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Medical-encounter mental health diagnoses, non-fatal injury and polypharmacy indicators of risk for accident death in the US Army enlisted soldiers, 2004–2009

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Abstract

Accidents are a leading cause of deaths in U.S. active duty personnel. Understanding accident deaths during wartime could facilitate future operational planning and inform risk prevention efforts. This study expands prior research, identifying health risk factors associated with U.S. Army accident deaths during the Afghanistan and Iraq war.

Military records for 2004–2009 enlisted, active duty, Regular Army soldiers were analyzed using logistic regression modeling to identify mental health, injury, and polypharmacy (multiple narcotic and/or psychotropic medications) predictors of accident deaths for current, previously, and never deployed groups.

Deployed soldiers with anxiety diagnoses showed higher risk for accident deaths. Over half had anxiety diagnoses prior to being deployed, suggesting anticipatory anxiety or symptom recurrence

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may contribute to high risk. For previously deployed soldiers, traumatic brain injury (TBI) indicated higher risk. Two-thirds of these soldiers had first TBI medical-encounter while non-deployed, but mild, combat-related TBIs may have been undetected during deployments. Post-Traumatic Stress Disorder (PTSD) predicted higher risk for never deployed soldiers, as did polypharmacy which may relate to reasons for deployment ineligibility.

Health risk predictors for Army accident deaths are identified and potential practice and policy implications discussed. Further research could test for replicability and expand models to include unobserved factors or modifiable mechanisms related to high risk. PTSD predicted high risk among those never deployed, suggesting importance of identification, treatment, and prevention of non-combat traumatic events. Finally, risk predictors overlapped with those identified for suicides, suggesting effective intervention might reduce both types of deaths.

Keywords

Military; Mental health; Accident death; Risk factors

1. Introduction

One of the leading causes of U.S. young adult deaths are accidents (Center for Disease Control (CDC), National Center for Injury Prevention and Control, 2015). In U.S. active duty service members, where young adults comprise a large proportion of personnel, accidents cause more deaths than suicides and, in most years, combat fatalities (Defense Manpower Data Center (DMDC), Defense Casualty Analysis System (DCAS), 2011). Moreover, demographic risk factors for U.S. active duty Army accident deaths overlap with those identified in general population studies (Lewandowski-Romps et al., 2014). Identifying risk factors for accident deaths in active duty Army soldiers serving in Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF), (Defense Manpower Data Center (DMDC), Defense Casualty Analysis System (DCAS), 2016) could facilitate future operational planning, and provide insights for targeting risk prevention efforts with military and civilian populations.

Military administrative data has been used to identify causes of, and soldier risk factors associated with, wartime unit attrition (Gilman et al., 2004). In a recent case-control analysis of administrative records for all U.S. Regular Army soldiers from 2004 to 2009, enlisted soldiers who were male, unmarried, in combat arms military occupation specialties (MOS), of lower rank/length of time in service, were rank demoted or had delayed rank progression were at higher risk for accident death (Lewandowski-Romps et al., 2014). High risk for never and previously deployed soldiers was also associated with a past-year medical encounter for any mental health diagnosis. The absence of this association in currently deployed soldiers could reflect a “healthy warrior effect” (soldiers with mental disorders are less likely to be deployed) (Larson et al., 2008) or absence of a mental health indicator with sufficient sensitivity and specificity to detect an association.

This investigation expands recent study risk models to include medical-encounter mental health diagnosis, non-fatal injury, and prescribed medication indicators associated with accident deaths in prior research.

1.1. Mental health diagnoses

In the general population, higher risk for accident death has been associated with medical-encounter diagnoses (inpatient and outpatient) of schizophrenia, bipolar disease, depression, anxiety, and alcohol/substance abuse disorders (Crump et al., 2013). In Army males on active duty from 1990 to 1998, higher risk was associated with prior hospitalization for alcohol and adjustment disorders (Garvey-Wilson et al., 2003). High rates of Army mental health-related hospitalizations observed during the OEF/OIF timeframe (Armed Forces Health Surveillance Center, 2013) could also reflect risk factors associated with wartime service demands.

Insomnia diagnoses increased for active duty Army soldiers from 2000 to 2009, (Armed Forces Health Surveillance Center, 2010) a time when military operational demands posed challenges for managing healthy sleep routines (Wasensten and Balkin, 2013). Poor sleep patterns (e.g., < 6 h of sleep per night) and sleep disorder sequelae (e.g., fatigue, inattention, slowed reaction time) have been linked to higher risk of accident death in the general population and pre-OEF/OIF serving, active duty Army males (Garvey-Wilson et al., 2003; Laugsand et al., 2014; Luyster et al., 2012). The current study considers whether soldier sleep disorders are also associated with higher risk for accident death during the Afghanistan and Iraq wars.

1.2. Non-fatal injuries

Prior hospitalization for non-fatal injury predicted accident death in Army males on active duty in the decade prior to OEF/OIF (Garvey-Wilson et al., 2003). A similar effect is even more likely in combat-exposed soldiers at risk of incurring multiple injuries, including TBIs (Sayer et al., 2014). Severe, combat-related TBIs and blast injury sequelae (e.g., chronic pain, impulsivity) are risk factors for soldier re-injury (The CDC, NIH, DoD, and VA Leadership Panel, 2013). Mild TBIs, (Defense Veterans Brain Injury Center, 2016) which are more common, can result in long-term neurocognitive, emotional and behavioral problems (The CDC, NIH, DoD, and VA Leadership Panel, 2013; Stein et al., 2013) that could heighten risk for accident death.

1.3. Polypharmacy

A growing challenge for medical practice in the general population is balancing clinical benefits against potential harms of prescribing multiple medications for comorbid conditions (Payne, 2016). Poly-pharmacy, in the form of prescribed combinations of painkillers and psychiatric medications, increased in the U.S. military during operations in Afghanistan and Iraq, as did soldier misuse of these medications (U.S. Headquarters, Department of the Army, 2012). Army deaths due to drug toxicity increased from 2006 to 2010, both accidental and whether accidental undetermined, with the number of deaths caused by one or more prescribed medications exceeding those caused by alcohol or illicit drugs (U.S.

Headquarters, Department of the Army, 2012). Findings suggest soldiers prescribed multiple narcotic and/or psychotropic medications may be at higher risk of accident death.

The current study is the first to combine medical-encounter predictors previously associated with accident deaths in multivariate risk models for enlisted, U.S. Army active duty soldiers (excluding Army National Guard and Army Reserve) between 2004 and 2009. Identifying health risk predictors for accident deaths during wartime can help inform allocation of resources aimed to improve soldier retention and readiness, and provide insights into risk prevention for military and civilian populations. Associations between medical indicators and high risk for accident death are believed to be less likely for currently deployed soldiers because of Army health fitness standards required for deployment. Risk factors that may be common causes of accident deaths and suicides are also explored.

2. Methods

2.1. Sample

Army and Department of Defense (DoD) administrative data records for all enlisted, active duty, Regular Army soldiers between January 1, 2004 and December 31, 2009 were integrated from multiple source systems into analysis files for the Army STARRS HADS (Kessler et al., 2013). Enlisted soldiers include rank paygrades E1 through E9 and exclude non-commissioned, commissioned and warrant officers. Sociodemographic and Army service data came from the DoD Defense Manpower Data Center (DMDC) Master Personnel and Transaction Files (MPTF), and the DMDC Contingency Tracking System (CTS) provided OEF and OIF deployment data. The Armed Forces Medical Examiner Tracking System (AFMETS) and Defense Casualty Information Processing System (DCIPS) provided date and manner of death. Records drawn solely from the Transportation Command (TRANSCOM) Regulating and Command and Control Evacuation System (TRAC2ES, medical air evacuation records) comprised only a small proportion of medical-encounter data used in current analyses (e.g., < 1% of injury records). Inpatient and outpatient medical encounter records were largely from the Medical Data Repository (MDR) and Theater Medical Data Store (TMDS, encounters during deployment) source systems. Construction of HADS data files and secondary analyses of data reported here were approved by the IRBs of the University of Michigan and Uniform Services University of the Health Sciences (representing DoD).

2.2. Outcome measures and analysis units

A case-control framework was used to identify associations between accident death and risk predictors for the 2004–2009 observation period. Each “soldier-month” of service had a binary outcome (Y), with a “case”(Y = 1) defined as an accident death, arising from unintentional injury while on active military duty but unrelated to hostile action, of an enlisted soldier within that month ($n = 1080$; 405 never, 223 currently, and 452 previously deployed). A “control” (Y = 0) was an enlisted soldier-month in which no death occurred ($n = 30,939,614$; 12,510,450 never, 7,212,887 currently, and 11,217,357 previously deployed). Without loss of generalization for the case-control analyses, a 1:400 random subsampling of control soldier-month observations was performed, resulting in just under 80,000

observations for the control sample (31,725 never, 20,114 currently, and 28,599 previously deployed). In study analyses, person-month data for “no death” control months were weighted by the inverse of the subsampling probability of selection to ensure unbiased estimation of crude death rates.

2.3. Predictors of risk

Time (year), sociodemographic variables (age, gender, race/ethnicity, religion, education level, and marital status), military service characteristics (rank, years of service, number of deployments, ever demoted [since January 2000]), and Army MOS (combat arms or other) were included as control variables, as in the previous study (Lewandowski-Romps et al., 2014). Analyses were limited to primary diagnoses recorded during past 12-month inpatient and outpatient medical encounters. Primary diagnoses were specified by International Classification of Diseases, Ninth Revision Clinical Modification (ICD-9-CM) codes present in soldier medical care records. Table 1 contains ICD-9-CM codes used to identify mental health diagnosis groups (anxiety, depression, adjustment, bipolar, impulsive, post-traumatic stress, attention deficit/learning, alcohol, drug, personality, sleep, conduct disorder/oppositional defiant and non-affective psychosis disorders). Several medical-encounter, primary mental health diagnoses were dropped from final models due to non-significance and/or low frequency in past 12-month medical-encounter records (non-affective psychosis, personality, bipolar, adjustment, conduct disorder/oppositional defiant disorders, drug, impulsive and attention deficit/learning disorders). Sleep disorders included ICD-9-CM codes for dyssomnias and parasomnias specified by the International Classification of Sleep Disorders, revised (American Academy of Sleep Medicine, 2005).

Primary medical-encounter TBI diagnoses (from January 2000 to two months prior to a death date) included ICD-9-CM codes specified by the DoD (310.2, 907.0, 950.1–0.3, 959.01, 800, 801, 803, 804, 850, 851, 852, 853, 854, V15.5_1–9, V15.5_A-F, V15.59_1–9, and V15.59_AF with or without fourth and/or fifth digits) (Armed Forces Health Surveillance Center, 2009). A three category (0, 1, 2+) primary non-fatal injury indicator (excluding TBI diagnostic codes and injury diagnoses within 7 days of death date) was created by summing the number of unique ICD-9-CM 800–999 codes. Only the earliest medical-encounter injury code was counted in cases where subsequent soldier records included identical codes within a 60 day period. Army guidelines for identifying soldiers receiving polypharmaceutical treatment (office of the Surgeon General (OTSG)/Medical command (MEDCOM) Policy Memorandum 13–032, 2015) were used to define a binary medical-encounter polypharmacy variable, which indicated one or more of the following: (1) prescription for five or more medications in a three month period, with recent history of at least one narcotic (past 4 years) (2) prescription for four or more narcotic or psychotropic medications in a three month period, within past 4 year period (3) prescription for narcotic during emergency room visit, with two additional emergency room visits involving prescription narcotics in the past year.

2.4. Analysis methods

The association between risk indicators and accident death was modeled using unconditional logistic regression analysis (Heeringa et al., 2010). Accident death dates shared by more

than three soldiers ($n = 149$) were removed to ensure that a single, catastrophic event did not exert a clustering effect on risk modeling. Models were fit separately for currently, previously and never deployed soldiers and logistic regression coefficients were exponentiated to obtain odds ratios (ORs) and 95% confidence intervals which under the model are interpreted as the average “within-month” association between accident death and the individual predictors assuming effects of other model predictors remain constant. Statistical significance is reported at the $\alpha = 5\%$ level. All analyses were conducted using (SAS Institute, Inc, 2003).

3. Results

3.1. Descriptives

There were 1080 Regular Army, enlisted soldier accident deaths from 2004 to 2009 (94% male; See Table 2). The crude accident death rate (41.9 accident deaths per 100,000 soldier-years) and relative rate patterns observed for sociodemographic, service-related and occupation categories were consistent with prior results for the full active duty, Regular Army sample (Lewandowski-Romps et al., 2014). Crude rates for newly added medical-encounter diagnosis and polypharmacy indicators are reported in Table 3 for all enlisted soldiers by deployment group. Previously deployed soldiers had the highest crude rate for accident death relative to current and never deployed soldier groups. Overall, rates were lowest for currently deployed. Comparing previously deployed to never deployed, previously deployed had higher crude rates for multiple non-fatal injuries, sleep disorders, TBI, and polypharmacy, but never deployed were higher for PTSD, depression, and anxiety disorders.

3.2. Logistic regression predicting accident death risk

Univariate odds ratios for accident death varied somewhat by deployment group (See Table 4). Estimated, adjusted odds ratios from multivariate, logistic regression models for currently, previously and never deployed soldiers are presented in Table 4. For all models, being male, unmarried, military occupational service (MOS) in combat arms, and being of lower rank/service length, delayed in rank progression or demoted in rank was associated with increased odds of accident death. First-order interactions between significant main effects and mental health disorder, non-fatal injury and polypharmacy predictors were tested for each deployment status group. Only one modest interaction effect was identified ($\beta = -1.1$; 95% CI, $-1.9 - -0.2$; $p = 0.014$). Never deployed soldiers with past-year, primary medical-encounter alcohol diagnosis had higher risk of accident death for females than males. First-order interactions between medical-encounter predictors and common, comorbid diagnoses (TBI, PTSD and sleep disorders) (Sayer et al., 2014; The CDC, NIH, DoD, and VA Leadership Panel, 2013; Bramoweth and Germain, 2013; Lang et al., 2014) were also tested with no significant effects identified. Absence of interaction effects could be due to the inclusion of only primary, medical-encounter diagnoses. This restriction, however, minimized the potential for overemphasizing explanatory significance of health conditions that may not be interfering with soldier functioning.

Among currently deployed soldiers, incidence of a past-year, medical-encounter anxiety disorder increased by 2.5 the odds (95% CI, 1.2–4.8) of a fatal accident, after adjusting for

other variables in the model. Past-year medical encounter for non-fatal injuries, depression, PTSD, alcohol and sleep disorders, TBI history (since 2000), and record of polypharmacy were not associated with higher odds of accident death for currently deployed soldiers. Previously deployed soldiers had higher odds of accident death if they also had two or more non-fatal injuries, primary medical-encounter sleep, alcohol or depression disorders in the past 12 months. Moreover, previously deployed soldiers with medical-encounter history of TBI (since 2000) had 1.6 times the odds (95% CI, 1.1–2.5) of accidental death, relative to those without record of TBI medical encounters. Controlling for other model predictors, never deployed soldiers had 1.5 times the odds (95% CI, 1.1–1.9) of accident death if they had a past 12 month medical encounter for two or more non-fatal injuries (vs. no injuries). Past-year medical-encounter sleep, alcohol, and post-traumatic stress disorders were also associated with increased odds of accident death for never deployed soldiers. Moreover, never deployed soldiers with past-year depression or anxiety disorders had roughly two times the odds (95% CI, 1.3–2.7 and 1.3–2.8, respectively) of accident death relative to those without these diagnoses. Finally, never deployed soldiers with record of polypharmacy had over one and a half times the odds (95% CI, 1.2–2.0) of dying by accident as those without recent record of these prescriptions.

4. Conclusion

Medical-encounter mental health diagnosis, non-fatal injury and polypharmacy predictors were identified for enlisted Regular Army accident deaths from 2004 to 2009. Sociodemographic and service-related risk effects and protective factors, such as being female and longer service tenure, are consistent with prior studies using military (Lewandowski-Romps et al., 2014; Hooper et al., 2006) and general population samples (Rockett et al., 2012). Relatively stable estimates for predictors of high risk varied in currently, previously and never deployed groups.

4.1. Currently deployed

Past-year anxiety disorder diagnosis was associated with higher odds of accident death for currently deployed soldiers, with symptoms possibly precipitated for the first time by deployment stressors. However, follow-up descriptive analyses found 62.4% of deployed soldiers had their first medical encounter (since 2000) for primary anxiety disorder while non-deployed and prior to their current deployment. This finding may reflect anticipatory anxiety and/or signal soldier vulnerability for symptom recurrence while deployed. Pre-deployment resilience training (Southwick et al., n.d.) and development of better screening instruments for predicting subsequent diagnoses (Niebuhr et al., 2013) may help reduce risk. Although findings are inconsistent with a “healthy warrior effect,” (Larson et al., 2008) anxiety disorder symptoms could be absent, undetected by screening instruments, or not perceived by health providers as a readiness threat at the time of pre-deployment assessment.

Finally, the associations between sleep problems and accident death risk previously reported (Garvey-Wilson et al., 2003; Laugsand et al., 2014; Luyster et al., 2012) may be absent due to differences in study indicators for sleep difficulties (e.g., sleep disorder diagnosis vs.

soldier reported sleep onset problems) or present for only a subgroup of deployed soldiers (e.g., greater degree of combat exposure) (Seelig et al., 2010).

4.2. Previously deployed

Previously deployed soldiers with past-year sleep, depression or alcohol diagnoses were at higher risk for accident death. These conditions are associated with deployment stress exposure and post-deployment adjustment difficulties (Schumm and Chard, 2012; Brown et al., 2013). Consequently, indicators of combat exposure effects, such as health-risk perceptions (Killgore et al., 2008) or post-deployment persistence of combat tactics (e.g., aggressive driving to avoid threat of attacks) (Possis et al., 2014), could further differentiate groups at high risk. Unlike prior research (Possis, et al., 2014), PTSD was not associated with high risk for accident death in previously deployed soldiers. This could be due to attrition of these soldiers from the Army (Hoge et al., 2006) or presence of subthreshold symptoms that did not meet primary PTSD diagnosis criteria during past-year medical encounters (Hoge et al., 2014).

Previously deployed soldiers with multiple prior injuries (excluding TBIs) also had increased likelihood of dying by accident. Adding to models more refined injury predictors (e.g., severity, cause of injury, type of injury) could help identify modifiable, causal links for target risk-management (Howland et al., 2007). Higher risk associated with prior TBI (since 2000) in this group could be a consequence of combat exposure (e.g., blast injuries). However, only 34.14% of previously deployed TBI diagnosed soldiers had their first TBI medical-encounter (since 2000) concurrent with deployment. Although a majority of TBIs are reportedly diagnosed in non-deployed settings (Defense Veterans Brain Injury Center, 2016), it is possible that mild, combat-related TBIs go undetected or untreated while soldiers are deployed and risk-reduction efforts could be improved through earlier identification, diagnosis and treatment of these injuries (The CDC, NIH, DoD, and VA Leadership Panel, 2013; Stein et al., 2013).

4.3. Never deployed

Never deployed soldiers had the highest number of medical-encounter indicators associated with increased risk for accident death. Reasons for deployment ineligibility (e.g., disability, lack of skill training) could further differentiate high risk soldiers within this group. Similar to previously deployed soldiers, never deployed soldiers with multiple prior injuries (excluding TBIs) had increased likelihood of dying by accident. Additionally, higher risk was associated with poly-pharmacy. It is possible that particular health disorder profiles are differentially linked to polypharmacy-related risk factors such as medication abuse or misuse (Seale et al., 2012). Moreover, chronic pain conditions could mediate the relationship between polypharmacy and accident death risk. The Army has already started to implement initiatives to identify best practices for treating soldiers prescribed narcotics for pain management and policies to more closely monitor soldiers receiving polypharmaceutical treatment (U.S. Headquarters, Department of the Army, 2012; Lillis-Hearne, 2011).

Past-year medical-encounter PTSD diagnosis was also an indicator of risk for never deployed soldiers. Although often associated with combat-exposure, PTSD can be triggered

by non-combat trauma in the military (e.g., serious accidents) (Jones et al., 2012) or reflect pre-enlistment trauma (Rosellini et al., 2015). Providing effective treatment for non-combat trauma or reducing incidences of those traumatic events (e.g., evaluating effectiveness of current sexual assault prevention programming) may help reduce accident death risk associated with PTSD.

Finally, never deployed females with past-year alcohol diagnoses had slightly higher risk of dying by accident than never deployed males with alcohol disorders. This may reflect deleterious effects of using alcohol to manage stressors unique to never deployed females (e.g., new to masculine culture of the military, limited growth associated with non-combat related career trajectories) (Kelty et al., 2010), or possible comorbid health conditions (Schumm and Chard, 2012). Although alcohol-related health-risk behaviors (e.g., driving while intoxicated) are higher for males than females in the general population and military (Ames and Cunradi, 2004; Center for Disease Control, n.d.), females are more vulnerable to alcohol-related problems at lower levels of consumption (Brown et al., 2010). When this is taken into account, Army females demonstrate higher rates of unsafe drinking compared to males (Lande et al., 2007), and those with symptoms of alcohol dependency show greater risk of injury, co-occurring health conditions, death, and may also be more likely than males to go un-diagnosed by health providers until symptoms have progressed (Lande et al., 2007; Wooten et al., 2013).

4.4. Shared risk factors for accident and suicide deaths

Identified health-risk indicators for accident death have also been associated with higher risk for suicide in the Army (U.S. Headquarters, Department of the Army, 2012; Kessler et al., 2015; Hyman et al., 2012). A review of concentration of risk (CR) supports the presence of shared risk factors in current models. Within the top decile of model-predicted accident death risk were 28% of currently, 33% of previously, and 37% of never deployed soldier accident deaths. Also within this highest risk stratum were 25% of currently, 31% of previously, and 39% of never deployed soldier suicides. Mental health diagnoses comprised five of the eight medical-encounter predictors included in current models and could be more strongly related to both types of deaths compared to other health-risk indicators.

Results provide insights for allocation of Army resources aimed to improve soldier retention and readiness. Also highlighted are areas of consideration for prevention initiatives, including timely detection and treatment of health risk conditions, and effective screening for symptoms and potential symptom recurrence. For all deployment groups, health risk diagnoses were observed by healthcare providers, presenting opportunities for risk assessment and close monitoring of disorder/injury symptoms (e.g., poor concentration) (Wasensten and Balkin, 2013; Laugsand et al., 2014; The CDC, NIH, DoD, and VA Leadership Panel, 2013; Adler et al., 2011), and sequelae (e.g., risky driving behaviors, sensory deficits, fatigue) (Luyster et al., 2012; Sayer et al., 2014; The CDC, NIH, DoD, and VA Leadership Panel, 2013; Stein et al., 2013; Possis et al., 2014), that may interfere with soldier performance and inform subsequent safety planning. Moreover, future study of potential mediating factors between health risk conditions and accident deaths could help

inform existing interventions and further differentiate high risk soldiers within deployment groups.

4.5. Strengths and Limitations

Study limitations include the censoring of the probability of deployment across the study timeframe and exclusion of officers, activated Army National Guard and Reserve soldiers, secondary medical-encounter diagnoses, and unobserved factors that may be related to high risk (e.g., health concerns prior to the last year, pre-enlistment traumas such as childhood maltreatment) (Rosellini et al., 2015). Moreover, administrative data may contain entry errors, lack details of health-risk behaviors for the full population, contain misclassifications of some deaths (Pompili et al., 2012), and fail to capture subthreshold or underreported health conditions (e.g., illicit drug use). Study strengths include the use of multivariate models to identify independent medical-encounter predictors of high risk for accident death. Strengths associated with use of administrative data include accessibility to complete and universal population records for enlisted, active duty, U.S. Army active soldiers. This data permitted inclusion of never before combined sociodemographic, service-related, and health-risk indicators for all accident death cases. Finally, analysis of administrative data illustrates how readily available military records can be used to examine epidemiological trends and track changes in accident death rates to evaluate risk prevention initiatives.

4.6. Next steps

Application of models to activated Army National Guard and Army Reserve soldiers, future Army cohorts, other branches of the U.S. Armed Forces, and civilians could test generalizeability of results. Inclusion of individual-level health, behavior and treatment indicators (e.g., severity of injury, treatment type) in future risk models could better elucidate modifiable links between current study predictors and subsequent accident death, including (1) a more granular look at timing of diagnoses relative to exposure to dangerous environments or contextual risk factors associated with the accident event (e.g., type of accident), (2) shared health-risk predictors for accident and suicide deaths, and (3) individual (e.g., comorbid health conditions) or situational factors specific to currently, previously and never deployed soldier groups during times of intense military operations.

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Table 1

International classification of diseases, ninth revision clinical modification (ICD-9 CM) codes used to identify mental health disorders.

Diagnoses	ICD-9-CM codes
Adjustment disorder	309.29, .3, .4, .82, .83, .89, .9
Depression disorders (major depression/ dysthymic disorder/neurasthenia/depression NOS)	296.2, .20, .21, .22, .23, .24, .25, .26, .3, .30, .31, .32, .33, .34, .35, .36, .82, .90, .99 300.4, .5 309.0, .1 311, .0, .1 313.1
Bipolar disorder	296.00, .01, .02, .03, .04, .05, .06, .10, .11, .12, .13, .14, .15, .16, .40, .41, .42, .43, .44, .45, .46, .50, .51, .52, .53, .54, .55, .56, .60, .61, .62, .63, .64, . 65, .66, .7, .80, .81, .89 301.13
Anxiety state/disorder	300.00, .01, .02, .09, .20, .21, .22, .23, .29, .3 309.21, .24, .28 313.0, .21, .22, .23
Post-traumatic stress disorder	309.81
ADHD/learning disorder	314.0, .00, .01, .1, .2, .8, .9 315.00, .01, .02, .09, .1, .2, .3, .31, .32, .34, .39, .4, .5, .8, .9
Conduct disorder/oppositional defiant disorder	301.7 312.4, .8, .81, .82, .89, .9 313.81 V62.83
Other impulse control disorder	312.00, .01, .02, .03, .10, .11, .12, .13, .20, .21, .22, .23, .3, .30, .31, .32, .33, .34, .35, .39
Alcohol disorder (alcohol induced mental disorders/abuse/dependence)	291.0, .1, .2, .3, .4, .5, .8, .81, .82, .89, .9 303.00, .01, .02, .03, .9, .90, .91, .92, .93 305, .0, .00, .01, .02, .03
Drug disorder (abuse/dependence)	304.305.2, .20, .21, .22, .23, .3, .30, .31, .32, .33, .4, .40, .41, .42, .43, .5, .50, .51, .52, .53, .6, .60, .61, .62, .63, .7, .70, .71, .72, .73, .8, .80, .81, .82, . 83, .9, .90, .91, .92, .93
Personality disorder	301.0, .1, .10, .11, .12, .20, .21, .22, .3, .4, .50, .51, .59, .6, .8, .80, .81, .82, .83, .84, .89, .9
Non-affective psychosis	295.00, .01, .02, .03, .04, .05, .10, .11, .12, .13, .14, .15, .20, .21, .22, .23, .24, .25, .30, .31, .32, .33, .34, .35, .40, .41, .42, .43, .44, .45, .50, .51, .52, . 53, .54, .60, .61, .62, .63, .64, .65, .70, .71, .72, .73, .74, .75, .80, .81, .82, .83, .84, .85, .90, .91, .92, .93, .94, .95 297.0, .1, .2, .3, .8, .9 298.0, .1, .2, .3, .4, .8, .9, .90
Sleep disorder	307.3, .40, .41, .42, .43, .44, .45, .46, .47, .48, .49 770.80, .81 780.51, .52, .53, .54, .55, .56, .59 289, 306.8, 347, 729.82, 786.09, 788.36, 798

Table 2

Descriptive statistics for enlisted, U.S. Regular Army soldiers serving on active duty 2004–2009.

Demographic/service characteristics	Cases % (95% CI)	Controls % (95% CI)
Time		
2004	14.3 (12.2, 16.3)	16.2 (15.9, 16.4)
2005	16.9 (14.6, 19.1)	15.8 (15.5, 16.0)
2006	16.2 (14.0, 18.4)	16.0 (15.7, 16.2)
2007	16.9 (14.6, 19.1)	16.7 (16.4, 16.9)
2008	19.8 (17.4, 22.2)	17.5 (17.2, 17.8)
2009	16.0 (13.8, 18.2)	17.9 (17.6, 18.2)
Gender		
Male	94.4 (93.1, 95.8)	86.2 (86.0, 86.5)
Female	5.6 (4.2, 6.9)	13.8 (13.5, 14.0)
Race/ethnicity		
White	66.7 (63.9, 69.5)	59.8 (59.5, 60.2)
Black	18.7 (16.4, 21.0)	22.6 (22.3, 22.9)
Hispanic	10.2 (8.4, 12.0)	11.5 (11.3, 11.7)
Other	4.4 (3.2, 5.7)	6.0 (5.9, 6.2)
Education		
< High school/alternative education certificate/GED	17.9 (15.6, 20.2)	12.7 (12.5, 12.9)
High school	76.9 (74.3, 79.4)	76.3 (76.0, 76.6)
Some college/college +	5.3 (3.9, 6.6)	11.0 (10.8, 11.2)
Marital status		
Married	42.9 (39.9, 45.8)	54.5 (54.1, 54.8)
Previously/never married	57.1 (54.2, 60.1)	45.5 (45.2, 45.9)
Demoted		
No	82.2 (79.9, 84.5)	89.4 (89.2, 89.6)
Yes	17.8 (15.5, 20.1)	10.6 (10.4, 10.8)
Rank ^a /length of service (months)		
E1, E2/13–60	19.4 (17.1, 21.8)	12.3 (12.0, 12.5)

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Demographic/service characteristics	Cases % (95% CI)	Controls % (95% CI)
E3/13–24	13.0 (11.0, 15.0)	12.0 (11.8, 12.2)
E3/25–60	3.9 (2.7, 5.0)	2.0 (1.9, 2.1)
E4/13–60	25.7 (23.1, 28.4)	22.6 (22.3, 22.9)
E5/13–60	5.8 (4.4, 7.2)	7.0 (6.8, 7.2)
Enlisted/ > 60	32.1 (29.3, 34.9)	44.2 (43.8, 44.5)
Total deployments		
0	37.5 (34.6, 40.4)	40.4 (40.1, 40.8)
1	42.9 (39.9, 45.8)	37.8 (37.4, 38.1)
2	14.6 (12.5, 16.7)	16.1 (15.9, 16.4)
3 +	5.0 (3.7, 6.3)	5.6 (5.5, 5.8)
Aviation		
No	96.0 (94.9, 97.2)	95.4 (95.2, 95.5)
Yes	4.0 (2.8, 5.1)	4.6 (4.5, 4.8)
MOS categories		
Combat arms	49.2 (46.2, 52.2)	33.7 (33.4, 34.0)
Combat service/support	50.8 (47.8, 53.8)	66.3 (66.0, 66.6)

^aE1/E2 = Private (PVT)/Private 2 (PVT2), E3 = Private First Class (PFC), E4 = Specialist (SPC)/Corporal (CPL), E5 = Sergeant (SGT), E6 = Staff Sergeant (SSG), E7 = Sergeant First Class (SFC), E8 = Master Sergeant (MSG)/First Sergeant (1SG), E9 = Sergeant Major (SGM)/Command Sergeant Major (CSM)/Sergeant Major of the Army (SMA).

Table 3

Accidental deaths for Regular Enlisted Army U.S. soldiers serving on active duty 2004–2009.

Army enlisted soldier population	Crude rates of accident death per year/100,000			
	Enlisted: All	Currently deployed	Previously deployed	Never deployed
N	81,518	20,337	29,051	32,130
All soldiers	41.9	37.1	48.4	38.8
Unique injury				
0	38.2	42.7	41.8	34.4
1	38.8	38.6	42.1	35.9
2 +	46	32.4	53.4	45.5
Sleep disorders				
No	40.3	37.2	45.8	37.1
Yes	84.7	32.5	98.6	89.9
Alcohol				
No	38.8	36.1	44.5	35.2
Yes	177	92	197	197
Post traumatic stress				
No	40.6	36.8	45.8	38.3
Yes	135	91.8	130	233
Depression				
No	38.8	36.5	44.6	35
Yes	118	59.1	124	134
Anxiety disorder				
No	39.1	36.1	44.9	35.6
Yes	118	80.5	114	139
TBI				
No	41.2	36.7	46.9	38.7
Yes	98.3	65.8	119	70.6
Polypharmacy				
No	37.7	37.8	43.2	32.9
Yes	58.3	33	66.9	60.6

Estimated odds ratios for accidental deaths: enlisted U.S. Regular Army soldiers serving on active duty 2004–2009.

Table 4

Effect	Category of effect ^a	Currently deployed, odds ratio (95% CI)	Previously deployed, odds ratio (95% CI)	Never deployed, odds ratio (95% CI)
Univariate odds ratios		0.9 (0.7, 1.0)	1.3 (1.1, 1.4)	0.9 (0.8, 1.0)
Demographic/service characteristics				
Time	2004	2.0 (1.3, 3.3)	1.3 (0.9, 1.8)	0.9 (0.6, 1.2)
	2005	2.0 (1.2, 3.2)	1.3 (0.9, 1.8)	1.2 (0.9, 1.7)
	2006	1.4 (0.9, 2.3)	1.5 (1.1, 2.0)	1.1 (0.7, 1.5)
	2007	1.1 (0.7, 1.8)	1.3 (0.9, 1.7)	1.3 (0.9, 1.9)
	2008	1.0 (0.6, 1.6)	1.0 (1.0, 1.8)	1.5 (1.1, 2.1)
Gender	Male	2.7 (1.2, 5.8)	4.4 (2.4, 7.9)	2.1 (1.5, 2.9)
Race/ethnicity	Black	0.8 (0.5, 1.2)	1.2 (0.9, 1.5)	1.1 (0.9, 1.5)
	Hispanic	1.3 (0.9, 1.8)	0.8 (0.6, 1.1)	0.9 (0.6, 1.2)
	Other	1.0 (0.6, 1.8)	0.6 (0.4, 1.0)	1.0 (0.7, 1.6)
Education	< high school/alternative education certificate/GED	1.4 (0.6, 3.0)	1.5 (1.0, 2.4)	1.5 (0.9, 2.5)
	High school	1.7 (0.9, 3.6)	1.2 (0.8, 1.8)	1.6 (1.0, 2.6)
Marital status	Married	0.7 (0.5, 0.9)	0.6 (0.5, 0.8)	0.7 (0.5, 0.9)
Denoted	Yes	1.7 (1.2, 2.5)	1.4 (1.1, 1.8)	0.8 (0.5, 1.1)
Rank ^b /length of service (months)	E1,E2/13–60	–	–	2.0 (1.4, 2.9)
	E3/13–24	0.9 (0.5, 1.7)	0.8 (0.4, 1.6)	0.8 (0.6, 1.0)
	E3/25–60	1.0 (0.5, 2.2)	0.5 (0.3, 1.0)	1.6 (1.0, 2.6)
	E4/13–60	0.7 (0.4, 1.2)	0.7 (0.4, 1.1)	0.6 (0.4, 0.9)
	E5/13–60	0.5 (0.3, 1.1)	0.5 (0.3, 0.9)	0.5 (0.3, 1.0)
	Enlisted/ >60	0.5 (0.3, 0.9)	0.4 (0.3, 0.7)	0.5 (0.3, 0.7)
Total deployments		1.2 (1.0, 1.4)	1.0 (0.9, 1.1)	–
Aviation	Yes	0.6 (0.3, 1.2)	0.8 (0.5, 1.2)	0.5 (0.3, 0.9)
MOS categories	Combat arms	1.7 (1.3, 2.2)	1.6 (1.3, 2.0)	2.0 (1.6, 2.4)
Past 12 month primary diagnosis ^c				
Unique injury	1	1.0 (0.7, 1.4)	1.0 (0.8, 1.4)	1.1 (0.3, 1.5)
	2 +	1.0 (0.7, 1.3)	1.4 (1.1, 1.8)	1.5 (1.1, 1.9)

Effect	Category of effect ^a	Currently deployed, odds ratio (95% CI)	Previously deployed, odds ratio (95% CI)	Never deployed, odds ratio (95% CI)
Sleep disorders	Yes	0.9 (0.4, 2.3)	1.6 (1.2, 2.3)	1.7 (1.1, 2.4)
Alcohol	Yes	1.5 (0.8, 2.9)	2.1 (1.5, 3.0)	2.5 (1.8, 3.5)
Post traumatic stress	Yes	1.8 (0.5, 6.0)	1.2 (0.8, 1.8)	2.8 (1.3, 6.1)
Depression	Yes	1.2 (0.5, 2.5)	1.7 (1.2, 2.3)	1.9 (1.3, 2.7)
Anxiety disorder	Yes	2.5 (1.2, 4.8)	1.4 (1.0, 2.0)	1.9 (1.3, 2.8)
TBI	Yes	1.8 (0.7, 4.6)	1.6 (1.1, 2.5)	1.0 (0.4, 2.6)
Polypharmacy	Yes	0.9 (0.6, 1.4)	1.2 (0.9, 1.5)	1.6 (1.2, 2.0)

Note: bold type face signifies odds ratio (OR) estimates for which the 95% CI does not include OR = 1.0.

^aReference categories are: 2009, female, white, at least some college education, previously/never married, not demoted, E1/E2 = 60 Months for currently and previously deployed and E1/E2 = 12 Months for never deployed, not aviation, combat service/support, 0 previous injury, no primary insomnia diagnosis, no primary alcohol abuse diagnosis, no primary PTSD diagnosis, no primary depression diagnosis, no primary anxiety diagnosis, no primary TBI diagnosis, no PolyPharmacy. Total deployments = number of deployments. For each increase in the number of deployments there are 1.2 times the odds of accident death.

^bE1/E2 = Private (PVT)/Private 2 (PVT2), E3 = Private First Class (PFC), E4 = Specialist (SPC)/Corporal (CPL), E5 = Sergeant (SGT), E6 = Staff Sergeant (SSG), E7 = Sergeant First Class (SFC), E8 = Master Sergeant (MSG)/First Sergeant (1SG), E9 = Sergeant Major (SGM)/Command Sergeant Major (CSM)/Sergeant Major of the Army (SMA).

^cUnique injury, count (0, 1, 2+) of primary non-fatal injury diagnoses (excluding TBI diagnostic codes and injury diagnoses within 7 days of death date) specified by ICD-9-CM 800-999 codes. Injury codes present in soldier records multiple time were excluded from count totals unless separated by more than a 60 day time period. Sleep disorders, alcohol, post traumatic stress, depression and anxiety disorder represent any in- or out- patient primary medical encounter diagnosis in the past 12 months. TBI (traumatic brain injury), primary diagnosis from January 2000 to two months prior to a death event. Polypharmacy, meet one of the following criteria: (1) 5 or more medications in a 3-month period with at least one narcotic or psychotropic medications in a 3-month period, (3) at least 3 ER visits within the past year all with narcotic medications. See Table 1 for the list of ICD-9-CM codes.