Published in final edited form as:
Psychol Med. 2014 September ; 44(12): 2579–2592. doi:10.1017/S003329171400018X.

Sociodemographic and career history predictors of suicide mortality in the United States Army 2004–2009

S. E. Gilman[1], **E. J. Bromet**[2], **K. L. Cox**[3], **L. J. Colpe**[4], **C. S. Fullerton**[5], **M. J. Gruber**[6], **S.G. Heeringa**[7], **L. Lewandowski-Romps**[7], **A.M. Millikan-Bell**[3], **J. A. Naifeh**[5], **M. K. Nock**[8], **M. V. Petukhova**[6], **N. A. Sampson**[6], **M. Schoenbaum**[9], **M. B. Stein**[10,11], **R. J. Ursano**[5], **S. Wessely**[12], **A.M. Zaslavsky**[6], and **R. C. Kessler**[6,*] **on behalf of the Army STARRS Collaborators**

[1]Departments of Social and Behavioral Sciences, and Epidemiology, Harvard School of Public Health, Boston, MA, USA

[2]Department of Psychiatry and Behavioral Science, Stony Brook School of Medicine, Stony Brook, NY, USA

[3]US Army Public Health Command, Aberdeen Proving Ground, MD, USA

[4]Division of Services and Intervention Research, National Institute of Mental Health, Bethesda, MD, USA

[5]Center for the Study of Traumatic Stress, Department of Psychiatry, Uniformed Services University School of Medicine, Bethesda, MD, USA

[6]Department of Health Care Policy, Harvard Medical School, Boston, MA, USA

[7]Institute for Social Research, University of Michigan, Ann Arbor, MI, USA

[8]Department of Psychology, Harvard University, Cambridge, MA, USA

[9]Office of Science Policy, Planning and Communications, National Institute of Mental Health, Bethesda, MD, USA

[10]Departments of Psychiatry and Family and Preventive Medicine, University of California San Diego, La Jolla, CA, USA

[11]VA San Diego Healthcare System, San Diego, CA, USA

[*]Address for correspondence: R. C. Kessler, Ph.D., Department of Health Care Policy, Harvard Medical School, Boston, MA, USA. (ncs@hcp.med.harvard.edu).

Declaration of Interest

M.B.S. has been a consultant for Care Management Technologies, received payment for his editorial work from *UpToDate* and *Depression and Anxiety*, and had research support for pharmacological imaging studies from Janssen. R.C.K. has been a consultant for AstraZeneca, Analysis Group, Bristol-Myers Squibb, Cerner-Galt Associates, Eli Lilly & Company, GlaxoSmithKline Inc., HealthCore Inc., Health Dialog, Hoffman-LaRoche, Inc., Integrated Benefits Institute, J & J Wellness & Prevention, Inc., John Snow Inc., Kaiser Permanente, Lake Nona Institute, Matria Inc., Mensante, Merck & Co, Inc., Ortho-McNeil Janssen Scientific Affairs, Pfizer Inc., Primary Care Network, Research Triangle Institute, Sanofi-Aventis Groupe, Shire US Inc., SRA International, Inc., Takeda Global Research & Development, Transcept Pharmaceuticals Inc., and Wyeth-Ayerst; has served on advisory boards for Appliance Computing II, Eli Lilly & Company, Mindsite, Ortho-McNeil Janssen Scientific Affairs, Johnson & Johnson, Plus One Health Management and Wyeth-Ayerst; has had research support for his epidemiological studies from Analysis Group Inc., Bristol-Myers Squibb, Eli Lilly & Company, EPI-Q, GlaxoSmithKline, Johnson & Johnson Pharmaceuticals, Ortho-McNeil Janssen Scientific Affairs, Pfizer Inc., Sanofi-Aventis Groupe, Shire US, Inc., and Walgreens Co.; and owns 25% share in DataStat, Inc.

[12]King's Centre for Military Health Research, King's College London, London, UK

Abstract

Background—The US Army suicide rate has increased sharply in recent years. Identifying significant predictors of Army suicides in Army and Department of Defense (DoD) administrative records might help focus prevention efforts and guide intervention content. Previous studies of administrative data, although documenting significant predictors, were based on limited samples and models. A career history perspective is used here to develop more textured models.

Method—The analysis was carried out as part of the Historical Administrative Data Study (HADS) of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). De-identified data were combined across numerous Army and DoD administrative data systems for all Regular Army soldiers on active duty in 2004–2009. Multivariate associations of sociodemographics and Army career variables with suicide were examined in subgroups defined by time in service, rank and deployment history.

Results—Several novel results were found that could have intervention implications. The most notable of these were significantly elevated suicide rates (69.6–80.0 suicides per 100000 person-years compared with 18.5 suicides per 100000 person-years in the total Army) among enlisted soldiers deployed either during their first year of service or with less than expected (based on time in service) junior enlisted rank; a substantially greater rise in suicide among women than men during deployment; and a protective effect of marriage against suicide only during deployment.

Conclusions—A career history approach produces several actionable insights missed in less textured analyses of administrative data predictors. Expansion of analyses to a richer set of predictors might help refine understanding of intervention implications.

Keywords

Army; Army STARRS; epidemiology; military; risk factors; suicide

Introduction

The US military suicide rate, although historically below the civilian rate, has climbed steadily since the beginning of the Iraq and Afghanistan conflicts (Armed Forces Health Surveillance Center, 2012) and has exceeded the matched civilian rate since 2008 (Kuehn, 2009). Successful interventions to address this problem will require improved understanding of risk factors. The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS; www.armystarrs.org) is a multi-component epidemiological–neurobiological study designed to help provide this understanding. As described in more detail elsewhere (Kessler *et al.* 2013), Army STARRS includes large-scale cross-sectional surveys of new soldiers and of all soldiers exclusive of those in training, a panel survey of combat brigades assessed shortly before and after returning from deployment, neurocognitive tests and blood samples obtained from survey respondents, linkage of survey data to administrative data, and retrospective case–control studies of attempted and completed suicides. Another Army STARRS component is the Historical Administrative Data Study (HADS) (Kessler *et al.* 2013). The HADS combines information culled from numerous Army and Department of

Defense (DoD) administrative databases for all soldiers on active duty in 2004–2009, including information on manner and timing of death.

Prior Army studies of administrative predictors of suicide, while limited either to descriptive analyses of suicides without controls (Logan *et al.* 2012; Bush *et al.* 2013), bivariate comparisons (Black *et al.* 2011; Schoenbaum *et al.* in press), or simple multivariate comparisons (Bell *et al.* 2010; Hyman *et al.* 2012) documented a number of sociodemographic (e.g. male, young) and Army career (e.g. low rank, deployment history) predictors. Speculation also exists that multiple deployments, long deployments and short dwell times (times between end of one deployment and beginning of next) might be risk factors for suicide (Rona *et al.* 2007; Reger *et al.* 2009).

While the current report presents the first multivariate HADS results, an earlier HADS report of bivariate predictors found that male sex, lower enlisted rank, history of deployment and being unmarried were associated with suicide (Schoenbaum *et al.* in press). That report also documented significant changes in associations of basic sociodemographics with suicide over the course of the military career, leading to the multivariate analyses reported here. We focus on associations of key sociodemographic and career history variables with suicide separately among enlisted soldiers and officers in the first 4 years of service (the typical first term of enlistment) and later years of service, distinguishing soldiers who never deployed, were currently deployed, and who previously deployed. This career history perspective is also motivated by emerging life history models of suicide that emphasize windows of opportunity to target interventions at developmentally appropriate stages (Fergusson *et al.* 2000; Gunnell & Lewis, 2005; Riordan *et al.* 2006; Seguin *et al.* 2007; Shiner *et al.* 2009; Maniglio, 2011; Mittendorfer-Rutz *et al.* 2012).

Method

Sample

De-identified HADS data were analysed from: (*a*) the DoD Defense Manpower Data Center (DMDC) Master Personnel and Transaction Files (sociodemographic and Army career characteristics); (*b*) the DMDC Contingency Tracking System (activations, mobilizations, deployments); and (*c*) the Armed Forces Medical Examiner Tracking System (suicides). We focused on HADS records for the 975 057 Regular Army soldiers (excluding activated Army National Guard and Army Reserve) on active duty at some time between 1 January 2004 and 31 December 2009, 569 of whom completed suicide during that active duty time period. As detailed below in the section on analysis methods, we analysed these data using a discrete-time survival framework with person-month the unit of analysis (Willett & Singer, 1993). This approach treats each month in the career of each soldier as a separate observational record. There were approximately 37 million person-months in the study period; only 569 of them coded 1 on the dichotomous yes/no suicide outcome variable. Rather than include this enormous number of control person-months in the analysis, we took advantage of the fact that discrete-time survival coefficients can be estimated without bias when control person-months are randomly sub-sampled and weighted using the logic of case–control analysis (Schlesselman, 1982) and selected an equal-probability 1:400 sample of control person-months stratified by sex, rank, time in service, deployment history (never,

currently, previously) and historical time (n = 92 507) from the population. These controls were combined with the 569 suicide person-months to create a case–control sample of 93 076 person-months. Each control person-month was assigned a weight of 400 to adjust for under-sampling. HADS data collection and analysis were approved by the Human Subjects Committees of the Uniformed Services University of the Health Sciences for the Henry M. Jackson Foundation (the primary grantee), the University of Michigan Institute for Social Research (site of the Army STARRS Data Enclave) and Harvard Medical School (site of data analysis).

Measures

Although the data considered here are limited to sociodemographic and Army career variables, additional HADS data are being collected (e.g. on mental and physical health care utilization and criminal justice) but were not available for the current analysis. Administrative data are also being merged with the Army STARRS survey data to facilitate more in-depth analysis of associations in the HADS data for the roughly 100 000 soldiers who participated in these surveys. The sociodemographics considered here include age, sex, race–ethnicity, education, marital status and number of dependants. The Army career variables include enlistment age, time in service, rank, and history of deployments to a combat zone or in direct support of Operation Enduring Freedom in Afghanistan or Operation Iraqi Freedom. We also considered length of current deployment, time since returning from most recent deployment, and dwell time (amount of time between end of one deployment and beginning of the next) among soldiers with a history of multiple deployments. Time-varying variables were coded at current values in each person-month.

Analysis methods

As noted above, discrete-time survival analysis with person-month the unit of analysis was used to examine associations of predictors with suicide. Logistic regression analysis was used to predict a yes/no suicide outcome controlling for time in service. When used to analyse this type of person-month data array, logistic regression coefficients can be interpreted as discrete-time survival coefficients (Willett & Singer, 1993). All models also included controls for calendar month based on the suicide rate increasing over the study period (Black *et al.* 2011). The implicit assumption that odds ratios (ORs) do not vary over time was tested and, consistent with earlier bivariate HADS results (Schoenbaum *et al.* in press), was supported.

Before estimating the models, simple cross-tabulations were used to examine subgroups defined by a coarse cross-classification of rank (enlisted υ. officer), time in service (0–4 υ. more than 4 years) and deployment history (never, currently, previously). The suicide rate was sufficiently different across the six enlisted soldier subgroups that models were estimated separately in each. The number of suicides among officers, in comparison, was so small that the model was estimated only for all officers combined.

A three-step process was used to build the models. First, we examined bivariate associations and discretized ordered predictors (e.g. age at enlistment, years of education) to capture

functional forms of associations with suicide. The two variables consistently non-significant in this step (race–ethnicity and number of dependants) were excluded from further analysis.

Second, joint associations were estimated for the two pairs of predictors found in the first step to be strongly related with each other: time in service with age; and rank with education. Age and education were excluded from further analysis based on neither predicting suicide net of time in service and rank. We also examined joint associations of rank and time in service with suicide and found several important interactions that were built into the final analysis step.

Third, pooled multivariate survival models were estimated separately for enlisted soldiers and officers to evaluate global interactions of sociodemographic and Army career variables with time in service and deployment history. Less complex models were then estimated based on results of significance tests. Significance was evaluated using 0.05-level two-sided tests. Global significance was evaluated using Wald χ^2 tests.

Final model coefficients were then used to calculate standardized suicide rates (Roalfe *et al.* 2008); that is, estimated numbers of suicides per 100 000 person-years (PY) for each category of each predictor under the model assuming other predictors were at their sample-wide means. Final model coefficients were also used to estimate population attributable risk (PAR) of suicides associated with targeted predictors based on simulation methods (Hanley, 2001). PAR can be interpreted as the proportion of observed suicides that might have been prevented if the predictor variable coefficients represented causal effects and interventions could have been implemented to eradicate these effects (Rothman & Greenland, 1998).

Results

Suicide rates by rank, time in service and deployment history

The mean suicide rate was 18.5/100000 PY. Only two of 12 subgroups created by cross-classifying rank, time in service and deployment history had rates meaningfully higher than this mean: currently and previously deployed enlisted soldiers in their first 4 years of service (31.3–29.4/100000 PY). The vast majority (90.9%) of Regular Army suicides were completed by enlisted soldiers (51.3% during the first 4 years of service and 39.5% after more time in service). Officers, making up 16.4% of all Regular Army personnel, accounted for the remaining 9.1% of suicides. Only five officers completed suicide during their first 4 years of service, while the suicide rate among officers with more than 4 years of service was low and unrelated to deployment status (11.3/100000 PY) (Tables 1 and 2).

Thinking in career history terms and focusing only on enlisted soldiers, the suicide rate during the first 4 years of service was about 70% higher among currently deployed (31.3/100 000 PY) and previously deployed (29.4/100 000 PY) than never-deployed (18.4/100000 PY) soldiers. Among enlisted soldiers with more years in service, the suicide rate was consistently (across deployment history categories) lower than among those in their first 4 years of service. Among enlisted soldiers with more than 4 years of service, in comparison, the suicide rate was relatively similar for the currently (13.1/100000 PY) and

never (12.1/100000 PY) deployed but considerably higher among the previously deployed (20.8/100000 PY).

Testing for variation in suicide risk by time in service and deployment history

Officers—Among officers with more than 4 years of service, associations (ORs) of sociodemographic and Army career predictors with suicide did not vary significantly by either time in service ($\chi^2_{11}=16.4$, $p = 0.13$) or deployment history ($\chi^2_{14}=15.4$, $p = 0.35$). Nor did any of the sociodemographic or Army career variables predict suicide significantly in a multivariate additive model among officers. Given these results, the remaining analyses focused on enlisted soldiers.

Enlisted soldiers—Global interaction tests showed that the associations of sociodemographic and Army career predictors with suicide among enlisted soldiers varied significantly by deployment history ($\chi^2_{16}=41.5$, $p<0.001$) but not time in service ($\chi^2_{8}=1.9$, $p = 0.99$) or the conjunction of deployment history and time in service ($\chi^2_{11}=11.5$, $p = 0.16$). We consequently estimated a final enlisted soldier model retaining all significant two-way interactions with deployment history in addition to all main effects. Standardized suicide rates and PAR simulations were based on this model.

Associations of predictors with suicide among enlisted soldiers

Sex—Enlisted males had higher odds of suicide than females in all subgroups. However, the male:female OR was lower (and not statistically significant) among currently deployed (1.8) than never-deployed or previously deployed (5.0) soldiers (Table 3). This difference was due to the female suicide rate among the currently deployed being substantially higher than among the never deployed (a 3.8-fold higher rate, 14.2 ט. 3.7/100000 PY, during the first 4 years of service; and a 2.4-fold higher rate, 6.5 ט. 2.7/100000 PY, during later years of service), whereas currently deployed males had a rate only slightly higher than that of never-deployed males during the first 4 years of service (25.5 ט. 18.4/100000 PY) and somewhat lower than the never deployed during later years of service (11.6 ט. 13.6/100000 PY). Furthermore, after returning from deployment the suicide rate among women returned nearly to the pre-deployment level but either remained elevated (during the first 4 years of service) or increased (during later years of service) among men.

Marital status—The suicide rate was significantly higher (OR = 1.8) among unmarried than married soldiers during deployment regardless of time in service, but unrelated to marital status among the never and previously deployed. This difference in ORs was due partly to the suicide rate being significantly higher among currently than never-deployed unmarried soldiers (29.8 ט. 13.8/100000 PY) but only insignificantly higher among currently than never-deployed married soldiers (17.1 ט. 13.9/100000 PY). Furthermore, after returning from deployment the suicide rate among married soldiers increased (21.9 ט. 17.1/100000 PY during the first 4 years of service; 17.7 ט. 9.4/100000 PY during later years of service), while the suicide rate either decreased (during the first 4 years or service; 21.9 ט. 29.8/100000 PY) or remained the same (in later years of service) among unmarried soldiers.

Enlistment age—Similar to the pattern for marital status, enlistment age was associated with suicide only during deployment. Specifically, the suicide rate of currently deployed enlisted soldiers was significantly higher (OR = 1.6) among those who enlisted as teenagers than at later ages, while enlistment age was unrelated to suicide (OR = 0.9) among the never deployed and previously deployed. This significant variation in ORs was due partly to the suicide rate of soldiers enlisting as teenagers being much higher among the currently than never deployed (30.1/100000 PY ט. 13.4/100000 PY during the first 4 years of service; 13.6/100000 PY ט. 9.4/100 000 PY during later years of service), which was not the case for soldiers enlisting at later ages (19.2/100000 PY ט. 14.2/100000 PY during the first 4 years of service; 8.7/100000 PY ט. 10.0/100000 PY during later years of service). Changes in suicide rates after returning from deployment also differed by age at enlistment. During the first 4 years of service, when the overall suicide rate was lower among the previously than currently deployed, this post-deployment lowering was confined to soldiers who enlisted as teenagers (21.2/100000 PY among the previously deployed ט. 30.1/100000 PY among the currently deployed), whereas among soldiers who enlisted at older ages the suicide rate was slightly higher after returning from deployment than during deployment (22.6/100000 PY among the previously deployed ט. 19.2/100000 PY among the currently deployed). In later years of service, the elevated suicide rate of previously than currently deployed soldiers was less pronounced among those who enlisted as teenagers (17.1/100000 PY ט. 13.6/100000 PY) than at later ages (18.2/100000 PY ט. 8.7/100000 PY).

Rank/time in service—Significant interactions were found between rank and a fine-grained measure of time in service. One of these interactions involved soldiers deployed in their first year of service. While making up only 5.7% of currently deployed soldiers with less than 4 years in service, these relatively inexperienced soldiers accounted for nearly 15% of all suicides.

Other interactions involved high suicide rates among lower-ranking enlisted soldiers (i.e. E1–E4) with less than expected (LTE) rank based on time in service (i.e. E1–E2 with more than 18 months in service and E3 with more than 24 months in service). Significantly elevated ORs associated with LTE rank were in the range 2.4–2.8. The only exception was an insignificant OR of LTE E3 rank among the currently deployed (0.9). (Further analysis, results available on request, shows that the elevated ORs associated with LTE were comparable for soldiers who were demoted and those not promoted on schedule.) Inspection of standardized suicide rates shows that the suicide rate of soldiers with LTE rank among the never deployed was more than twice as high as among other junior enlisted soldiers (29.9–35.6/100000 PY ט. 12.5/100000 PY). Among currently deployed soldiers, the standardized suicide rate of LTE E1–E2 soldiers was much higher than that of other junior enlisted soldiers (59.8/100000 PY ט. 25.0/100000 PY). A similar pattern was found among previously deployed soldiers, where the suicide rate of those with LTE rank was 61.6–73.2/100000 PY ט. 25.7/100000 PY for other junior enlisted soldiers. At the other extreme, the relatively small proportion of higher ranking enlisted soldiers with less than 4 years of service (made up almost entirely of E5–E6) had consistently low suicide rates (2.8–5.8/100000 PY). Among enlisted soldiers with more than 4 years of service, in comparison, the suicide rate was inversely related to rank, only about 10% higher among the currently

than never deployed, and 65% higher among the previously than currently deployed, with the highest rate (28.8/100000 PY) among previously deployed junior rank enlisted soldiers.

Deployment timing and history—Neither time in current deployment ($\chi^2_3=3.4$, p = 0.34), time since returning from deployment ($\chi^2_3=5.9$, p = 0.12), history of multiple deployments ($\chi^2_1=0.0$, p = 0.96), nor dwell time [examined both in absolute terms (i.e. number of months between end of second most recent deployment and beginning of most recent deployment) and in relative terms (i.e. length of absolute dwell time divided by length of prior deployment)] ($\chi^2_1=0.07-0.19$, p = 0.78–0.66) was significantly related to suicide.

PARs

PAR is a joint function of standardized risk (Table 3) and prevalence (Table 4) of predictors.

Sex—How much would the overall Army suicide rate be affected if the higher suicide rate of enlisted women during deployment than among the never deployed could be reduced to the same ratio as men? PAR suggests that such a change would reduce total suicides of currently deployed enlisted soldiers by 3.8% in the first 4 years of service and 4.1% in later years. These relatively low percentages reflect the low proportion of deployed soldiers who are women (9.9% during first 4 years of service; 9.2% during later years) and the fact that women have a much lower overall suicide rate than men.

Marital status and enlistment age—How much would the overall Army suicide rate be reduced if the elevated suicide rates during deployment of unmarried enlisted soldiers and those who enlisted as teenagers could be reduced to the same proportional elevations as among the married and soldiers with later enlistment ages? PAR for marriage is 32.4% of all suicides completed by currently deployed enlisted soldiers in their first 4 years of service and 18.3% in later years. PAR for young enlistment age is 22.7% of all suicides completed by currently deployed enlisted soldiers in their first 4 years of service.

Early deployment and LTE rank—The two most dramatic results with potential intervention implications regarding rank and time in service are those associated with junior enlisted soldiers deployed in their first year of service or with LTE rank having significantly elevated suicide rates. Reduction of these rates to the levels among other junior enlisted soldiers would reduce the Army suicide rate by 20.3% for never deployed, 14.9% for currently deployed, and 13.6% for previously deployed enlisted soldiers in their first 4 years of service.

Discussion

Limitations of the data are: that some genuine suicides might have been inaccurately classified as accidents or undetermined (i.e. inadequate evidence to determine manner of death); that data were not available for years more recent than 2009; and that reliance on register-based data limited the range of predictors that could be studied. As noted in the Introduction, the latter limitation will be addressed in future analyses of Army STARRS survey data linked to administrative data. Another noteworthy limitation is that differences

between never-deployed and ever-deployed soldiers and differences between soldiers in their first 4 years of service and later years of service cannot be interpreted as evidence of within-person changes in suicide risk, as we know that neither deployment nor attrition from Army service occurs at random (Hoge *et al.* 2006; Warner *et al.* 2011; Ireland *et al.* 2012). In addition, only net associations of predictors were examined controlling other predictors without attempting to trace out indirect pathways of distal predictors through proximal predictors.

Within the context of these limitations, our results replicate and extend previous studies of military suicides in a number of ways.

Sex

Although the higher suicide rate of men than women is well known, no previous research documented variation in this association by deployment status. This specification could be due to deployment-related stressors being higher among women than men, access to firearms increasing more among women than men during deployment, vulnerabilities to stressor effects increasing during deployment more among women than men, sex-linked differential selection into deployment, or some combination of these processes. The possibilities involving stress have been the subject of considerable speculation in the years since women began to have expanded combat roles (Bond, 2004; La Bash *et al.* 2009; Street *et al.* 2009). Limited empirical research suggests that deployed women might be exposed to more interpersonal stresses than men (Kang *et al.* 2005; Vogt *et al.* 2005, 2011) but that sex differences in adverse psychological effects of deployment-related stresses are insignificant (Vogt *et al.* 2011; Woodhead *et al.* 2012). Policies to increase the combat roles of women heighten the practical importance of examining this specification in more depth in future HADS analyses.

Marital status

Previous studies of military suicide have found, consistent with the HADS finding, that the protective effect of marriage is weaker among soldiers than in the general population (Black *et al.* 2011; Hyman *et al.* 2012; Logan *et al.* 2012) and in civilians (Kposowa, 2000). This result has been interpreted as reflecting unique stresses of military marriages (Drummet *et al.* 2003). However, this cannot be a completely adequate explanation, as available evidence shows that these stresses are more intense among soldiers with than without a history of deployment (Sheppard *et al.* 2010; Harvey *et al.* 2012; Riviere *et al.* 2012), whereas our data show that marriage is associated with low suicide risk among currently deployed enlisted soldiers. More fine-grained analysis of these complex specifications is needed.

Enlistment age

Although previous research found enlistment age unrelated to soldier suicides overall (Gradus *et al.* 2013), our study is the first to examine interactions of enlistment age with deployment status. A plausible interpretation of our finding that early enlistment predicts suicide during deployment is that early enlistment is an indicator of unmeasured vulnerabilities to deployment-related stress, but more fine-grained analysis of this possibility

is needed before considering interventions to enhance resilience among soon-to-deploy soldiers with early enlistment age.

Rank and time in service

Although a number of previous studies found inverse associations of suicide with rank (Bell *et al.* 2010; Bachynski *et al.* 2012; Hyman *et al.* 2012) and time in service (Bell *et al.* 2010), none investigated the conjunction of rank and time in service; this led us to discover high suicide rates among junior enlisted soldiers either deployed during their first year of service or with LTE junior rank. Interventions aimed at these junior enlisted soldiers could be significant, as soldiers in their first year of service account for nearly 15% of all suicides among deployed enlisted soldiers in their first 4 years and soldiers with LTE rank account for 35.3% of all suicides among never-deployed, 24.0% among currently deployed, and 21.7% among previously deployed enlisted soldiers in their first 4 years of service. Although the simple descriptive results presented here provide no insights into the most appropriate preventive interventions for these soldiers, the high PAR values associated with these predictors make them important targets for future analyses of underlying causal processes.

Deployment

As noted in the Introduction, a number of previous studies have documented higher suicide rates among ever-deployed than never-deployed soldiers (Black *et al.* 2011; Thomsen *et al.* 2011; Hyman *et al.* 2012; Bachynski *et al.* 2012). However, those studies examined deployment history in the aggregate rather than with the specifications considered here and consequently failed to document the subgroup variations found here in the associations of deployment history with suicide. These specifications require more in-depth investigation to elucidate their underlying mechanisms. We also noted in the Introduction that speculation exists that multiple deployments (Ritchie, 2012), long deployments (Shen *et al.* 2012) and short dwell times between deployments (MacGregor *et al.* 2012) might be risk factors for suicide, although at least some previous empirical research is inconsistent with these suggestions (Hyman *et al.* 2012; Leard-Mann *et al.* 2013). There is also evidence that multiple deployments are associated with screening positive for post-traumatic stress disorder (PTSD) in post-deployment assessment surveys (Reger *et al.* 2009) and that shorter dwell times are associated with high risk of PTSD and other mental health problems (MacGregor *et al.* 2012). However, we found no evidence for associations of suicide with any of these variables in our analyses.

Implications beyond the US Army

Although the focus of this report was on predictors of suicide among US Army soldiers, Army STARRS results have broader relevance in two ways. First, our findings regarding the associations of sex and marital status with suicide touch on patterns found in the general population (Nock *et al.* 2008). The male:female suicide ratio in the HADS is roughly comparable with the ratio in the total US population (Rockett *et al.* 2012) despite women making up a much smaller proportion of the Army than the general population. The finding that the male:female suicide ratio varied significantly by deployment documents that the sex difference in suicide is sensitive to environmental experiences, raising the question whether

parallel variation exists in the general population. We are unaware of research on this question. However, more focused analysis of the factors underlying this specification in the Army (i.e. changes in sex differences in stress exposure or reactivity during rather than before or after deployment) might provide useful information on the factors underlying sex differences in suicide more generally. Similarly, more in-depth analysis of the fact that the protective effect of marriage emerges only during deployment among US Army personnel might expand our understanding of the ways that marriage protects against suicide more generally.

Second, while most of the predictors in our analysis were defined only for the military, the constructs underlying these predictors have civilian counterparts. This means that our findings might be used to suggest new areas of investigation in studies of the general population. For example, while our measure of LTE junior enlisted rank is unique to the US Army, LTE career advancement exists in the general population and might be a significant predictor of suicide. We are unaware of any previous research on the latter possibility, but our results suggest that this might be an important area of investigation either because low career advancement is a marker of vulnerability or is associated with stressors that lead to suicide. Similarly, future analyses linking the Army STARRS survey data to the HADS might generate more textured results regarding the effects of underlying causal factors that are relevant to suicides in the general population.

Acknowledgments

The study received the following financial support. Army STARRS was sponsored by the Department of the Army and funded under cooperative agreement number U01MH087981 with the US Department of Health and Human Services, National Institutes of Health, National Institute of Mental Health (NIH/NIMH). The contents are solely the responsibility of the authors and do not necessarily represent the views of the Department of Health and Human Services, NIMH, the Department of the Army, or the DoD.

The Army STARRS Team co-principal investigators are R. J. Ursano, M.D. (Uniformed Services University of the Health Sciences) and M. B. Stein, M.D., M.P.H. (University of California San Diego and VA San Diego Healthcare System). Site principal investigators are S. G. Heeringa, Ph.D. (University of Michigan) and R. C. Kessler, Ph.D. (Harvard Medical School). National Institute of Mental Health (NIMH) collaborating scientists are L. J. Colpe, Ph.D., M.P.H. and M. Schoenbaum, Ph.D. Army liaisons/consultants are COL S. Cersovsky, M.D., M.P.H. (US Army Public Health Command, USAPHC) and K. L. Cox, M.D., M.P.H. (USAPHC). Other team members are P. A. Aliaga, M.A. (Uniformed Services University of the Health Sciences), COL D. M. Benedek, M.D. (Uniformed Services University of the Health Sciences), S. Borja, Ph.D. (NIMH), G. G. Brown, Ph.D. (University of California San Diego), L. Campbell-Sills, Ph.D. (University of California San Diego), C. L. Dempsey, Ph.D., M.P.H. (Uniformed Services University of the Health Sciences), R. Frank, Ph.D. (Harvard Medical School), C. S. Fullerton, Ph.D. (Uniformed Services University of the Health Sciences), N. Gebler, M.A. (University of Michigan), J. Gelernter, M.D. (Yale University), R. K. Gifford, Ph.D. (Uniformed Services University of the Health Sciences), S. E. Gilman, Sc.D. (Harvard School of Public Health), M. G. Holloway, Ph.D. (Uniformed Services University of the Health Sciences), P. E. Hurwitz, M.P.H. (Uniformed Services University of the Health Sciences), S. Jain, Ph.D. (University of California San Diego), T.-C. Kao, Ph.D. (Uniformed Services University of the Health Sciences), K. C. Koenen, Ph.D. (Columbia University), L. Lewandowski-Romps, Ph.D. (University of Michigan), H. Herberman Mash, Ph.D. (Uniformed Services University of the Health Sciences), J. E. McCarroll, Ph.D., M.P.H. (Uniformed Services University of the Health Sciences), K. A. McLaughlin, Ph.D. (Harvard Medical School), J. A. Naifeh, Ph.D. (Uniformed Services University of the Health Sciences), M. K. Nock, Ph.D. (Harvard University), R. Raman, Ph.D. (University of California San Diego), S. Rose, Ph.D. (Harvard Medical School), A. J. Rosellini, Ph.D. (Harvard Medical School), N. A. Sampson, B.A. (Harvard Medical School), LCDR P. Santiago, M.D., M.P.H. (Uniformed Services University of the Health Sciences), M. Scanlon, M.B.A. (National Institute of Mental Health), J. Smoller, M.D., Sc.D. (Harvard Medical School), M. L. Thomas, Ph.D. (University of California San Diego), P. L. Vegella, M.S., M.A. (Uniformed Services University of the Health Sciences), C. Wassel, Ph.D. (University of Pittsburgh) and A. M. Zaslavsky, Ph.D. (Harvard Medical School). A complete list of Army STARRS publications can be found at http://www.armystarrs.org

The role of the sponsors was as follows. As a cooperative agreement, scientists employed by the NIMH (L. J. Colpe and M. Schoenbaum) and Army liaisons/consultants (COL S. Cersovsky, M.D., M.P.H. USAPHC and K. L. Cox, M.D., M.P.H. USAPHC) collaborated to develop the study protocol and data collection instruments, supervise data collection, plan and supervise data analyses, interpret results and prepare reports. Although a draft of this manuscript was submitted to the Army and NIMH for review and comment prior to submission, this was with the understanding that comments would be no more than advisory.

References

Armed Forces Health Surveillance Center. Deaths while on active duty in the U.S. Armed Forces, 1990–2011. Medical Surveillance Monthly Reports. 2012; 19:2–5.

Bachynski KE, Canham-Chervak M, Black SA, Dada EO, Millikan AM, Jones BH. Mental health risk factors for suicides in the US Army, 2007–8. Injury Prevention. 2012; 18:405–412. [PubMed: 22398362]

Bell NS, Harford TC, Amoroso PJ, Hollander IE, Kay AB. Prior health care utilization patterns and suicide among U.S. Army soldiers. Suicide and Life-Threatening Behavior. 2010; 40:407–415. [PubMed: 20822367]

Black SA, Gallaway MS, Bell MR, Ritchie EC. Prevalence and risk factors associated with suicides of army soldiers 2001–2009. Military Psychology. 2011; 23:433–451.

Bond EF. Women's physical and mental health sequellae of wartime service. Nursing Clinics of North America. 2004; 39:53–68. [PubMed: 15062727]

Bush NE, Reger MA, Luxton DD, Skopp NA, Kinn J, Smolenski D, Gahm GA. Suicides and suicide attempts in the U.S. Military, 2008–2010. Suicide and Life-Threatening Behavior. 2013; 43:262–273. [PubMed: 23330611]

Drummet AR, Coleman M, Cable S. Military families under stress: implications for family life education. Family Relations. 2003; 52:279–287.

Fergusson DM, Woodward LJ, Horwood LJ. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood. Psychological Medicine. 2000; 30:23–39. [PubMed: 10722173]

Gradus JL, Shipherd JC, Suvak MK, Giasson HL, Miller M. Suicide attempts and suicide among Marines: a decade of follow-up. Suicide and Life-Threatening Behavior. 2013; 43:39–49. [PubMed: 23082753]

Gunnell D, Lewis G. Studying suicide from the life course perspective: implications for prevention. British Journal of Psychiatry. 2005; 187:206–208. [PubMed: 16135856]

Hanley JA. A heuristic approach to the formulas for population attributable fraction. Journal of Epidemiology and Community Health. 2001; 55:508–514. [PubMed: 11413183]

Harvey SB, Hatch SL, Jones M, Hull L, Jones N, Greenberg N, Dandeker C, Fear NT, Wessely S. The long-term consequences of military deployment: a 5-year cohort study of United Kingdom reservists deployed to Iraq in 2003. American Journal of Epidemiology. 2012; 176:1177–1184. [PubMed: 23186749]

Hoge CW, Auchterlonie JL, Milliken CS. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. Journal of the American Medical Association. 2006; 295:1023–1032. [PubMed: 16507803]

Hyman J, Ireland R, Frost L, Cottrell L. Suicide incidence and risk factors in an active duty US military population. American Journal of Public Health. 2012; 102(Suppl. 1):S138–S146. [PubMed: 22390588]

Ireland RR, Kress AM, Frost LZ. Association between mental health conditions diagnosed during initial eligibility for military health care benefits and subsequent deployment, attrition, and death by suicide among active duty service members. Military Medicine. 2012; 177:1149–1156. [PubMed: 23113440]

Kang H, Dalager N, Mahan C, Ishii E. The role of sexual assault on the risk of PTSD among Gulf War veterans. Annals of Epidemiology. 2005; 15:191–195. [PubMed: 15723763]

Kessler RC, Colpe LJ, Fullerton CS, Gebler N, Naifeh JA, Nock MK, Sampson NA, Schoenbaum M, Zaslavsky AM, Stein MB, Ursano RJ, Heeringa SG. Design of the Army Study to Assess Risk and

Resilience in Servicemembers (Army STARRS). International Journal of Methods in Psychiatric Research. 2013; 22:267–275. [PubMed: 24318217]

Kposowa AJ. Marital status and suicide in the National Longitudinal Mortality Study. Journal of Epidemiology and Community Health. 2000; 54:254–261. [PubMed: 10827907]

Kuehn BM. Soldier suicide rates continue to rise: military, scientists work to stem the tide. Journal of the American Medical Association. 2009; 301:1111–1113. [PubMed: 19293405]

La Bash HA, Vogt DS, King LA, King DW. Deployment stressors of the Iraq War: insights from the mainstream media. Journal of Interpersonal Violence. 2009; 24:231–258. [PubMed: 18467690]

LeardMann CA, Powell TM, Smith TC, Bell MR, Smith B, Boyko EJ, Hooper TI, Gackstetter GD, Ghamsary M, Hoge CW. Risk factors associated with suicide in current and former US military personnel. Journal of the American Medical Association. 2013; 310:496–506. [PubMed: 23925620]

Logan J, Skopp NA, Karch D, Reger MA, Gahm GA. Characteristics of suicides among US Army active duty personnel in 17 US states from 2005 to 2007. American Journal of Public Health. 2012; 102(Suppl. 1):S40–S44. [PubMed: 22390599]

MacGregor AJ, Han PP, Dougherty AL, Galarneau MR. Effect of dwell time on the mental health of US military personnel with multiple combat tours. American Journal of Public Health. 2012; 102(Suppl. 1):S55–S59. [PubMed: 22390601]

Maniglio R. The role of child sexual abuse in the etiology of suicide and non-suicidal self-injury. Acta Psychiatrica Scandinavica. 2011; 124:30–41. [PubMed: 20946202]

Mittendorfer-Rutz E, Rasmussen F, Lange T. A life-course study on effects of parental markers of morbidity and mortality on offspring's suicide attempt. PLOS ONE. 2012; 7:e51585. [PubMed: 23251584]

Nock MK, Borges G, Bromet EJ, Cha CB, Kessler RC, Lee S. Suicide and suicidal behavior. Epidemiologic Reviews. 2008; 30:133–154. [PubMed: 18653727]

Reger MA, Gahm GA, Swanson RD, Duma SJ. Association between number of deployments to Iraq and mental health screening outcomes in US Army soldiers. Journal of Clinical Psychiatry. 2009; 70:1266–1272. [PubMed: 19689917]

Riordan DV, Selvaraj S, Stark C, Gilbert JS. Perinatal circumstances and risk of offspring suicide. Birth cohort study. British Journal of Psychiatry. 2006; 189:502–507. [PubMed: 17139033]

Ritchie EC. Suicide and the United States Army: perspectives from the former psychiatry consultant to the Army Surgeon General. Cerebrum. 2012 (http://www.dana.org/Cerebrum/Default.aspx?id=39471).

Riviere LA, Merrill JC, Thomas JL, Wilk JE, Bliese PD. 2003–2009 marital functioning trends among U.S. enlisted soldiers following combat deployments. Military Medicine. 2012; 177:1169–1177. [PubMed: 23113443]

Roalfe AK, Holder RL, Wilson S. Standardisation of rates using logistic regression: a comparison with the direct method. BMC Health Services Research. 2008; 8:275. [PubMed: 19113996]

Rockett IR, Regier MD, Kapusta ND, Coben JH, Miller TR, Hanzlick RL, Todd KH, Sattin RW, Kennedy LW, Kleinig J, Smith GS. Leading causes of unintentional and intentional injury mortality: United States, 2000–2009. American Journal of Public Health. 2012; 102:e84–e92. [PubMed: 22994256]

Rona RJ, Fear NT, Hull L, Greenberg N, Earnshaw M, Hotopf M, Wessely S. Mental health consequences of overstretch in the UK armed forces: first phase of a cohort study. British Medical Journal. 2007; 335:603. [PubMed: 17664192]

Rothman, K.; Greenland, S. Modern Epidemiology. 2nd edn.. Philadelphia: Lippincott Williams and Wilkins; 1998.

Schlesselman, JJ. Case-control Studies: Design, Conduct, Analysis. New York: Oxford University Press; 1982.

Schoenbaum M, Kessler RC, Gilman SE, Colpe LJ, Heeringa SG, Stein MB, Ursano RJ, Cox KL. Predictors of suicide and accident death in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). JAMA Psychiatry. (in press).

Seguin M, Lesage A, Turecki G, Bouchard M, Chawky N, Tremblay N, Daigle F, Guy A. Life trajectories and burden of adversity: mapping the developmental profiles of suicide mortality. Psychological Medicine. 2007; 37:1575–1583. [PubMed: 17572932]

Shen YC, Arkes J, Williams TV. Effects of Iraq/Afghanistan deployments on major depression and substance use disorder: analysis of active duty personnel in the US military. American Journal of Public Health. 2012; 102(Suppl. 1):S80–S87. [PubMed: 22390609]

Sheppard SC, Malatras JW, Israel AC. The impact of deployment on U.S. military families. American Psychologist. 2010; 65:599–609. [PubMed: 20822199]

Shiner M, Scourfield J, Fincham B, Langer S. When things fall apart: gender and suicide across the life-course. Social Science and Medicine. 2009; 69:738–746. [PubMed: 19608323]

Street AE, Vogt D, Dutra L. A new generation of women veterans: stressors faced by women deployed to Iraq and Afghanistan. Clinical Psychology Review. 2009; 29:685–694. [PubMed: 19766368]

Thomsen CJ, Stander VA, McWhorter SK, Rabenhorst MM, Milner JS. Effects of combat deployment on risky and self-destructive behavior among active duty military personnel. Journal of Psychiatric Research. 2011; 45:1321–1331. [PubMed: 21549392]

Vogt D, Vaughn R, Glickman ME, Schultz M, Drainoni ML, Elwy R, Eisen S. Gender differences in combat-related stressors and their association with postdeployment mental health in a nationally representative sample of U.S. OEF/OIF veterans. Journal of Abnormal Psychology. 2011; 120:797–806. [PubMed: 21639595]

Vogt DS, Pless AP, King LA, King DW. Deployment stressors, gender, and mental health outcomes among Gulf War I veterans. Journal of Traumatic Stress. 2005; 18:272–284. [PubMed: 16281224]

Warner CH, Appenzeller GN, Parker JR, Warner CM, Hoge CW. Effectiveness of mental health screening and coordination of in-theater care prior to deployment to Iraq: a cohort study. American Journal of Psychiatry. 2011; 168:378–385. [PubMed: 21245086]

Willett JB, Singer JD. Investigating onset, cessation, relapse, and recovery: why you should, and how you can, use discrete-time survival analysis to examine event occurrence. Journal of Consulting Clinical Psychology. 1993; 61:952–965. [PubMed: 8113496]

Woodhead C, Wessely S, Jones N, Fear NT, Hatch SL. Impact of exposure to combat during deployment to Iraq and Afghanistan on mental health by gender. Psychological Medicine. 2012; 42:1985–1996. [PubMed: 22234270]

Table 1

Suicide rate (suicides/100 000 person-years) by rank, time in service and deployment history among Regular Army soldiers in the Army STARRS 2004–2009 Historical Administrative Data Systems sample (n = 93 076)[a]

	Deployment history							
	Never		Currently		Previously		Total	
	Suicide rate	(n_1/n_2[b])	Suicide rate	(n_1/n_2[b])	Suicide rate	(n_1/n_2[b])	Suicide rate	(n_1/n_2[b])
Enlisted soldiers								
First 4 years in service	18.4	(128/697)	31.3	(90/287)	29.4	(74/252)	23.6	(292/1236)
More than 4 years in service	12.1	(42/346)	13.1	(41/314)	20.8	(142/683)	16.8	(225/1343)
Total	16.3	(170/1043)	21.8	(131/601)	23.1	(216/935)	20.1	(517/2579)
Officers								
First 4 years in service	5.8	(3/51)	0.0	(0/20)	11.6	(2/17)	5.7	(5/88)
More than 4 years in service	14.3	(20/140)	11.5	(9/78)	9.0	(18/199)	11.3	(47/417)
Total	12.0	(23/191)	9.2	(9/98)	9.2	(20/216)	10.3	(52/505)
All soldiers: enlisted and officers								
First 4 years in service	17.5	(131/748)	29.3	(90/307)	28.3	(76/269)	22.4	(297/1324)
More than 4 years in service	12.8	(62/486)	12.8	(50/392)	18.1	(160/882)	15.5	(272/1760)
Total	15.6	(193/1234)	20.0	(140/699)	20.5	(236/1151)	18.5	(569/3084)

Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers.

[a]The sample of 93076 person-months includes all 569 suicides of active duty Regular Army soldiers recorded in the administrative records during the years 2004–2009 plus a 1:400 stratified probability sample of all other person-months in the population exclusive of those associated with other types of death (i.e. combat death, homicide, and death due to other injuries or illnesses). All records in the 1:400 sample were assigned a weight of 400 to adjust for the under-sampling months not associated with suicide.

[b]n_1 = number of suicides; n_2 = number of person-years, not person-months, in thousands in the population. As noted in note a, the 93076 person-months in the sample represent a 1:400 sample of the 37.0 million person-months (3.084 million person-years) in the population of Regular Army soldiers (i.e. excluding those in the US Army National Guard and Army Reserve) on active duty for 1 or more month in the calendar years 2004–2009.

Table 2

Percentages of all active duty Regular Army suicides and soldiers by rank, time in service, and deployment history among Regular Army soldiers in the Army STARRS 2004–2009 Historical Administrative Data Systems sample (n = 93 076)[a]

	Deployment history							
	Never		Currently		Previously		Total	
	Suicides	Soldiers	Suicides	Soldiers	Suicides	Soldiers	Suicides	Soldiers
Enlisted soldiers								
First 4 years in service	22.5	22.6	15.8	9.3	13.0	8.2	51.3	40.1
More than 4 years in service	7.4	11.2	7.2	10.2	25.0	22.2	39.5	43.5
Total	29.9	33.8	23.0	19.5	38.0	30.3	90.9	83.6
Officers								
First 4 years in service	0.5	1.7	0.0	0.6	0.4	0.6	0.9	2.9
More than 4 years in service	3.5	4.5	1.6	2.5	3.2	6.5	8.3	13.5
Total	4.0	6.2	1.6	3.2	3.5	7.0	9.1	16.4
All soldiers: enlisted and officers								
First 4 years in service	23.0	24.3	15.8	9.9	13.4	8.7	52.2	42.9
More than 4 years in service	10.9	15.7	8.8	12.7	28.1	28.6	47.8	57.1
Total	33.9	40.0	24.6	22.6	41.5	37.3	100.0	100.0

Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers.

[a]The sample of 93 076 person-months includes all 569 suicides of active duty Regular Army soldiers recorded in the administrative records during the years 2004–2009 plus a 1:400 stratified probability sample of all other person-months in the population exclusive of those associated with other types of death (i.e. combat death, homicide, and death due to other injuries or illnesses). All records in the 1:400 sample were assigned a weight of 400 to adjust for the under-sampling months not associated with suicide.

Table 3

Multivariate associations (ORs) of age at enlistment, rank/time in service and deployment history with suicide among enlisted soldiers in the Army STARRS 2004–2009 Historical Administrative Data Study sample (n = 77610)[a]

	ORs by deployment history				Standardized suicide rates by time in service and deployment history							
	Never		Current		Previous		First 4 years in service			More than 4 years in service		
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	Never	Current	Previous	Never	Current	Previous
Sex												
Male	5.0	(2.8–8.6)*	1.8	(0.9–3.7)	5.0	(2.8–8.6)*	18.4	25.5	26.2	13.6	11.6	20.9
Female	1.0	–	1.0	–	1.0	–	3.7	14.2	5.3	2.7	6.5	4.2
χ^2_1		32.0*		2.6		32.0*						
Marital status												
Unmarried	1.0	(0.8–1.3)	1.8	(1.2–2.6)*	1.0	(0.8–1.3)	13.8	29.8	21.9	9.7	16.4	17.6
Married	1.0	–	1.0	–	1.0	–	13.9	17.1	21.9	9.7	9.4	17.7
χ^2_1		0.0		8.0*		0.0						
Enlistment age, years												
17–19	0.9	(0.8–1.2)	1.6	(1.1–2.3)*	0.9	(0.8–1.2)	13.4	30.1	21.2	9.4	13.6	17.1
20+	1.0	–	1.0	–	1.0	–	14.2	19.2	22.6	10.0	8.7	18.2
χ^2_1		0.4		5.6*		0.4						
Rank/time in service among soldiers in their first 4 years of service[b]												
Deployed <13 MIS	–	–	3.2	(1.7–6.0)*	–	–	–	79.4	–	–	–	–
E1–E2 >18 MIS LTE	2.4	(1.6–3.6)*	2.4	(1.6–3.6)*	2.4	(1.6–3.6)*	29.9	59.8	61.6	–	–	–
E3 >24 MIS LTE	2.8	(2.0–4.1)*	0.9	(0.3–2.5)	2.8	(2.0–4.1)*	35.6	22.7	73.2	–	–	–
Other E1–E4	1.0	–	1.0	–	1.0	–	12.5	25.0	25.7			
E5–E6	0.2	(0.1–0.6)*	0.2	(0.1–0.6)*	0.2	(0.1–0.6)*	2.8	5.6	5.8			
χ^2_{3-4}		59.1*		70.4*		59.1*						
Rank/time in service among soldiers with more than 4 years of service[b]												

	ORs by deployment history				Standardized suicide rates by time in service and deployment history							
	Never		Current		Previous		First 4 years in service			More than 4 years in service		
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	Never	Current	Previous	Never	Current	Previous
E1–E4	1.0	–	1.0	–	1.0	–	–	–	–	15.9	17.4	28.8
E5–E6	0.6	(0.4–0.8)*	0.6	(0.4–0.8)*	0.6	(0.4–0.8)*	–	–	–	9.1	9.9	16.4
E7–E9	0.5	(0.3–0.8)*	0.5	(0.3–0.8)*	0.5	(0.3–0.8)*	–	–	–	8.1	8.8	14.6
χ^2_2		15.5*		15.5*		15.5*						
History of prior deployment												
Yes	–	–	1.0	(0.8–1.3)	1.0	(0.8–1.3)	–	24.2	22.0	–	11.0	17.7
No	–	–	1.0	–	1.0	–	–	24.0	21.9	–	11.0	17.6
χ^2_1	–			0.0		0.0						
Time in current deployment, months												
0–3	–	–	1.0	–	–	–	–	18.6	–	–	8.4	–
4–6	–	–	1.6	(1.0–2.5)	–	–	–	29.0	–	–	13.1	–
7–9	–	–	1.4	(0.8–2.4)	–	–	–	25.7	–	–	11.7	–
10+	–	–	1.4	(0.8–2.2)	–	–	–	25.3	–	–	11.5	–
χ^2_3		–		3.4	–							
Time since returning from most recent deployment, months												
0–3	–	–	–	–	1.0	–	–	–	16.2	–	–	12.4
4–6	–	–	–	–	1.8	(1.1–2.9)*	–	–	28.6	–	–	21.8
7–12	–	–	–	–	1.3	(0.8–2.1)	–	–	21.0	–	–	16.0
13+	–	–	–	–	1.6	(1.0–2.4)	–	–	25.1	–	–	19.1
χ^2_3		–		–		5.9						
Dwell time ratio[c]												
Q1	–	–	0.9	(0.6–1.4)	0.9	(0.6–1.4)	–	21.8	19.9	–	10.1	16.2
All others	–	–	1.0	–	1.0	–	–	24.1	22.0	–	11.2	17.9
χ^2_1		–		0.2		0.2						

	ORs by deployment history				Standardized suicide rates by time in service and deployment history							
	Never		Current		Previous		First 4 years in service			More than 4 years in service		
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	Never	Current	Previous	Never	Current	Previous
Subjects, *n*							21031	8404	7373	10414	9454	20634

OR, Odds ratio; Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers; CI, confidence interval; MIS, months in service; LTE, less than expected rank given time in service, representing soldiers that either were not promoted on time or were demoted; dwell time, number of months between end of second most recent deployment and beginning of most recent deployment; dwell time ratio, dwell time divided by duration of second most recent deployment; Q1, lowest quartile of the dwell time ratio in the population (less than or equal to 0.84).

[a]The sample of 77610 person-months includes all 517 suicides of active duty Regular Army enlisted soldiers recorded in the administrative records during the years 2004–2009 (note that this number excludes all officers) plus a 1:400 stratified probability sample of all other person-months in the population of Regular Army enlisted soldiers exclusive of those associated with other types of death (i.e. combat death, homicide, and death due to other injuries or illnesses). All records in the 1:400 sample were assigned a weight of 400 to adjust for the under-sampling months not associated with suicide.

[b]Based on multivariate logistic regression equations in subgroups of enlisted soldiers defined by the cross-classification of rank, time in service and deployment history. As described in the text, coefficients were constrained to be equal across subgroups defined by time in service based on an insignificant global significance test of interactions between the predictors and time in service. However, the coefficients were allowed to vary with deployment history when this variation was significant based on a significant global interaction test between the predictors and deployment history.

[c]well time is defined only for soldiers with two or more deployments.

[*]$p<0.05$ (two-sided test).

Table 4

Distributions of predictor variables in the Army STARRS 2004–2009 Historical Administrative Data Systems sample exclusive of officers in the first 4 years in service (n = 90 173)[a]

	Enlisted soldiers first 4 years in service			Enlisted soldiers more than 4 years in service			Officers more than 4 years of service
	Never deployed	Currently deployed	Previously deployed	Never deployed	Currently deployed	Previously deployed	
Sex							
Female	17.9 (0.3)	9.9 (0.3)	11.1 (0.4)	21.1 (0.4)	9.2 (0.3)	10.5 (0.2)	14.2 (0.3)
Male	82.1 (0.3)	90.1 (0.3)	88.9 (0.4)	78.9 (0.4)	90.8 (0.3)	89.5 (0.2)	85.8 (0.3)
Marital status							
Currently married	30.6 (0.3)	38.6 (0.5)	44.4 (0.6)	71.0 (0.4)	71.1 (0.5)	73.3 (0.3)	77.8 (0.4)
Not currently married	69.4 (0.3)	61.4 (0.5)	55.6 (0.6)	29.0 (0.4)	28.9 (0.5)	26.7 (0.3)	22.2 (0.4)
Deployment history							
Never deployed	100.0 (0.0)	–	–	100.0 (0.0)	–	–	33.5 (0.4)
Currently deployed	–	100.0 (0.0)	–	–	100.0 (0.0)	–	18.7 (0.3)
Previously deployed	–	–	100.0 (0.0)	–	–	100.0 (0.0)	47.8 (0.4)
Age at enlistment, years							
17–19	46.7 (0.3)	50.0 (0.5)	50.2 (0.6)	50.0 (0.5)	52.5 (0.5)	51.3 (0.3)	–
20+	53.3 (0.3)	50.0 (0.5)	49.8 (0.6)	50.0 (0.5)	47.5 (0.5)	48.7 (0.3)	–
17–22	–	–	–	–	–	–	59.3 (0.4)
23+	–	–	–	–	–	–	40.7 (0.4)
Rank/time in service							
Deployed <13 MIS	–	5.7 (0.3)	–	–	–	–	–
E1–E2 >18 MIS LTE	5.2 (0.2)	4.2 (0.2)	3.1 (0.2)	–	–	–	–
E3 >24 MIS LTE	9.8 (0.2)	4.9 (0.2)	5.0 (0.3)	–	–	–	–
Other E1–E4	81.7 (0.3)	76.2 (0.5)	75.9 (0.5)	19.0 (0.4)	22.1 (0.4)	17.4 (0.3)	–
E5–E6	3.2 (0.1)	9.0 (0.3)	16.1 (0.4)	48.5 (0.5)	59.8 (0.5)	60.1 (0.3)	–
E7–E9	–	–	–	32.5 (0.5)	18.1 (0.4)	22.6 (0.3)	–
Warrant officer	–	–	–	–	–	–	18.4 (0.3)
Commissioned officer 1–3	–	–	–	–	–	–	40.0 (0.4)
Commissioned officer 4	–	–	–	–	–	–	21.7 (0.4)

	Enlisted soldiers first 4 years in service			Enlisted soldiers more than 4 years in service			Officers more than 4 years of service
	Never deployed	Currently deployed	Previously deployed	Never deployed	Currently deployed	Previously deployed	
Commissioned officer 5+	–	–	–	–	–	–	19.8 (0.4)
History of prior deployment							
Yes	–	16.1 (0.4)	9.5 (0.3)	–	65.1 (0.5)	42.1 (0.3)	28.4 (0.4)
No	–	83.9 (0.4)	90.5 (0.3)	–	34.9 (0.5)	57.9 (0.3)	71.6 (0.4)
Time in current deployment, months[b]							
0–3	–	28.3 (0.5)	–	–	24.5 (0.4)	–	5.4 (0.2)
4–6	–	23.7 (0.5)	–	–	22.1 (0.4)	–	4.2 (0.2)
7–9	–	19.4 (0.4)	–	–	19.8 (0.4)	–	3.6 (0.2)
10+	–	28.5 (0.5)	–	–	33.6 (0.5)	–	5.4 (0.2)
Time since most recent deployment, months[b]							
0–3	–	–	24.1 (0.5)	–	–	13.2 (0.2)	5.3 (0.2)
4–6	–	–	20.5 (0.5)	–	–	12.0 (0.2)	5.1 (0.2)
7–12	–	–	32.8 (0.5)	–	–	21.6 (0.3)	9.1 (0.3)
13+	–	–	22.6 (0.5)	–	–	53.3 (0.3)	28.3 (0.4)
Dwell time ratio							
Q1[c]	–	3.3 (0.2)	3.5 (0.2)	–	15.1 (0.4)	12.4 (0.2)	7.7 (0.2)
Subjects, *n*	21031	8704	7373	10414	9454	20 634	12563

Values are given as percentage (standard error).

Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers; MIS, months in service, LTE, less than expected rank given time in service, representing soldiers that either were not promoted on time or were demoted; dwell time, number of months between end of second most recent deployment and beginning of most recent deployment; dwell time ratio, dwell time divided by duration of second most recent deployment; Q1, lowest quartile of the dwell time ratio in the population.

[a]The sample of 90173 person-months includes all 564 suicides of active duty Regular Army soldiers recorded in the administrative records during the years 2004–2009 (note that this number excludes officers with less than 4 years of service, five of whom committed suicide) plus a 1:400 stratified probability sample of all other person-months in the population of all enlisted soldiers and the subset of officers with more than 4 years in service exclusive of those associated with other types of death (i.e. combat death, homicide, and death due to other injuries or illnesses). All records in the 1:400 sample were assigned a weight of 400 to adjust for the under-sampling months not associated with suicide.

[b]Percentages among officers are defined on the base of all officers with more than 4 years in service, not only those currently or previously deployed. As a result, the percentages sum either to the proportion of such officers currently deployed (in the case of time in current deployment) or previously deployed (in the case of time since most recent deployment).

[c]The proportion of officers in Q1 is calculated in the table on the base of all officers.