Stress Fracture Incidence and Risk Factors Among Army Recruits During Initial Entry Training

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For athletes and Soldiers, stress fractures (SF) limit their ability to train and perform. For the Army, unit-level surveillance tracks SFs among new recruits during initial entry training, including basic training (BCT: 10 weeks) and one station unit training for military police, engineers and infantry, (OSUT: 13-19 weeks). SFs have been previously reported for BCT but not for OSUT.

PURPOSE: Describe SF incidence for recruits who began BCT and OSUT from 1 October 2009 to 30 September 2011 and identify SF risk factors.

METHODS: Army Training and Doctrine Command provided personnel rosters with demographic data (sex, age, height, weight, and race) for recruits who began BCT and OSUT from October 2009 to September 2011 (24 months).These data were linked to injury data from the Defense Medical Surveillance System. SF incidence was calculated (SFs per 100 recruits) for BCT and OSUT. Quartiles of BMI (kg/m^2) were calculated for men and women separately. Logistic regression (odds ratio [OR] and 95% confidence interval [CI]) was used to compare injury odds for "SF" compared to "no SF."

RESULTS: Analysis included 166,767 men (BCT: n=112,239; OSUT: n=54,528) and 39,995 women (BCT: n=37,031; OSUT: n=2,964. SF incidence was higher in OSUT than BCT for men (OSUT: 28.3%; BCT: 7.2%; p<.001) and women (OSUT: 36.9%; BCT: 33.3%; p<.001). After adjusting for age, race, BMI, and training type, women (BCT and OSUT, combined) had 5 times higher SF odds than men (OR=5.3 [4.9-5.9]). After adjusting for age, race, and BMI, recruits in OSUT had higher SF odds compared to those in BCT (men: OR= 4.4 [4.0-4.8]; women: OR=4.9 [4.3-5.5]). For men and women, SF odds increased with age (per year) (men: OR=1.09 [1.09-1.10]; women: OR=1.06 [1.05-1.07]) and SF odds were highest for recruits in the lowest BMI quartile ([1st BMI quartile vs. 2nd quartile] men: OR=1.3 [1.1-1.4]; women: OR=1.2 [1.0-1.3]).

CONCLUSION: During Army initial entry training, women are at greater odds of SF compared to men and SF odds are higher for men and women in OSUT when compared to BCT. Older age and low BMI appear to be key risk factors in this training environment.

BACKGROUND.

Stress fractures are common among athletes who participate in weight-bearing sports such as running, basketball, soccer, lacrosse, and ballet. In the short term, stress fractures limit the athlete's ability to train and compete. But some stress fractures, such as those that involve the femoral neck, can also have significant long-term sequelae that include hip fracture or avascular necrosis.

Stress fractures are also common during the initial entry training courses for new recruits entering the Army. This training involves high levels of weight-bearing exercise and activity. Similar to athletes, recruits with stress fractures are unable to train, may require medical discharge from the Army, and can have long term sequelae from the injury.

Previous reports of stress fracture rates during the Army 10-week Basic Combat Training (BCT) course have ranged from 0.8% to 5.1% for men. But only two-thirds of new Army recruits attend BCT. The remainder attend one of three longer training courses that combine the 10-week BCT with job-specific training for recruits who will be infantry soldiers, engineers, or military police. These One Station Unit Training (OSUT) courses range from 13.5 to 19 weeks in duration. Unlike BCT, stress fractures rates among OSUT recruits have not been previously reported.

PURPOSE. To report stress fracture rates for Army recruits who attended BCT or OSUT (infantry, engineer or military police) between 1 October 2009 and 30 September 2011 and to evaluate potential risk factors for stress fracture. This poster focuses on the stress fracture analysis among male recruits.

METHODS.

Army Training and Doctrine Command provided personnel rosters with demographic data (sex, age, height, weight, and race) for recruits who began BCT or the infantry, engineer or military police OSUT courses from October 2009 to September 2011 (fiscal years 2010-2011). These data were linked to injury data from the Defense Medical Surveillance System. Stress fractures were identified using ICD-9-CM codes 733.93-733.98. The stress fracture case definition required at least two medical encounters with a stress fracture diagnosis. Stress fracture rates (number recruits with a stress fracture per 1,000 person-months of training) were calculated for BCT and each of the OSUTs. Stress fractures rates for the first 10 weeks of each OSUT course were compared to the rates during the 10-week BCT course. Similarly, logistic regression (odds ratio [OR] and 95% confidence interval [CI]) was used to compare the odds for stress fracture versus no stress fracture during BCT and the first 10 weeks of each OSUT.

RESULTS.

Demographic characteristics of male recruits who attended BCT or one of the OSUTs from 1 October 2009 to 30 September 2011 (fiscal years 2010 and 2011) are summarized in **Tables 1 and 2.** There were 167,767 male recruits. There were small but statistically significant differences in the distributions for age, race, and body mass index (BMI) comparing BCT to each of the OSUTs.

Table 1. Demographics of Initial Entry Training Recruits by Training Type (Men, fiscal years 2010-2011)

Characteristic	All Men (n=166,767)	Basic Combat Training (n=112,239)	OSUT - Engineer (n=8,123)		OSUT - Infantry (n=38,525)		OSUT - Military Police (n=7,880)	
	Percent	Percent	Percent	p-value[1]	Percent	p-value[1]	Percent	p-value[1]
Age (years)				0.001		0.001		0.001
17-19	43.60%	41.30%	48.30%		47.30%		54.90%	
20-24	39.50%	39.50%	38.40%		40.50%		35.20%	
25-29	10.90%	12.10%	8.70%		9.00%		6.50%	
30+	6.00%	7.10%	4.60%		3.20%		3.40%	
Unknown	0.00%	0.00%	0.00%		0.00%		0.00%	
Race				0.001		0.001		
White	67.80%	64.00%	70.20%		77.10%		73.60%	
Black	15.50%	18.80%	13.80%		7.40%		11.20%	
Hispanic	11.20%	11.40%	10.80%		10.50%		11.90%	
Other	5.40%	5.70%	20.00%		4.90%		3.20%	
Unknown		1.00%	0.20%		0.10%		0.10%	
Body Mass Index (kg/m^2)				0.001		0.001	0.001	0.001
Underweight (<18.5)	1.60%	1.60%	1.60%		1.60%		1.60%	
Normal weight (18.5 - 24.9)	48.50%	47.70%	48.70%		50.90%		47.80%	
Overweight (25 - 29.9)	37.50%	38.20%	36.20%		36.10%		36.90%	
Obese (≥30)	12.10%	12.40%	13.30%		10.60%		13.70%	
Unknown	0.30%	0.10%	0.10%		0.90%		0.10%	
Location of Training for BCT								
Jackson		48.60%						
Sill		20.40%						
Leonard Wood		15.70%						
Benning		15.30%						

[1] Chi-square comparing the OSUT training type to Basic Combat Training

Table 2. Mean Age and Body Mass Index of Initial Entry Training Recruits by Training Type (Men, fiscal years 2010-2011)

Characteristic	All Men (n=166,767)	Basic Combat Training (n=112,239)	OSUT - Infantry (n=38,525)		OSUT - Engineer (n=8,123)		OSUT - Military Police (n=7,880)	
	Mean ± SD	Mean ± SD	Mean ± SD	p-value[1]	Mean ± SD	p-value[1]	Mean ± SD	p-value[1]
Age (mean ± SD)	21.4 ± 4.3	21.7 ± 4.5	20.8 ± 3.6	.001	20.9 ± 3.9	.001	20.4 ± 3.5	.001
Body Mass Index (mean kg/m2)	25.2 ± 3.9	25.3 ± 3.9	25.0 ± 3.8	.001	25.3 ± 4.0	.002	25.4 ± 4.0	.001

[1] T-test comparing mean for the OSUT training type to Basic Combat Training

Table 3 presents the stress fracture rates for BCT and each OSUT. The rate for the entire length of each OSUT course (13.5 to 19 weeks) was compared to BCT rates. Rates for the first 10-weeks of each OSUT were also compared to the 10-week BCT rates. For the 10-week comparison, OSUT rates were 1.8 to 3.7 times higher than the BCT rate.

Table 3. Stress Fracture Rates and Rate Ratios (compared to BCT) for Complete Training Cycles and for the First 10 Weeks of Training for OSUTs

Training Type	Stress Fractures during Complete Training Cycles				Stress Fractures during First 10 Weeks of Training			
	Stress Fractures (n)	Rate (SF/1,000 per-mos)	Rate Ratio (compared to BCT)	95% CI	Stress Fractures (n)	Rate (SF/1,000 per-mos)	Rate Ratio (compared to BCT)	95% CI
BCT (n=112,239)	809	3.10	Referent	-	809	3.10	Referent	-
OSUT – Infantry (n=38,525)	1182	9.82	3.17	2.90 - 3.47	1035	11.55	3.73	3.40 - 4.09
OSUT – Engineer (8,123)	226	8.55	2.76	2.38 - 3.20	196	10.38	3.35	2.86 - 3.91
OSUT – Military Police (n=7,880)	157	4.51	1.46	1.23 - 1.73	103	5.62	1.81	0.47 - 2.07

Figure 1 shows the stress fracture rates for BCT and the OSUTs. The rate during the first 10-weeks of each OSUT course is represented by the darker portion of each vertical bar; the rate for the remaining weeks (infantry: 3.5 weeks; engineers: 4 weeks and military police: 9 weeks) is represented by the lighter portion of each bar. For each OSUT, the rate during the first 10 weeks is higher than for BCT.

Figure 1. Stress Fracture Rates (per 1,000 person-months) during the First 10 Weeks of Training and during the Remainder of Training for OSUTs

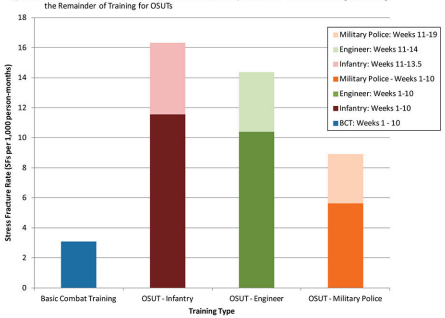
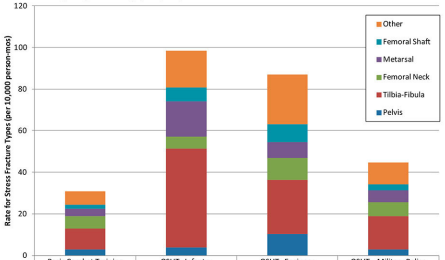


Figure 2 shows the stress fracture rates for anatomic locations of injury (stress fractures per 10,000 person-months) by training type. The tibia/fibula had the highest rate for each training type.

Figure 2. Stress Fracture Rates (per 10,000 person-months) for the Anatomic Location of Injury by Training Type during Complete Training Cycles (Men)



	Basic Combat Training	OSUT - Infantry	OSUT - Engineer	OSUT - Military Police
Other	6.6	17.6	23.8	10.6
Femoral Shaft	1.8	6.6	8.7	2.9
Metarsal	3.5	17.0	7.6	5.7
Femoral Neck	6.1	5.8	10.6	6.6
Tibia-Fibula	10.0	47.6	26.1	16.1
Pelvis	2.9	3.8	10.2	2.9

Table 4 presents the results of four multivariate logistic regression models for the association of stress fracture during the first 10-weeks of training and potential risk factors. In Model 1, which includes all male trainees, the stress fracture odds are higher for each OSUT compared to BCT. Odds for the infantry and engineer OSUTs are 4 and 3.2 times higher, respectively, than BCT. Models 2, 3 and 4 provide the adjusted odds for age, race, and BMI for each training type, separately. For each training type, age was a significant risk factor, with odds increasing by approximately 10% per year. From this, we would expect odds for 30 year old males to be two times higher than the odds for 20 year olds. Recruits who were white had the highest odds compared with recruits of other races. For each training type, odds were highest for recruits with lowest BMI, but this association was statistically significant only for BCT and infantry soldiers. Overall, and for men in BCT and Infantry OSUT, obese men had 33% to 38% lower odds compared to those with normal weight.

Table 4. Multivariate Models for the Association of Stress Fractures and Potential Risk Factors during the First 10 Weeks of Training, by Training Type

Risk Factor	All Men (Model 1)			Basic Combat Training (Model 2)			OSUT - Infantry (Model 3)			OSUT - Engineer (Model 4)			OSUT - Military Police (Model 4)		
	Odds Ratio	95% C.I.		Odds Ratio	95% C.I.		Odds Ratio	95% C.I.		Odds Ratio	95% C.I.		Odds Ratio	95% C.I.	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Training Type															
Basic Combat Training	1.00														
OSUT – Infantry	4.04	3.67	4.44												
OSUT – Engineer	3.71	3.17	4.35												
OSUT - Military Police	2.06	1.67	2.53												
Age (per year)	1.09	1.09	1.10	1.10	1.09	1.11	1.08	1.07	1.10	1.10	1.08	1.13	1.11	1.07	1.15
Race															
White	1.00			1.00			1.00			1.00			1.00		
Black	0.74	0.64	0.86	0.72	0.59	0.88	0.76	0.58	0.99	0.72	0.45	1.14	0.86	0.44	1.68
Hispanic	0.91	0.79	1.05	0.88	0.71	1.11	0.84	0.67	1.04	1.11	0.72	1.70	1.39	0.81	2.39
Other	0.77	0.63	0.95	0.77	0.57	1.05	0.78	0.57	1.08	0.58	0.27	1.25	1.34	0.53	3.37
Body Mass Index															
Underweight (<18.5)	1.83	1.40	2.40	2.12	1.42	3.17	1.68	1.13	2.50	1.10	0.34	3.53	1.99	0.61	6.47
Normal weight (18.5 - 24.9)	1.00			1.00			1.00			1.00			1.00		
Overweight (25 - 29.9)	0.78	0.71	0.86	0.74	0.63	0.86	0.79	0.69	0.91	0.89	0.65	1.23	0.82	0.53	1.25
Obese (≥30)	0.65	0.56	0.76	0.67	0.53	0.85	0.62	0.49	0.78	0.87	0.56	1.36	0.46	0.22	0.96
Location of Training															
Jackson				1.00											
Sill				0.60	0.46	0.78									
Leonard Wood				2.94	2.48	3.49									
Benning				2.41	2.01	2.89									

SUMMARY.

- This is the first report of stress fracture rates among Army recruits attending OSUT courses for infantry (13.5 weeks), engineer (14 weeks), and military police (19 weeks).
  - Men in the infantry, engineer, and military police OSUTs had 4.0, 3.7, and 2.1 times higher stress fracture odds, respectively, during the first 10-weeks of training than men in BCT.
  - The infantry and engineer occupational specialties are rated among the most physically demanding in the Army (very heavy). They also have among the highest requirements for weight bearing activity. By comparison, military police is rated moderately heavy for physical demands and lower levels of weight bearing activity.
- Stress fracture cumulative incidence during BCT has been reported in the past, ranging from 0.8% to 5.1% for men. The BCT stress fracture incidence for men in this study was 0.7% (809/112,239). This slightly lower incidence may have resulted from the case definition in this study that required "at least two medical encounters" with a stress fracture diagnosis, rather than "at least one encounter" as used in some previous studies.
- Risk factors for stress fracture from this study of male recruits in BCT and OSUT are similar to those reported in previous reports that included only BCT recruits.
  - Odds of stress fracture increased with age.
  - White men had the highest odds of stress fracture.
  - Men with the lowest BMI had the highest odds of stress fracture compared to those with normal BMI and successively higher BMI groups showed successively lower odds of stress fracture
- Odds of stress fracture during BCT varied by location with Forts Leonard Wood and Benning having more than 2 times higher odds than Fort Jackson.