT were over three times more likely to be discharged than recruits who reported no previous injury. No statistically significant excess risk of attrition was found among participants who suffered a pre-BT lower extremity injury that had healed sufficiently. Previous studies have not differentiated between pre-BT injuries that have incompletely healed from pre-BT injuries that have healed completely. We believe additional risk factor studies are necessary to confirm these findings. In addition, while pre-BT lower extremity injuries cannot be targeted directly for intervention at recruit training centers, recruits who report a pre-BT injury can be sent to a local military physical therapy department to have their previous injuries clinically screened and managed to help prevent or lower the risk of reinjury and attrition.

Nonparticipation in competitive exercise before BT was shown to be an independent risk factor for attrition, although the strength of the association was modest. One explanation for this finding may be that competitive sports participation represents an individual skills component related to intrinsic motivation, perseverance, and drive toward competitive activities (qualities that may lead to the successful completion of BT) that was not entirely captured from the self-report item of physical fitness, which was also significantly inversely associated with discharge. We also speculate that recruits who participated in competitive exercise may have been more likely to be engaged in team sports, although no distinction was made in our questionnaire between team (e.g., basketball, soccer, football) and competitive individual exercise activities (e.g., bodybuilding, marathons). One of the requirements for success in team sports is the ability for each member to work together toward a shared common goal, such as winning. The transition from civilian to military life demands that all entering recruits renounce their individual identity, conform without hesitation to established military policies, and work in partnership with fellow recruits toward the success of their unit. Therefore, military recruit training may be an environment where the utilization of team-oriented skills learned during civilian competitive sporting activities may differentiate a successful from an unsuccessful recruit. Previous studies have reported that successful Basic Underwater Demolition/SEAL (BUD/S) trainees are those who are involved in their work and adept at group activities.[24] A recent qualitative study of eight BUD/S instructors also highlighted team orientation as a predictor of successful completion of BUD/S training.[25]

Non-Hispanic race/ethnicity and older age were independent, nonmodifiable risk factors for discharge. Age has generally shown a bimodal association with discharge since both younger and older recruits have been shown to be at an increased risk.[6,7] We confirmed this bimodal association; however, the increased risk of attrition among the youngest participants was not statistically significant. An increased risk for discharge among those of a Caucasian race/ethnicity has been frequently reported across the services, without a clear explanation.[3–5,8,9]

A strength of the current study was the ability to evaluate risk factors for BT discharge across several domains to assess the relative importance and independent effect of each risk factor, a limitation of previous studies examining attrition from BT. In addition, the generalizability of our results is enhanced by the high participation rate and the recruitment of a large sample of recruits using a systematic sampling strategy that incorporated eight consecutive companies. Furthermore, the use of medical records that documented clinically confirmed stress fractures, as opposed to a recruit's self-report, increased the accuracy of our stress fracture injury rates.

We acknowledge several limitations of our study. First, we relied upon self-report or rating of previous exercise habits, fitness, and injuries before BT, as opposed to incorporating objective markers of fitness such as a test of cardiorespiratory fitness or muscular endurance, and medical record documentation for pre-BT injuries. Self-reported exercise has been shown to be subject to social desirability bias.[26] However, we were interested in using an inexpensive and prompt means of assessing these factors with a simple questionnaire that could be completed during recruit processing to identify high-risk recruits before the start of BT while minimizing the need for

additional military manpower or expense. Second, we were limited in our ability to evaluate whether potential risk factors investigated in the current study were consistent across the specific reasons for BT discharge due to the small number of participants within each discharge category.

In summary, the results of the current study suggest that there are several potentially modifiable risk factors for discharge from Marine Corps BT. These factors include a self-reported poor/fair incoming physical fitness level, a previous injury without complete recovery, and the occurrence of a stress fracture during training. Older age, non-Hispanic race/ethnicity, and nonparticipation in competitive exercise before BT were also important predictors of attrition. Although the sample population was limited to male Marine Corps recruits, we believe there is no reason to assume that these risk factors would be different for males across the services. Therefore, commanders of basic training commands are encouraged to consider the potential for conservative, comprehensive, and progressively increasing preconditioning programs before BT to enhance the fitness level of low-fit recruits, to identify and properly manage incoming recruits with a pre-BT lower extremity musculoskeletal injury that has not healed completely, and to incorporate preventive tactics designed to lessen the stress fracture risk among recruits during training.

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14. ABSTRACT (maximum 200 words)

Purpose: To assess risk factors for discharge from basic training (BT) among 2,137 male Marine Corps recruits between February and April 2003. **Methods:** Physical and demographic characteristics, exercise, and previous lower extremity injuries prior to training were assessed by questionnaire during intake processing. Stress fractures were confirmed by x-ray, triple-phase bone scan, or magnetic resonance imaging. **Results:** Overall, 223 (10.4%) participants were discharged from training. In addition to the occurrence of a stress fracture during BT, older age (>23 years), non-Hispanic race, poor incoming self-rated physical fitness, no history of competitive exercise, and incoming lower extremity injury with incomplete recovery were independent risk factors for discharge. **Conclusions:** Strategies that allow identification and proper healing time for pre-BT lower extremity injuries, including interventions to improve the physical fitness of recruits prior to BT and reduce stress fractures during BT, may be indicated to lower attrition during training.

15. SUBJECT TERMS
military personnel, exercise, physical fitness, injury, stress fracture

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