

Lateral ankle sprain risk differs between occupations in the combat elements and branches of the United States Armed Forces

John J. Fraser, PT, DPT, PhD^{1,2}; Mark A. Dreyer, DPM, FACFAS^{1,3}; Michael D. Gibboney, DPM, FACFAS^{1,4}

¹Foot & Ankle Subcommittee, Neuromusculoskeletal Clinical Community Advisory Board, US Navy Bureau of Medicine and Surgery, Falls Church, VA; ²Warfighter Performance Department, Naval Health Research Center, San Diego, CA; ³Department of Surgical Services, Naval Health Clinic New England, Newport, RI; ⁴Orthopedics Department, Naval Medical Center Camp Lejeune, Camp Lejeune, NC



Statement of Purpose

To assess the factors of occupation within combat elements [ground/surface (GCE), aviation (ACE), logistics/services (LCE)] and military branch on risk of lateral ankle sprains (LASs) in all US Army, Navy Marine Corps, and Air Force personnel.

Methods/Procedures

A retrospective cohort study of all service members in the US Armed Forces was performed assessing military occupation within the GCE, ACE, and LCE on the outcome of LAS incidence. The Defense Medical Epidemiology Database was queried for the number of distinct patients diagnosed with LAS associated with the ICD-9 diagnosis codes 845.00 (sprain of ankle, unspecified site) and 845.02 (sprain of calcaneofibular ligament of ankle) on their initial encounter between 2006 and 2015. Relative risk (RR) point estimates and 95% confidence intervals (CIs), risk difference point estimates, and chi-square statistics were calculated in the assessment of occupation and military branch. The GCE served as the reference in the assessment of occupation with the combat elements. The Army served as the reference for comparison by military branch. The level of significance was $p \leq .05$ for all analyses. RR point estimates were considered statistically significant if CIs did not cross the 1.00 threshold.

Literature Review

Lateral ankle sprains (LASs) are ubiquitous among athletes,^{1,2} military service members,²⁻⁴ and the general public.^{2,5} While most LASs resolve within 1 year following injury, 40% will progress to develop chronic ankle instability,⁶ a condition characterized by persistent perceived or episodic giving way of the ankle that results in activity limitation and participation restriction.⁷ Most epidemiological studies of ankle sprain in the military have focused on cadets and midshipmen enrolled in the military academies⁸ or in recruit training.^{9,10} In the only epidemiological study of ankle sprain in all branches of the US military, Cameron and colleagues⁴ investigated the factors of age, sex, and branch of service on LAS rates from 1998 to 2006. This study epoch occurred during the transition from a period of relative peacetime to one of conflict that started following the initiation of Operation Enduring Freedom (OEF) in October 2001 and Operation Iraqi Freedom (OIF) in March 2003, with subsequent drawdowns occurring in 2010 from OIF and 2014 from OEF. Each branch of service comprises a diverse range of military occupations that have unique requirements for physical performance and encompass diverse environmental hazards. While prior studies have assessed military occupation as a factor in LAS in the US Army,^{11,12} it is unclear if these findings are generalizable to other branches of the military. Furthermore, changes in military operations resulting from evolving geopolitics may also influence injury rates. Due to the potential impact for degradation of unit readiness resulting from LAS, an updated assessment of burden of LAS in the military and the factors that can increase risk for this injury is warranted.

Results

Number and Cumulative Incidence of Lateral Ankle Sprains among the Combat Elements in the United States Armed Forces from 2006 to 2015

	Ground & Surface Combat Element			Aviation Combat Element			Combat Logistics & Services Element			Total		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
Army	32,746	534	26,907	899	61	960	82,927	20,773	103,700	116,572	21,368	131,567
Navy	1,238	217	1,276	1,730	236	1,966	35,647	7,955	43,602	38,615	8,408	46,844
Air Force	631	0	798	2,406	154	2,560	45,346	10,264	55,610	48,383	10,418	58,968
Marines	5,167	4	5,407	626	28	654	25,109	2,701	27,810	30,902	2,733	33,871
Total	39,782	755	34,388	5,661	479	6,140	189,029	41,693	230,722	234,472	42,927	271,250
Cumulative Incidence (per 1,000 person-years)												
Army	13.7	26.9	12.7	5.2	6.4	5.2	14.7	18.0	15.2	14.2	18.1	14.4
Navy	4.9	7.8	4.7	6.1	11.3	6.5	8.9	10.2	9.1	8.5	10.1	8.7
Air Force	7.8	-	7.7	6.0	7.2	6.0	11.5	11.5	11.5	10.9	11.4	11.0
Marines	7.0	4.7	6.9	5.2	7.9	5.3	11.8	12.8	11.9	10.3	12.7	10.4
Total	11.5	15.6	10.5	5.8	8.6	5.9	12.0	13.7	12.3	11.6	13.7	11.7

Assessment of Risk of Lateral Ankle Sprains by Combat Element in the United States Armed Forces from 2006 to 2015.

	US Army				US Navy				US Marine Corps				US Air Force			
	Aviation Combat Element*															
Relative Risk (95% CI)	0.41 (0.39-0.44)				1.39 (1.29-1.49)				0.76 (0.70-0.83)				0.79 (0.73-0.85)			
Risk Difference (per 1000 person-years)	-7.4				1.8				-1.6				-1.7			
<i>p</i>	<.001				<.001				<.001				<.001			
Combat Logistics & Services Element*																
Relative Risk (95% CI)	1.20 (1.18-1.22)				1.95 (1.85-2.06)				1.72 (1.67-1.77)				1.50 (1.40-1.61)			
Risk Difference (per 1000 person-years)	2.5				4.5				5.0				3.8			
<i>p</i>	<.001				<.001				<.001				<.001			

* Contrasted to the Ground Combat Element

Assessment of Risk of Lateral Ankle Sprains by Service Branch in the United States Armed Forces from 2006 to 2015*

	Ground Combat Element			Aviation Combat Element			Combat Logistics & Services Element		
	US Navy	US Marine Corps	US Air Force	US Navy	US Marine Corps	US Air Force	US Navy	US Marine Corps	US Air Force
Relative Risk (95% CI)	0.37 (0.35-0.39)	0.54 (0.53-0.56)	0.61 (0.56-0.65)	1.23 (1.14-1.33)	1.00 (0.91-1.11)	1.15 (1.06-1.23)	0.60 (0.59-0.61)	5.95 (5.90-5.99)	0.76 (0.75-0.76)
Risk Difference (per 1000 person-years)	-8.0	-5.8	-5.0	1.2	0.0	0.8	-6.1	75.3	-3.7
<i>p</i>	<.001	<.001	<.001	<.001	.96	<.001	<.001	<.001	<.001

* Contrasted to the US Army

Analysis and Discussion

- Combat Elements:** When compared with the GCE, the Army, Marine Corps, and Air Force ACE had significantly lower risk of LAS. Only the Navy ACE had significantly increased risk of LAS. The LCE of all service branches had consistently higher risk of LAS compared with the GCE.
- Service Branches:** When compared with the Army, the Navy, Marine Corps, and Air Force GCE and the Navy and Air Force LCE had lower risk of LAS. The Navy and Air Force ACE and the Marine Corps LCE had significantly higher risk.
- These findings are likely attributed to disparity between service branches and combat elements in occupational hazard exposure, adiposity, physical fitness, and health care access and utilization. Service-specific cultural factors also likely influence care seeking.¹⁶

References

- Luciano A de P, Lara LCR. Epidemiological study of foot and ankle injuries in recreational sports. *Acta Ortop Bras*. 2012;20(6):339-342. doi:10.1590/S1413-78522012000600005
- Doherty C, Delahunt E, Caulfield B, Hertel J, Ryan J, Bleakley C. The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. *Sports Med*. 2014;44(1):123-140. doi:10.1007/s40279-013-0102-5
- Ruscio B, Smith J, Amoroso P, et al. *DOD Military Injury Prevention Priorities Working Group: Leading Injuries, Causes and Mitigation Recommendations*. DTIC Document; 2006. http://bit.ly/2MPRz6P. Accessed November 19, 2014.
- Cameron KL, Owens BD, DeBerardino TM. Incidence of ankle sprains among active-duty members of the United States Armed Forces from 1998 through 2006. *J Athl Train*. 2010;45(1):29-38. doi:10.4085/1062-6050-45.1.29
- Waterman BR. The epidemiology of ankle sprains in the United States. *J Bone Jt Surg Am*. 2010;92(13):2279. doi:10.2106/JBJS.I.01537
- Doherty C, Bleakley C, Hertel J, Caulfield B, Ryan J, Delahunt E. Recovery from a first-time lateral ankle sprain and the predictors of chronic ankle instability: a prospective cohort analysis. *Am J Sports Med*. 2016;44(4):995-1003. doi:10.1177/0363546516628870
- Gribble PA, Delahunt E, Bleakley C, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International Ankle Consortium. *J Orthop Sports Phys Ther*. 2013;43(8):585-591. doi:10.2519/jospt.2013.0303
- Waterman BR, Belmont PJ, Cameron KL, DeBerardino TM, Owens BD. Epidemiology of Ankle Sprain at the United States Military Academy. *Am J Sports Med*. 2010;38(4):797-803. doi:10.1177/0363546509350757
- Almeida SA, Williams KM, Shaffer RA, Brodine SK. Epidemiological patterns of musculoskeletal injuries and physical training. [Miscellaneous Article]. *Med Sci Sports Exerc*. 1999;31(8):1176-1182.
- Linenger J, Shwayhat A. Epidemiology of podiatric injuries in US Marine recruits undergoing basic training. *J Am Podiatr Med Assoc*. 1992;82(5):269-271. doi:10.7547/87507315-82-5-269
- Bulathsinhala L, Hill OT, Scofield DE, Haley TF, Kardouni JR. Epidemiology of Ankle Sprains and the Risk of Separation From Service in US Army Soldiers. *J Orthop Sports Phys Ther*. 2015;45(6):477-484. doi:10.2519/jospt.2015.5733
- Teyhen DS, Goffar SL, Shaffer SW, et al. Incidence of Musculoskeletal Injury in US Army Unit Types: A Prospective Cohort Study. *J Orthop Sports Phys Ther*. 2018;48(10):749-757. doi:10.2519/jospt.2018.7979
- Fraser JJ, Schmied E, Rosenthal MD, Davenport TE. Physical therapy as a force multiplier: population health perspectives to address short-term readiness and long-term health of military service members. *Cardiopulm Phys Ther J*. In press.