Journal of Safety Research 60 (2017) 29–34

Contents lists available at ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

Non-battle injuries among U.S. Army soldiers deployed to Afghanistan and Iraq, 2001–2013☆

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ARTICLE INFO

Article history:
Received 29 March 2016
Received in revised form 5 July 2016
Accepted 17 November 2016
Available online 28 November 2016

Keywords:
Occupational injury
Military
Surveillance
Medical evacuation
Falls

ABSTRACT

Introduction: Many non-battle injuries among deployed soldiers are due to occupational-related tasks. Given that non-battle injuries are a significant cause of morbidity and mortality, occupational safety and health are of great concern to the military. Some of the leading causes of non-battle injuries in the military are also common in non-military occupational settings. Nationally, falls and motor-vehicle accidents are leading causes of non-fatal occupational injuries in the civilian workforce. The objective of this research is to identify the leading causes, types, and anatomic locations of non-fatal non-battle injuries in Afghanistan and Iraq. *Methods:* Non-battle injuries were identified from medical air evacuation records. Causes of air evacuated injuries were identified and coded using the diagnosis and narrative patient history in the air evacuation records. Descriptive statistics were used to report the air evacuated non-battle injury rates, causes, injury types, and anatomic locations. *Results:* Between 2001 and 2013, there were 68,349 medical air evacuations from Afghanistan and Iraq. Non-battle injuries accounted for 31% of air evacuations from Afghanistan and 34% from Iraq. These injuries were the leading diagnosis category for air evacuations. The three leading causes of injury for Afghanistan and Iraq, respectively, were sports/physical training (23% and 24%), falls/jumps (19% and 16%), and military vehicle-related accidents (8% and 11%). The leading injury types were fractures (21%), overuse pain and inflammation (16%), and dislocations (11%). *Practical applications:* Given that over 30% of medical evacuations of soldiers result from non-battle injuries, prevention of such conditions would substantially enhance military readiness during combat.

1. Introduction

Injuries directly affect the overall mission readiness of individual soldiers and units during United States (U.S.) military operations (Jones, Canham-Chervak, & Sleet, 2010). From 2001 to 2006, 67% of all air evacuated injuries were non-battle related, and they have emerged as a major cause of morbidity in the U.S. Army (Hauret, Taylor, Clemmons, Block, & Jones, 2010). While the focus during military operations and wars is typically on the care and treatment of soldiers wounded in battle, the occurrence of disease and non-battle injuries has exceeded combat-related injuries in every major U.S. military operation from World War I through Vietnam (Walker & Blood, 1999). During deployments, injuries can result in limited duty or non-duty days that directly affect unit and mission readiness. It is, therefore, important to identify causes of non-battle injuries to determine prevention strategies.

The causes of non-fatal injuries among soldiers are similar to the leading causes of non-fatal occupational injuries for the civilian workforce. Among the civilian population in 2014, the overall rate of occupational injury and illness cases in the U.S. was 107 cases per 10,000 full-time workers, with 27% attributed to falls, slips, or trips and 5% to motor-vehicle incidents (Bureau of Labor Statistics, 2014, 2015). For the U.S. Army, falls have historically been among the top five causes of non-battle injuries (Canham-Chervak, Cowan, Pollack, Jackson, & Jones, 2015). In 1992, falls represented the second highest rate (5.6 per 1000 person-years) of all hospitalized injuries in the Army (Smith, Dannenberg, & Amoroso, 2000). Military vehicle accidents are also among the leading causes of morbidity for U.S. military personnel (Jones, Perrotta, Canham-Chervak, Nee, & Brundage, 2000). From 2004 to 2007, motor-vehicle accidents made up 8.3% of non-battle injury in Iraq (MacGregor, Mayo, Dougherty, Girard, & Galarneau, 2012). Unlike the civilian workforce, sports/athletics was found to be a leading cause of occupation-related soldier injury (22.3%) for Afghanistan and Iraq between January 2005 and May 2006 (Skeehan et al., 2009). Although injuries from sports and physical training are not considered occupation-related in most civilian professions, they are among soldiers because of their necessary participation in physical activity to achieve and maintain a high level of fitness required of soldiers.

☆ The views expressed in this article are those of the author(s) and do not necessarily reflect the official policy of the Department of Defense, Department of the Army, U.S. Army Medical Department or the U.S.

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http://dx.doi.org/10.1016/j.jsr.2016.11.004
0022-4375/

Surveillance is important to identify causes of injury during deployments, such as Afghanistan and Iraq, to provide a basis for future efforts to prevent injuries. During military operations in Afghanistan (Operation Enduring Freedom) and Iraq (Operations Iraqi Freedom and New Dawn), the Army Injury Prevention Program monitored rates and causes of non-battle injury among deployed soldiers. The surveillance focused on injuries that required medical air evacuation from Afghanistan and Iraq, the lowest level of injury severity for which there was complete injury reporting throughout the operations. For the military, deployment injury surveillance is important to monitor injury trends, assess the impact of injuries on unit readiness, and identify causes of non-battle injury that are potentially preventable. Several previous injury reports during the operations in Afghanistan and Iraq focused on various sub-populations of deployed soldiers or covered shorter timeframes. Belmont et al. (2010) conducted a 15-month cohort study of diseases and non-battle injuries in a U.S. Army Brigade Combat Team with 4122 soldiers deployed to Iraq. Owens et al. (2008) reported injuries from 2001 through 2005 that were treated at U.S. military medical facilities in Afghanistan and Iraq.

The purposes of this investigation were to (a) describe air evacuated non-battle injury rates and causes for deployed Army soldiers from October 2001 through December 2013, (b) compare rates and causes for operations in Afghanistan and Iraq, and (c) identify the leading injury types and anatomic locations of these non-battle injuries. Differences in the distribution of injury rates and causes were expected due to the geographic, environmental, combat intensity, and mission differences between operations.

2. Methods

U.S. Army soldiers (Active Duty, Reserve, or National Guard) who were medically air evacuated from theater while deployed for operations in Afghanistan (Operation Enduring Freedom: October 2001 through December 2013) and Iraq (Operations Iraqi Freedom and New Dawn: March 2003 through December 2011) were identified from medical records obtained from the U.S. Transportation Command Regulating and Command & Control Evacuation System (TRAC^{2}ES). Every medical air evacuation, regardless of severity or type of casualty, was required to have a record in this system. TRAC^{2}ES is a secure online information system that maintains the patient's summary electronically to transfer information before the arrival of the injured or ill soldier who must be stabilized before being air evacuated to a higher level of care. Each patient's air evacuation record included demographics, medical diagnosis codes from the International Classification of Disease, 9th revision, Clinical Modification (ICD-9-CM), and a brief narrative patient history.

Trained coders reviewed each air evacuation record to categorize the soldier's casualty type as battle injury, non-battle injury, or disease. The Department of Defense standard case definition for non-battle injury is "a person who becomes a casualty due to circumstances not directly attributable to hostile action or terrorist activity" (Department of Defense Instruction, 2008). Causes of non-battle injury were identified from the injury diagnosis and narrative patient history and were categorized using a standardized coding scheme (North Atlantic Treaty Organization Standardization Agreement (STANAG) No.2050, 5th edition) for cause of injury. During deployments soldiers are considered to be on duty at all times therefore injuries from all activities, including exercise and sports, are coded to be on-duty injuries (personal leave time was not included in this analysis).

Descriptive statistics were used to report the distributions for casualty type (i.e., non-battle injury, battle injury, or disease) and primary diagnosis category for all air evacuations. For non-battle injuries, descriptive statistics were used to report distributions for cause of injury, type/nature of injury (e.g., fracture, open wound), and anatomic location of injury. The Statistical Package for the Social Sciences (SPSS) version 21 was used for all statistical analyses. A Z-score with a confidence level of .95 was used to determine significant differences in distributions between Afghanistan and Iraq. A T-statistic was used to test for trend in rates for Iraq and Afghanistan from 2003 to 2013. Annual rates for non-battle injuries were calculated (number injured per 1000 person-years of deployment) using troop strength data obtained from the Armed Forces Health Surveillance Branch of the Defense Health Agency. The total number of soldiers deployed from October 2001 through December 2013 was provided by the Contingency Tracking System, Defense Manpower Data Center.

3. Results

The total number of U.S. Army soldiers deployed in support of Operation Enduring Freedom (October 2001 through December 2013) in Afghanistan and Operations Iraqi Freedom and New Dawn (March 2003 through December 2011) in Iraq was 1,302,611. During this timeframe, there were 68,349 medical air evacuations for injury (non-battle or battle) or disease.

Fig. 1 shows the percent distribution of air evacuations by diagnosis category for Afghanistan and Iraq, separately. Overall, there were 20,702 air evacuations from Afghanistan and 47,647 from Iraq. The rank order of the diagnosis categories was the same for medical evacuations from both locations. The leading diagnosis categories for Afghanistan and Iraq, respectively, were non-battle injury (31% and 34%), battle injury (21% and 16%), and behavioral health (12% and 10%).

Table 1 shows the overall rates (injured per 1000 person-years) for air evacuated non-battle and battle injuries for Afghanistan and Iraq. For Afghanistan, the annual rates for non-battle and battle injuries were 15.9 and 10.6, respectively. The non-battle injury rate for Iraq (16.2) was similar to Afghanistan's rate (15.9; $p = .09$), but Iraq's battle injury rate (7.7) was lower than Afghanistan's rate (10.6; $p < .001$). Of the 22,577 combined non-battle injuries in Afghanistan and Iraq, 97.9% were unintentional, 1.5% was intentional, and 0.6% were unknown intent (data not shown). The intentional injuries ($n = 344$) were further defined as "inflicted by another" ($n = 99$; 29%) and "self-inflicted" ($n = 245$; 71%).

Fig. 2 shows the non-battle injury rates by year for the operations in Afghanistan and Iraq. From 2004 to 2011, the yearly rates were higher in Afghanistan than Iraq. Overall, the annual rates decreased over time for Afghanistan (p for trend: <0.01) and Iraq (p for trend: <0.01). From 2003 through 2011, when both operations were active simultaneously, the overall rates per 1000 person-years were 19.4 for Afghanistan and 16.2 for Iraq.

Of the total number of non-battle injuries ($n = 22,577$), the specific cause of injury was specified from the narrative patient history for 69%. The distribution of leading causes of non-battle injury is displayed in Fig. 3 for operations in Afghanistan and Iraq. The rank order of injury causes for Afghanistan and Iraq were similar with a few exceptions. Sports/physical training (Afghanistan: 22.5%; Iraq: 24.2%) and falls/jumps (Afghanistan: 19.1%; Iraq: 16.5%) were the two leading causes for Afghanistan and Iraq. For Afghanistan and Iraq combined, 1336 falls/jumps were due to falling/jumping from one level to another (e.g., stairs, ladders, vehicles) and 963 were falling on the same level. Military vehicle accidents were the third leading cause for Iraq (11.4%) and the fourth leading cause for Afghanistan (8.2%). Crushing/blunt trauma was the third leading cause for Afghanistan ($n = 549$; 11.5%) and the fourth leading cause for Iraq ($n = 960$; 8.8%). Also, there were significant differences ($p < 0.05$) in the proportion between the two deployment sites for all causes except sports/physical training, weapons/explosives, cut/pierce, boarding/alighting, and toxic substances. For Iraq from 2003 to 2011, a decrease was observed in the annual rates for falls/jumps (p for trend <0.001), military vehicle accidents (p for trend <0.01), and crushing/blunt trauma (p for trend <0.01) that played a role in the overall decreasing trend of non-battle injury shown in Fig. 2 (data not shown).