Occupational, Physical Fitness, and Behavioral Risk Factors for Injury among U.S. Army Soldiers

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Abstract

In the U.S., injury risks vary by occupation, such as transportation, maintenance, or construction trades. Few studies of injury risk among military occupations can be found. Purpose: To investigate the association of occupation and occupational physical demand levels with injury risks among U.S. Army Soldiers. Methods: Military occupational specialty (MOS), physical demand level, physical training, physical fitness, and injury data were obtained by survey from enlisted male Soldiers in a U.S. Army light infantry brigade (n= 2,101). Physical demands for each MOS were categorized as "very heavy", "heavy", "moderately heavy", "medium", and "light". Odds ratios (OR) and 95% confidence intervals (95% CI) from a multivariable analysis assessing injury risk were calculated. Results: Overall self-reported injury incidence for the prior 12 months was 43%. Controlling for age, physical demand level, APFT push-up and sit-up, higher risk of injury was associated with several MOSs (OR (Chemical, explosives & ammunition/Infantry) = 3.53; OR (Armor/Infantry) = 1.53; OR (Military intelligence/Infantry) = 1.84), BMI >29.9 (obese) (OR (Obese/Normal) = 1.63), cigarette smoking (OR (Smoker/Nonsmoker) = 1.36), and low aerobic endurance (OR (Slowest 2 mile run time quartile/Fastest 2 mile run time quartile) = 1.65). A marginal association was found for Medical MOS (OR (Medical /Infantry) = 1.59). Conclusion: Results suggest Soldiers in certain Army occupations may be at higher risk of injury. Further investigation into reasons for their higher risk is warranted. Improvements in aerobic endurance, healthy weight maintenance, and reduction in smoking may reduce injuries in this population and similarly healthy active working populations.

Background

As in the U.S. workforce, within the U.S. Army there are a variety of occupations with unique physical demands and skills needed to successfully accomplish a wide variety of tasks. These occupations have been classified into Military Occupational Specialties (MOS). Each MOS has a specific job description and assigned physical demand level [1]. It is essential that Soldiers develop and maintain appropriate levels of physical fitness in order to perform at their required MOS physical demand level [2-3]. A few studies investigating physical demand level by U.S. Army occupation found Soldiers assigned to physically-demanding jobs are at an increased risk of injury, hospitalization, and disability [3, 7-8]. Another study found the five most frequent occupations receiving physical therapy for musculoskeletal injuries included Infantry, Engineering, Supply & Logistics, Maintenance, and Medical [9]. The purpose of this project was to investigate the association of MOS and physical demand levels by MOS on injury risk among U.S. Army Soldiers in a light infantry brigade.

Methods

Surveys were completed by active duty U.S. Army enlisted male Soldiers in a light infantry brigade as part of an ongoing evaluation of a physical training program. Demographic information (age, ethnicity, education, and marital status) and MOS were obtained from the Defense Medical Surveillance System, a data system maintained by the Armed Forces Health Surveillance Center. Data on smoking, physical fitness, and injuries during the last 12 months were obtained by survey. Cigarette smokers were identified as those who had smoked at least 100 cigarettes in their lifetime and smoked at least one cigarette in the previous 30 days from the survey administration date. Physical fitness was measured by self-reported Army Physical Fitness Test (APFT) performance and BMI calculated from self-reported height and weight. BMI was categorized according to the Centers for Disease Control and Prevention classification for "underweight", "normal", "overweight", and "obese" [10]. The APFT consists of a 2-mile run for time, a timed (2-minute) push-up event, and a timed (2-minute) sit-up event. APFT scores were converted into quartiles (Q) where Q4 = lowest performance and Q1 = highest performance. [11-12].

MOSs were grouped by occupational structure based on the Department of Defense occupational coding structure and modified slightly for this analysis [1]. All Soldiers were assigned a MOS physical demand level as listed in the Department of the Army Pamphlet (DA Pam) 611-21. DA Pam 611-21 rates physical demand levels for every entry-level enlisted MOS and provides a physical work requirement necessary under combat conditions. Categories of physical demand are as follows: "Very Heavy", "Heavy", "Moderately Heavy", "Medium", or "Light" [1].

Data were analyzed using the Statistical Package for Social Sciences (SPSS), Version 19.0. Odds ratios and 95% CI were calculated to assess the association of MOS and MOS physical demand levels on injury risk, controlling for variables known to influence injury risk in Army populations. Variables with a p-value ≤0.10 were entered into the multivariate model. Results from a backward stepping multivariate analysis are reported.

Results

Surveys were completed by 2,101 enlisted male Soldiers, with a mean (±SD) age of 26.5 ±6.0 years. A majority of Soldiers were Caucasian (72%), high school graduates (87%), married (61%), of lower rank (E1-E4) (63%), were classified as overweight or obese (61%) according to CDC adult BMI standards, and cigarette smokers (52%). There were a total of 895 Soldiers injured in the previous 12 months (43%), with three MOS groups accounting for 56% of all injuries (Infantry, Armor, and Repair/Maintenance). The six most frequent occupational groups seeking medical care were Infantry (23%), Armor (17%), Repair/Maintenance (16%), Supply & Logistics (10%), Signals & Communication (7%), and Engineers (6%). Injury risk was higher among seven MOS groups as compared to Infantry, those with a physical demand level rated as heavy, Soldiers older than 21 years of age, Soldiers with a rank of E-3 to E-9, Soldiers who were overweight or obese, cigarette smokers, and Soldiers that showed poorer performance on the APFT (≤55 push-ups completed, ≤60 sit-ups completed, or >14.67 minutes on the 2 mile run).

Variables entered into the multivariate model (Table 1) included MOS and physical demand level. To control for other risk factors, BMI, age, cigarette smoking, APFT push-ups, APFT sit-ups, and APFT 2 mile run were also entered into the model. Enlisted rank and age were correlated, so only age was used. Higher risk of injury was associated with selected MOSs (OR (Chemical, explosives & ammunition/Infantry) = 3.53; OR (Armor/Infantry) = 1.53; OR (Military intelligence/Infantry) = 1.84), BMI >29.9 (obese) (OR (Obese/Normal) = 1.63), cigarette smoking (OR (Smoker/Nonsmoker) = 1.36), and low aerobic endurance (OR (Slowest 2 mile run time quartile/Fastest 2 mile run time quartile) = 1.65). There was marginal increased injury risk found for Soldiers in the Medical MOS (OR (Medical/Infantry) = 1.59).

Table 1. Multivariate Logistic Regression of Injury Risk Factors among Enlisted Male Soldiers in a Light Infantry Brigade

Variable	Variable Level	N	Adjusted Odds Ratio (95% CI)	p-value
MOS	Infantry	504	1.00	
	Chemical, explosives, & ammunition	23	3.53(1.45-8.64)	<0.01
	Military intelligence	58	1.84(1.05-3.23)	0.03
	Engineers	73	1.47(0.89-2.45)	0.14
	Signals & communication	100	1.47(0.94-2.30)	0.10
	Medical	87	1.50(0.94-2.41)	0.09
	Armor	264	1.53(1.12-2.09)	<0.01
	Repair/Maintenance	243	1.31(0.94-1.81)	0.11
	Support/Administration	29	1.40(0.65-3.03)	0.40
	Supply & logistics	159	1.11(0.76-1.63)	0.58
	Transportation	76	0.96(0.57-1.61)	0.88
	Field & air defense artillery	74	1.07(0.64-1.80)	0.79
	Military police	39	0.78(0.38-1.60)	0.50
BMI	<18.5 (underweight)	11	0.95(0.26-3.43)	0.94
	18.5-24.9 (normal)	704	1.00	
	25.0-29.9 (overweight)	792	1.16(0.93-1.44)	0.19
	>29.9 (obese)	222	1.63(1.16-2.29)	<0.01
Cigarette Smoking	Nonsmoker	839	1.00	
	Smoker	890	1.36(1.12-1.66)	<0.01
APFT 2 mile	≤13.75 (Q1)	427	1.00	
	13.76-14.67 (Q2)	427	1.05(0.79-1.41)	0.74
	14.68-15.75 (Q3)	436	1.29(0.95-1.73)	0.10
	≥15.76 (Q4)	439	1.65(1.19-2.29)	<0.01

Model also controlled for age, MOS physical demand level, APFT push-up and APFT sit-up performance

Discussion

This study identified injury risk factors for enlisted male Soldiers in a U.S. Army light infantry brigade. Certain MOS groups (Chemical, explosives & ammunition, Armor, and Military intelligence) exhibited higher risks. Soldiers in the Medical MOS experienced slightly higher risk. Other independent risk factors for injury in this population included BMI of >29.9 (obese), cigarette smoking, and poor aerobic endurance (2-mile run time).

The MOS groups that showed higher risk of injury compared to Infantry had several common factors that could be seen as explanations contributing to the higher risk. Further analysis revealed that the Chemical, explosives & ammunition, Armor, and Military intelligence MOS groups were all older and less fit compared to the Infantry group, using APFT performance as the criteria for fitness. Both older age and poor fitness have been shown to be risk factors for injury in Army populations [8, 13-14]. In an investigation examining older age and injury, individuals over the age of 25 years had an increased risk compared to individuals under 20 years (OR = 3.5) [13]. As seen in prior studies of Army populations, low cardio-respiratory endurance (as measured by performance on the APFT run event) was a risk factor for injuries [2, 11]. Military intelligence and Medical also had higher average BMIs compared to other MOSs, which has been shown to be a risk factor for injury in Army populations [13].

We expected to see injury risk associated with MOS physical demand levels, but in this analysis physical demand level did not remain in the model. This could have occurred because almost 77% of the Soldiers in the brigade were categorized in the "Very Heavy" level, which created very little variability among the different levels of occupational physical demand.

Overall, self-reported injury incidence was 43% in this population, with an injury rate of 35.7 per 1,000 person-months. There are only a few other studies that have investigated injury risk in operational Army units. A British Army investigation found that 59% of male infantry Soldiers experienced an injury over a 12-month period in a sample size of 660 Soldiers, for an injury rate of 49.1 per 1,000 person-months [15]. There are multiple factors such as demographics, physical training programs, and environment that could explain why these injury rates are higher than those found in this population.

Another study found the five most frequent MOS groups that sought physical therapy treatment included Infantry, Engineering, Supply & Logistics, Maintenance, and Medical [9]. These findings are similar to results of this analysis, which indicated the MOS groups seeking the most medical care included Infantry, Armor, Maintenance, Supply & Logistics, and Signals & Communication.

Implications

Further investigation and evaluation of prevention efforts are needed for MOS groups at higher risk for injury. Improvements in aerobic endurance, healthy weight maintenance, and reduction in smoking may reduce injuries in this population and similarly young, healthy, physically active working populations.

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