Trends in the Incidence of Persistent Postconcussion Syndrome Among Active Duty US Military Personnel Between 1997 and 2007

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Traumatic brain injury and associated sequelae, such as persistent postconcussion syndrome (PCS), have emerged as important public health concerns among military personnel serving in Iraq and Afghanistan. The objective of this study was to examine trends in the incidence of PCS among US service members on active duty between 1997 and 2007. Our primary hypothesis was that the incidence rate for PCS would be relatively stable prior to the initiation of combat operations in Iraq and Afghanistan but would significantly increase after 2002. A retrospective cohort study was conducted utilizing data from the Defense Medical Surveillance System to identify all incident cases of PCS within the study population. Multivariable Poisson regression was used to analyze the data. The overall incidence rate for PCS among all active duty military personnel was 1.09 (95% CI= 1.07, 1.10) cases per 1000 person-years. The adjusted average annual percentage increase in the incidence of PCS from 1997 through 2002 was 8.1%. Following the initiation of combat operations, the average annual percentage increase in the incidence rate for PCS was 49.7%. In comparison to the baseline period (1997-2002), the incidence rate for PCS was 5 times higher (IRR=5.08, 95% CI= 4.83, 5.34) in 2007. Significant increases in the incidence rate for PCS were observed following the initiation of combat operations in Iraq and Afghanistan and trends were influenced by branch of military service, occupational group, and deployment status. The increase in the incidence for PCS suggests an increased burden on the Military Health System during wartime.

Learning Areas:
Epidemiology
Occupational health and safety
Public health or related public policy

Learning Objectives:
To evaluate changes in the incidence rate of persistent postconcussion syndrome over time in active duty military personnel prior to and following the initiation of combat operations in Iraq and Afghanistan.

Keywords: Mental Health, Traumatic Brain Injury

Poster References

1. Army Medical Surveillnace Activity. Defense medical epidemiological database users guide: Version 3.6.4 Silver Springs, Maryland: US Army Center for Health Promotion and Preventive Medicine; 2004.
2. Alves W, Macciocchi SN, Barth JT. Postconcussive symptoms after uncomplicated mild head injury. *J Head Trauma Rehabil.* 1993;8:48-59.
3. Barth JT, Macciocchi SN, Giordani B, Rimel R, Jane JA, Boll TJ. Neuropsychological sequelae of minor head injury. *Neurosurgery.* 1983;13(5):529-533.
4. Bohnen N, Twijnstra A, Jolles J. Post-traumatic and emotional symptoms in different subgroups of patients with mild head injury. *Brain Inj.* 1992;6(6):481-487.

5. Centers for Disease Control and Prevention. Traumatic brain injury in the United States: A report to congress Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Avilable at: http://www.cdc.gov/ncipc/tbi/mtbi/report.htm; 1999.
6. Centers for Disease Control and Prevention. Report to congress on mild traumatic brain injury in the United States: Steps to prevent a serious public health problem.: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Available at: http://www.cdc.gov/ncipc/tbi/mtbi.report.htm; 2003.
7. Hoge CW, Goldberg HM, Castro CA. Care of war veterans with mild traumatic brain injury--flawed perspectives. *N Engl J Med.* 2009;360(16):1588-1591.
8. Ivins BJ, Schwab KA, Baker G, Warden DL. Hospital admissions associated with traumatic brain injury in the US Army during peacetime: 1990s trends. *Neuroepidemiology.* 2006;27(3):154-163.
9. Ivins BJ, Schwab KA, Warden D, Harvey LT, Hoilien MA, Powell CO, Johnson CS, Salazar AM. Traumatic brain injury in U.S. Army paratroopers: prevalence and character. *J Trauma.* 2003;55(4):617-621.
10. Joint Improvised Explosive Device Defeat Organization. Annual Report FY 2008. Department of Defense. Available at: www.jieddo.dod.mil; 2008.
11. Ling G, Bandak F, Armonda R, Grant G, Ecklund J. Explosive blast neurotrauma. *J Neurotrauma.* 2009;26(6):815-825.
12. Macciocchi SN, Barth JT, Littlefield LM. Outcome after mild head injury. *Clin Sports Med.* 1998;17(1):27-36.
13. McCrea MA. *Mild traumatic brain injury and postconcussion syndrome: the new evidence base for diagnosis and treatment.* New York, NY: Oxford University Press; 2008.
14. McLeod A, Wills A, Etherington J. Employment retention after moderate-severe traumatic brain injury (TBI) in the British Army 1989-98. *Occup Environ Med.* 2004;61(5):414-418.
15. Ommaya AK, Dannenberg AL, Salazar AM. Causation, incidence, and costs of traumatic brain injury in the U.S. military medical system. *J Trauma.* 1996;40(2):211-217.
16. Ommaya AK, Salazar AM, Dannenberg AL, Chervinsky AB, Schwab K. Outcome after traumatic brain injury in the U.S. military medical system. *J Trauma.* 1996;41(6):972-975.
17. Riggio S, Wong M. Neurobehavioral sequelae of traumatic brain injury. *Mt Sinai J Med.* 2009;76(2):163-172.
18. Rubertone MV, Brundage JF. The Defense Medical Surveillance System and the Department of Defense serum repository: glimpses of the future of public health surveillance. *Am J Public Health.* 2002;92(12):1900-1904.
19. Ryan LM, Warden DL. Post concussion syndrome. *Int Rev Psychiatry.* 2003;15(4):310-316.
20. Sosin DM, Sniezek JE, Thurman DJ. Incidence of mild and moderate brain injury in the United States, 1991. *Brain Inj.* 1996;10(1):47-54.
21. Stein MB, McAllister TW. Exploring the convergence of posttraumatic stress disorder and mild traumatic brain injury. *Am J Psychiatry.* 2009;166(7):768-776.
22. Terrio H, Brenner LA, Ivins BJ, Cho JM, Helmick K, Schwab K, Scally K, Bretthauer R, Warden D. Traumatic brain injury screening: preliminary findings in a US Army Brigade Combat Team. *J Head Trauma Rehabil.* 2009;24(1):14-23.
23. Thurman DJ. The epidemiology and economics of head trauma. In: Miller LG, Hayes RL, ed. *Head Trauma: Basic, Preclinical, and Clinical Directions.* New York: Wiley; 2001:327-347.
24. Warden D. Military TBI during the Iraq and Afghanistan wars. *J Head Trauma Rehabil.* 2006;21(5):398-402.
25. World Health Organization. The ICD-10 classification of mental and behavioral disorders: Clinical descriptions and diagnostic guidelines. Geneva, Switzerland: World Health Organization; 1992.
26. World Health Organization. The ICD-10 classification of mental and behavioral disorders: Diagnostic criteria for research. Geneva, Switzerland: World Health Organization; 1993.