Original Investigation

Prevalence and Correlates of Suicidal Behavior Among Soldiers
Results From the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS)

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IMPORTANCE The suicide rate among US Army soldiers has increased substantially in recent years.

OBJECTIVES To estimate the lifetime prevalence and sociodemographic, Army career, and psychiatric predictors of suicidal behaviors among nondeployed US Army soldiers.

DESIGN, SETTING, AND PARTICIPANTS A representative cross-sectional survey of 5428 nondeployed soldiers participating in a group self-administered survey.

MAIN OUTCOMES AND MEASURES Lifetime suicidal ideation, suicide plans, and suicide attempts.

RESULTS The lifetime prevalence estimates of suicidal ideation, suicide plans, and suicide attempts are 13.9%, 5.3%, and 2.4%. Most reported cases (47.0%-58.2%) had pre-enlistment onsets. Pre-enlistment onset rates were lower than in a prior national civilian survey (with imputed/simulated age at enlistment), whereas post-enlistment onsets of ideation and plans were higher, and post-enlistment first attempts were equivalent to civilian rates. Most reported onsets of plans and attempts among ideators (58.3%-63.3%) occur within the year of onset of ideation. Post-enlistment attempts are positively related to being a woman (with an odds ratio [OR] of 3.3 [95% CI, 1.5-7.5]), lower rank (OR = 5.8 [95% CI, 1.8-18.1]), and previously deployed (OR = 2.4-3.7) and are negatively related to being unmarried (OR = 0.1-0.8) and assigned to Special Operations Command (OR = 0.0 [95% CI, 0.0-0.0]). Five mental disorders predict post-enlistment first suicide attempts in multivariate analysis: pre-enlistment panic disorder (OR = 0.1 [95% CI, 0.0-0.8]), pre-enlistment posttraumatic stress disorder (OR = 0.1 [95% CI, 0.0-0.7]), post-enlistment depression (OR = 3.8 [95% CI, 1.2-11.6]), and both pre- and post-enlistment intermittent explosive disorder (OR = 3.7-3.8). Four of these 5 ORs (posttraumatic stress disorder is the exception) predict ideation, whereas only post-enlistment intermittent explosive disorder predicts attempts among ideators. The population-attributable risk proportions of lifetime mental disorders predicting post-enlistment suicide attempts are 31.3% for pre-enlistment onset disorders, 41.2% for post-enlistment onset disorders, and 59.9% for all disorders.

CONCLUSIONS AND RELEVANCE The fact that approximately one-third of post-enlistment suicide attempts are associated with pre-enlistment mental disorders suggests that pre-enlistment mental disorders might be targets for early screening and intervention. The possibility of higher fatality rates among Army suicide attempts than among civilian suicide attempts highlights the potential importance of means control (ie, restricting access to lethal means [such as firearms]) as a suicide prevention strategy.

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Suicide is among the leading causes of death worldwide.[1,2] Historically, the suicide rate among US Army soldiers has been below the general population rate. However, the Army suicide rate has increased dramatically in recent years, while the civilian rate has remained fairly stable.[3] The reason for this increase is unknown. Although several recent studies have examined patterns and correlates of Army suicides in an effort to increase our understanding of risk factors,[4,5] none carefully examined pre- vs post-enlistment risk factors. Such an analysis might help identify soldiers near the time of their enlistment who are at risk for later suicidal behavior so that they could be targeted for preventive interventions. Nor have previous military studies distinguished risk factors for suicidal ideation vs attempts among ideators, a distinction shown to be important in civilian studies.[6,7] Herein, we examine the associations of lifetime mental disorders having pre- and post-enlistment onsets with subsequent onsets of suicidal ideation, suicide plans, and suicide attempts in a representative sample of nondeployed US Army soldiers participating in Army STARRS (http://www.armystarrs.org), a large epidemiological-neurobiological study of Army suicides and their correlates.[8]

Methods

Sample

Data came from the April to December 2011 Army STARRS All-Army Study (AAS), a de-identified representative cross-sectional survey of active duty Army personnel exclusive of soldiers in Basic Combat Training or deployed to a combat theater excluding personnel in units of fewer than 30 soldiers (representing less than 2% of all Army personnel). The 5428 respondents considered herein consist of Regular Army personnel (ie, excluding activated Army National Guard and Army Reserve) who completed a group-administered self-report questionnaire survey and agreed to have their administrative records linked to their survey responses. Written informed consent was obtained prior to data collection. Informed consent and human subjects protection procedures were approved by the Human Subjects Committees of all collaborating organizations.

Although all unit members were ordered to report to informed consent sessions, 23.5% were absent owing to conflicting duty assignments. Most attendees (96.0%) consented to the survey, 98.0% of consenters completed the survey, 72.4% of those who completed the survey (hereafter referred to as completers) provided written consent for record linkage, and 95.6% of consenters were successfully linked. The survey completion-successful linkage cooperation rate was 65.1% ($0.96 \times 0.98 \times 0.724 \times 0.956$), and the response rate was 49.8% ($[1 − 0.235] \times 0.651$),[9] based on the American Association of Public Opinion Research COOP1 and RR1 calculation methods.[10] Although we were prohibited from attempting refusal conversion or obtaining individual-level administrative data for refusers, de-identified administrative data were provided for the entire Army and for survey respondents who agreed to linkage, allowing 2 weights to be created to adjust for nonresponse bias. Weight 1 adjusted for discrepancies in survey responses between survey completers with and without record linkage. Weight 2 adjusted for discrepancies between multivariate administrative record profiles of weighted (weight 1) survey completers with record linkage and the target population. Doubly weighted (weight 1 × weight 2) data were used in analyses. A more detailed description of AAS weighting is presented elsewhere, despite the fact that these differences were modest in substantive terms.[11] More detailed descriptions of the AAS design,[8] field procedures,[9] and weighting[11] are presented elsewhere. See Kessler et al[12] in this issue for the distributions of sociodemographic and Army career variables in the AAS compared with the target population of the entire active duty Regular Army.

Measures

Suicidal Behaviors

Suicidal behaviors were assessed using a modified version of the Columbia-Suicide Severity Rating Scale[13] assessing lifetime occurrence and age at onset of suicidal ideation ("Did you ever in your life have thoughts of killing yourself?" or "Did you ever wish you were dead or would go to sleep and never wake up?") and, among respondents who reported lifetime ideation, suicide plans ("Did you ever have any intention to act [on these thoughts/on that wish]?" and, if so, "Did you ever think about how you might kill yourself [eg, taking pills, shooting yourself] or work out a plan of how to kill yourself?") and attempts ("Did you ever make a suicide attempt [ie, purposefully hurt yourself with at least some intention to die]?").

DSM-IV Mental Disorders

The lifetime prevalence estimates of 12 common lifetime *DSM-IV* mental disorders were assessed: 8 internalizing disorders (major depressive disorder [MDD], bipolar disorder, panic disorder, generalized anxiety disorder, posttraumatic stress disorder [PTSD], specific phobia, social phobia, and obsessive-compulsive disorder), 3 externalizing disorders (attention-deficit/hyperactivity disorder, intermittent explosive disorder [IED], and substance use disorders, including alcohol and drug abuse and dependence), and a screening question for any other serious mental illness ("Did you ever in your life have any other serious mental illness, emotional problem, or nervous breakdown?"). The bipolar disorder assessment included bipolar I disorder, bipolar II disorder, and subthreshold bipolar disorder (hypomania without a history of major depression or subthreshold hypomania).[14] Screening scales from the Composite International Diagnostic Interview[15] were used to assess bipolar disorder, panic disorder, attention-deficit/hyperactivity disorder, and IED, and a revised self-report version of the Family History Screen (FHS)[16] modified to assess personal, rather than family, history of these disorders was used to assess the remaining disorders. The Composite International Diagnostic Interview screening scales have good concordance with independent clinical diagnoses in the AAS (area under the receiver operating characteristic curve of 0.69-0.79 across diagnoses).[17] The FHS has been shown to have acceptable concordance with best-estimate clinical diagnoses,[16] although the items used in the AAS yielded implausibly high prevalence estimates, and diagnoses based on the FHS should

Table 1. Lifetime Prevalence of Suicidal Behavior in the April to December 2011 Army STARRS AAS

| | % (SE) of Soldiers | | | | | | |
| | Total Sample (N = 5428) | | | Lifetime Ideators | | | |
Variable	Ideation	Plan	Attempt	Plan	Attempt	Attempt by Those With a Plan	Attempt by Those Without a Plan
Lifetime prevalence							
Total	13.9 (0.4)	5.3 (0.4)	2.4 (0.2)	38.5 (2.6)	17.1 (1.2)	34.4 (2.3)	6.3 (1.1)
Men	12.9 (0.5)	4.8 (0.5)	2.1 (0.2)	37.3 (3.3)	16.0 (1.1)	33.5 (2.9)	5.6 (1.0)
Women	19.9 (1.5)	8.6 (1.1)	4.3 (0.8)	43.2 (4.9)	21.5 (3.6)	37.6 (5.7)	9.3 (3.8)
Lifetime cases with pre-enlistment onsets							
Total	58.2 (2.1)	52.9 (4.1)	47.0 (5.6)	52.9 (4.1)	47.0 (5.6)	50.6 (6.7)	34.4 (2.7)
Men	58.3 (2.8)	54.9 (3.9)	49.8 (5.7)	54.9 (3.9)	49.8 (5.7)	54.5 (6.4)	33.1 (2.6)
Women	57.6 (4.2)	45.9 (11.5)	38.6 (8.1)	45.9 (11.5)	38.6 (8.1)	38.8 (10.7)	37.7 (2.0)

Abbreviations: AAS, All-Army Survey; Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers.

consequently be considered combinations of threshold and subthreshold disorders. Respondents were asked to estimate age at onset of each lifetime disorder.

Sociodemographic and Army Career Variables

The sociodemographic variables considered herein include age, sex, race/ethnicity, and marital status. Race and ethnicity were assessed in 2 questions, the first asking respondents if they were Spanish, Hispanic, or Latino (yes or no) and the second asking respondents to record their race by checking all applicable categories (white, black or African American, American Indian or Native American, Asian [eg, Chinese, Filipino, or Indian], and Native Hawaiian or other Pacific Islander) and/or by providing an open-ended response to the race category of "other." Responses were collapsed into the summary categories of non-Hispanic black, non-Hispanic white, Hispanic, and other. Race and ethnicity were assessed as part of an effort to obtain a comprehensive sociodemographic profile of soldiers. Army career variables include age at enlistment, rank, number of deployments to a combat theater (0, 1, 2, ≥3), and command assignment. The functional form of the association between each continuous predictor variable and suicide attempts was examined before collapsing the continuous variable, to guarantee that the categories described herein capture the nonlinearities in these associations.

Analysis Methods

Retrospective age-at-onset reports were analyzed using the 2-part actuarial method to estimate survival curves, a method differing from the Kaplan-Meier method[18] in using a more accurate way of estimating onsets within a given year.[19] Both absolute morbid risk (cumulative lifetime risk of ever having suicidal ideation, developing a suicide plan, or attempting suicide) and relative morbid risk (the proportion of total morbid risk at each age) are reported for each outcome. Discrete-time survival analysis (with person-years the unit of analysis, time-varying predictors, and a logistic link function[20]) was used to examine associations of temporally prior predictors with subsequent onset of post-enlistment suicidal behavior. A distinction was made between mental disorders that started at an ear-

lier age than age at enlistment vs after enlistment. Survival coefficients were exponentiated to create odds ratios (ORs) with 95% CIs.[18,19] Simulation methods (described in Cox and Li[21]) were used to calculate population-attributable risk proportions (PARPs), which describe the proportions of observed suicidal outcomes associated with subsets of predictors.[22] Because the AAS data are both clustered and weighted, the design-based Taylor series linearization method was used to produce standard errors.[23] Multivariate significance was examined using design-based Wald χ² tests.

Results

Lifetime Prevalence and Age at Onset of Suicidal Behaviors

The lifetime prevalence estimates of suicidal ideation, suicide plans, and suicide attempts are 13.9%, 5.3%, and 2.4%, respectively (Table 1). Prevalence estimates are significantly higher among women than men. More than one-third (38.5%) of ideators developed suicide plans, and 17.1% attempted suicide. Roughly one-third (34.4%) of ideators with a plan went on to make attempts compared with 6.3% of ideators without a plan, resulting in roughly 80% of first attempts being planned.

Age-at-onset curves were used to estimate that the proportions of soldiers who will ever have suicidal ideation, develop a suicide plan, or attempt suicide (morbid risk, as opposed to the proportions that ever did so up to the time of interview) are 21.0%, 9.0%, and 4.1%, respectively. These curves also show that lifetime prevalence is low through the early teens and then increases linearly through the mid-40s, with median age at onset in the early-20s (Figure). Overlap among curves suggests that transitions from ideation to plan and attempt typically are quite rapid. Speed-of-transition curves (available on request) show that 62.4% of transitions from ideation to plans and 58.3% of transitions from ideation to attempts occur within 1 year of onset of ideation, whereas 63.3% of transitions from plans to attempts occur within 1 year of onset of plans.

The majority of lifetime prevalent suicidal ideation began prior to age at enlistment (58.3% of men vs 57.6% of women; $\chi_1^2 = 0.1$, $P = .91$). The same was true of plans (54.9% of men vs 45.9% of women; $\chi_1^2 = 0.6$, $P = .45$). Approximately half of men's lifetime first attempts (49.8%) and 38.6% of women's lifetime attempts occurred prior to age at enlistment ($\chi_1^2 = 1.4$, $P = .24$).

Sociodemographic and Army Career Predictors of Suicidal Behavior

Using additive multivariate survival equations, we examined associations of sociodemographic and Army career variables with subsequent first onsets of suicidal behavior. The results are reported herein for post-enlistment onsets (Table 2).

Age

Among soldiers with no pre-enlistment history of suicidal behavior, age is unrelated to post-enlistment onset ($\chi_2^2 = 0.4$-3.9, $P = .14$-.81). However, age is positively related to rank, which is a significant predictor of post-enlistment suicidal behavior.

Sex

Women soldiers have significantly elevated odds of suicidal ideation (OR = 2.1 [95% CI, 1.4-3.1]), suicide plans (OR = 2.7 [95% CI, 1.5-5.1]), and suicide attempts (OR = 3.3 [95% CI, 1.5-7.5]).

Race/Ethnicity

Race/ethnicity is significantly associated with post-enlistment onset of suicidal ideation ($\chi_3^2 = 11.1$, $P = .011$), but not suicide plans ($\chi_3^2 = 1.8$, $P = .62$) or suicide attempts ($\chi_3^2 = 2.4$, $P = .49$). The only individually significant ORs associated with race/ethnicity are lower odds of ideation (OR = 0.4 [95% CI, 0.2-0.7]) among non-Hispanic blacks.

Marital Status

Although never married and previously married soldiers have lower odds than married soldiers of all 3 outcomes (OR = 0.1-1.0), the association of marital status with suicidal behavior is statistically significant only for suicide attempts ($\chi_2^2 = 7.4$, $P = .02$). This is due to the significantly reduced odds of attempts among previously married vs married soldiers (OR = 0.1 [95% CI, 0.0-0.4]).
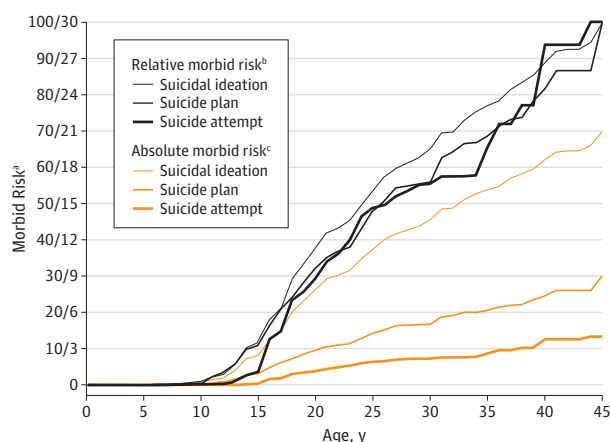
Age at Enlistment

Age at enlistment is significantly associated with post-enlistment onset of suicidal ideation ($\chi_3^2 = 9.4$, $P = .02$); however, this is due to a nonmonotonic pattern of elevated odds among soldiers who enlisted at 17 to 18 years of age (OR = 1.3 [95% CI, 0.7-2.5]) and decreased odds among those who enlisted at 21 to 23 years of age (OR = 0.7 [95% CI, 0.4-1.1]), neither of which is significantly different from the odds among soldiers who enlisted at 24 years of age or older (OR = 1.0). Age at enlistment is not significantly associated with either plans or attempts ($\chi_3^2 = 2.8$-4.2, $P = .24$-.42).

Rank

Rank is a consistently significant predictor of post-enlistment suicidal behavior ($\chi_2^2 = 7.4$-16.4, $P \le .001$-.03) owing to elevated odds among lower-rank enlisted soldiers (grades E1-

E4) vs officers (OR = 2.5-5.8). Odds for higher-rank enlisted soldiers (grades E5-E9) are also elevated compared with officers (OR = 1.2-2.5), but not significantly. A more detailed analysis (results available on request) shows that rank is primarily associated with ideation (ie, it is not significantly associated with the transitions from ideation to plans [$\chi_2^2 = 4.2$, $P = .12$] or from ideation to attempts when controlling for plans [$\chi_2^2 = 4.0$, $P = .14$]).

Deployment History

Two-thirds of AAS respondents had a history of deployment. Although the number of deployments is not significantly associated with suicidal behavior overall ($\chi_3^2 = 3.9$-7.5, $P = .06$-.27), ORs are consistently elevated among soldiers who were ever deployed vs those who were never deployed (OR = 1.3-3.7), significantly so for 2 deployments predicting attempts (OR = 2.4 [95% CI, 1.2-5.1]) and the highest for 3 or more deployments predicting attempts (OR = 3.7 [95% CI, 0.9-16.1]).

Army Command

Army Command assignment is not significantly associated with suicidal ideation or suicide plans ($\chi_5^2 = 3.6$-7.3, $P = .61$-.20), but is significantly associated with suicide attempts owing to a virtual absence of attempts in Special Operations Command. All other Commands have insignificantly lower odds of attempts than US Army Forces Command (OR = 0.5-0.8).

Associations of Lifetime Mental Disorders With Post-Enlistment Onset of Suicide Attempts

Four pre-enlistment–onset disorders and 10 post-enlistment–onset disorders have significant ORs in bivariate models (ie, considering only 1 disorder at a time) predicting subsequent (to the age at onset of the disorder) first suicide attempts after enlistment (Table 3). All these ORs other than the one for pre-enlistment panic disorder (OR = 0.1 [95% CI, 0.0-0.7]) are

Figure. Age-at-Onset Distributions of Lifetime Suicidal Ideation, Suicide Plans, and Suicide Attempts

[a]The numbers on the left indicate relative morbid risk, and those on the right indicate absolute morbid risk. [b]Cumulative lifetime risk of ever having suicidal ideation, developing a suicide plan, and attempting suicide. [c]Proportions of total morbid risk as of each age.

Table 2. Associations of Sociodemographic and Army Career Variables With Post-Enlistment Onset of Suicidal Behavior in the April to December 2011 Army STARRS AAS[a]

Variable	Odds Ratio (95% CI)		
	Ideation (n = 4897)	Plans (n = 5239)	Attempts (n = 5324)
Age, y			
17-19	1 [Reference]	1 [Reference]	1 [Reference]
20-24	0.8 (0.4-1.7)	0.6 (0.3-1.2)	1.1 (0.3-3.4)
≥25	0.7 (0.3-2.0)	0.5 (0.1-1.7)	0.3 (0.1-2.0)
χ^2_2 Value	0.4	1.8	3.9
Sex			
Men	1 [Reference]	1 [Reference]	1 [Reference]
Women	2.1 (1.4-3.1)[b]	2.7 (1.5-5.1)[b]	3.3 (1.5-7.5)[b]
χ^2_1 Value	13.8[b]	10.0[b]	8.6[b]
Race/ethnicity			
Non-Hispanic white	1 [Reference]	1 [Reference]	1 [Reference]
Non-Hispanic black	0.4 (0.2-0.7)[b]	0.7 (0.3-1.3)	0.5 (0.2-1.3)
Hispanic	1.0 (0.7-1.4)	0.8 (0.4-1.8)	1.2 (0.4-3.8)
Other	0.4 (0.1-1.3)	0.6 (0.1-3.0)	1.4 (0.3-6.1)
χ^2_3 Value	11.1[b]	1.8	2.4
Marital status			
Married	1 [Reference]	1 [Reference]	1 [Reference]
Previously married	0.2 (0.0-1.7)	0.5 (0.1-3.4)	0.1 (0.0-0.4)[b]
Never married	1.0 (0.8-1.2)	0.8 (0.4-1.5)	0.8 (0.3-1.7)
χ^2_2 Value	2.1	1.0	7.4[b]
Age at enlistment, y			
17-18	1.3 (0.7-2.5)	1.4 (0.4-4.4)	0.5 (0.1-2.5)
19-20	1.1 (0.6-2.1)	2.0 (0.8-5.4)	0.8 (0.2-3.5)
21-23	0.7 (0.4-1.1)	0.9 (0.3-2.6)	0.4 (0.1-1.8)
≥24	1 [Reference]	1 [Reference]	1 [Reference]
χ^2_3 Value	9.4[b]	4.2	2.8
Rank of enlisted soldier			
Lower rank (grades E1-E4)	2.5 (1.3-5.0)[b]	4.5 (1.4-14.0)[b]	5.8 (1.8-18.1)[b]
Higher rank (grades E5-E9)	1.2 (0.8-1.7)	1.8 (0.7-4.5)	2.5 (0.9-7.3)
Officer (grades W1-W5 or O1-O9)	1 [Reference]	1 [Reference]	1 [Reference]
χ^2_2 Value	7.4[b]	10.7[b]	16.4[b]
χ^2_1 Value[c]	5.5[b]	10.0[b]	13.4[b]
Deployments, No.			
0	1 [Reference]	1 [Reference]	1 [Reference]
1	1.6 (1.0-2.7)	1.7 (0.7-4.0)	1.3 (0.5-3.2)
2	1.9 (0.8-4.8)	2.2 (0.7-6.9)	2.4 (1.2-5.1)[b]
≥3	1.8 (0.8-3.7)	2.7 (1.0-7.7)	3.7 (0.9-16.1)
χ^2_3 Value	4.1	3.9	7.5
Command			
FORSCOM	1 [Reference]	1 [Reference]	1 [Reference]
Area Service Component Commands[d]	1.3 (0.8-2.1)	1.9 (0.6-5.4)	0.8 (0.3-1.8)
USASOC	0.7 (0.2-2.1)	0.3 (0.0-1.8)	0.0 (0.0-0.0)[b]
MEDCOM	0.8 (0.3-2.1)	1.2 (0.2-7.0)	0.7 (0.1-3.9)
TRADOC	0.7 (0.3-1.6)	1.4 (0.8-2.6)	0.5 (0.1-2.7)
All other regular Army Commands[e]	0.8 (0.5-1.4)	1.4 (0.6-3.3)	0.6 (0.2-2.1)
χ^2_6 Value	3.6	7.3	2040.8[b]

Abbreviations: AAS, All-Army Survey; Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers; FORSCOM, US Army Forces Command; MEDCOM, US Army Medical Command; TRADOC, US Army Training and Doctrine Command; USASOC, US Army Special Operations Command.

[a] Based on a series of discrete-time survival models with a logistic link function to predict first lifetime onset of suicidal ideation, suicide plan, and suicide attempt in the years subsequent to enlistment, with all the predictors in the same model. Sample sizes are successively larger in predicting the 3 component outcomes owing to some respondents having first onsets of either (1) ideation but not plans or (2) plans but not attempts prior to their age at enlistment.

[b] Significant at the .05 level, determined by use of a 2-sided test.

[c] Tests for the significance of the difference between lower-ranking and higher-ranking enlisted soldiers.

[d] The complete set of Area Commands includes US Army Africa, Central, North, South, Europe, and Pacific.

[e] Including US Army Materiel Command, all other Army Service Component Commands, and all other Direct Reporting Units. See http://www.army.mil/info/organization/ for a complete description of the US Army Command Structure.

positive (OR = 3.3-7.4). Most ORs become attenuated in multivariate models (ie, considering all disorders simultaneously), with only 5 multivariate ORs that were statistically sig- nificant: pre-enlistment panic disorder (inverse association), PTSD (inverse association), and IED and post-enlistment MDD and IED.

Table 3. Prevalence and Associations of Lifetime Mental Disorders Having Pre-and Post-Enlistment Onsets With the Occurrence of Subsequent Post-Enlistment First Suicide Attempts in the April to December 2011 Army STARRS AAS[a]

| | % of Solders (SE) | | Odds Ratio (95% CI) | | | |
| | Lifetime Prevalence of Mental Disorders (n = 5324) | | Bivariate Associations | | Multivariate Associations | |
Disorder	Pre-Enlistment Disorders	Post-Enlistment Disorders	Pre-Enlistment Disorders	Post-Enlistment Disorders	Pre-Enlistment Disorders	Post-Enlistment Disorders
Internalizing disorders						
MDD[a]	11.6 (0.5)	10.3 (0.7)	1.9 (0.6-6.3)	6.5 (2.3-18.8)[b]	1.6 (0.6-4.4)	3.8 (1.2-11.6)[b]
BPD	1.9 (0.3)	1.8 (0.3)	Not shown[c]	4.1 (1.4-11.8)[b]	Not shown[c]	1.5 (0.5-5.2)
PD	3.1 (0.4)	8.3 (0.5)	0.1 (0.0-0.7)[b]	3.8 (1.2-11.8)[b]	0.1 (0.0-0.8)[b]	0.9 (0.3-2.6)
GAD[a]	13.5 (0.8)	18.9 (0.9)	1.3 (0.5-3.3)	3.5 (1.1-11.1)[b]	1.0 (0.4-2.3)	0.9 (0.3-2.9)
PTSD	11.2 (0.6)	22.7 (1.0)	0.3 (0.1-1.3)	3.3 (1.6-6.8)[b]	0.1 (0.0-0.7)[b]	1.1 (0.4-3.1)
OCD[a]	4.3 (0.4)	7.7 (0.4)	4.1 (1.1-15.7)[b]	4.0 (1.4-11.7)[b]	4.2 (1.0-17.6)	1.0 (0.4-2.4)
Specific phobia[d]	9.6 (0.7)	4.1 (0.3)	0.5 (0.2-1.7)	6.1 (1.8-21.4)[b]	0.5 (0.2-1.6)	2.9 (0.7-11.6)
Social phobia[d]	12.2 (0.8)	6.1 (0.6)	1.7 (0.6-4.6)	2.8 (1.0-8.0)	1.0 (0.4-2.6)	0.8 (0.2-3.0)
Externalizing disorders						
ADHD[e]	7.0 (0.6)	Restricted[e]	4.3 (2.3-8.1)[b]	Restricted[e]	1.8 (0.5-6.9)	Restricted[e]
IED	15.5 (0.7)	4.8 (0.5)	3.9 (2.1-7.3)[b]	5.9 (2.2-15.4)[b]	3.7 (1.7-8.3)[b]	3.8 (1.2-11.6)[b]
SUD	6.7 (0.5)	8.1 (0.4)	1.2 (0.3-4.8)	3.9 (1.4-10.8)[b]	0.8 (0.2-2.8)	2.0 (0.7-6.2)
Other disorders						
Other SMI[a]	2.8 (0.2)	5.9 (0.4)	2.1 (0.7-6.2)	7.4 (1.9-27.9)[b]	1.4 (0.4-4.8)	2.1 (0.8-5.9)

Abbreviations: AAS, All-Army Survey; ADHD, attention-deficit/hyperactivity disorder; Army STARRS; Army Study to Assess Risk and Resilience in Servicemembers; BPD, bipolar disorder; GAD, generalized anxiety disorder; IED, intermittent explosive disorder; MDD, major depressive disorder; OCD, obsessive-compulsive disorder; PD, panic disorder; PTSD, posttraumatic stress disorder; SMI, serious mental illness; SUD, substance use disorder.

[a] Based on discrete-time survival models with person-years as the unit of analysis and a logistic link function to predict first lifetime onset of suicide attempts in the years subsequent to enlistment in the subsample of AAS respondents who reported never having attempted suicide prior to age at enlistment.

[b] Significant at the .05 level, determined by use of a 2-sided test.

[c] Small cell sizes for BPD with pre-enlistment onsets (results not shown).

[d] Threshold and subthreshold spectrum disorders assessed with a self-report version of the Family History Screen questions.[17]

[e] All cases of ADHD had pre-enlistment onsets. In addition, the assessment of ADHD, unlike that of the other disorders, was restricted to current (at the time of interview) cases.

Table 4. Disaggregation of Significant Multivariate Associations of Lifetime Mental Disorders Having Pre- and Post-Enlistment Onsets With the Occurrence of Subsequent Post-Enlistment First Suicide Attempts Through Intermediate Outcomes in the April to December 2011 Army STARRS AAS[a]

| | Odds Ratio (95% CI) | | | |
Disorder	Ideation (n = 4897)	Plans Among Ideators (n = 612)	Attempt Among Ideators, Controlling for Plan (n = 697)	Attempt (n = 5324)
Pre-enlistment PD	0.3 (0.1-0.8)[b]	0.4 (0.1-3.0)	0.1 (0.0-1.0)[b]	0.1 (0.0-0.8)[b]
Pre-enlistment PTSD	0.8 (0.3-2.2)	0.4 (0.1-1.0)	0.2 (0.0-1.5)	0.1 (0.0-0.7)[b]
Post-enlistment MDD	2.6 (1.2-5.7)[b]	0.7 (0.3-1.9)	1.0 (0.3-2.9)	3.8 (1.2-11.6)[b]
Pre-enlistment IED	2.6 (1.7-4.0)[b]	1.4 (0.7-2.7)	1.6 (0.6-3.9)	3.7 (1.7-8.3)[b]
Post-enlistment IED	2.2 (1.3-3.9)[b]	0.3 (0.0-1.6)	5.0 (1.4-18.0)[b]	3.8 (1.2-11.6)[b]

Abbreviations: AAS, All-Army Survey; Army STARRS; Army Study to Assess Risk and Resilience in Servicemembers; IED, intermittent explosive disorder; MDD, major depressive disorder; PD, panic disorder; PTSD, posttraumatic stress disorder.

[a] Based on discrete-time survival models with person-year as the unit of analysis and a logistic link function to predict first lifetime onset of suicidal ideation, suicide plans among ideators, and suicide attempts among ideators controlling for plan in the years subsequent to enlistment in the subsample of AAS respondents who reported never having had the outcome prior to age at enlistment. Sample sizes are successively larger in predicting the 3 component outcomes owing to some respondents having first onset of either (1) ideation but not plans or (2) plans but not attempts prior to their age at enlistment.

[b] Significant at the .05 level, determined by use of a 2-sided test.

Disaggregation of Associations Through Proximal Outcomes

It is instructive to trace out the association of the 5 significant mental disorders predicting post-enlistment attempts through ideation, plans among ideators, and attempts among ideators (controlling for presence vs absence of a plan) (Table 4). All 3 component associations involving pre-enlistment panic disorder are inverse (OR = 0.1-0.4), and 2 are significant. All com-

ponent associations involving pre-enlistment PTSD are also inverse (OR = 0.2-0.8) but insignificant. The association with ideation is significant for the 3 other disorders (pre- and post-enlistment IED and post-enlistment MDD; OR = 2.2-2.6), but none of the disorders is associated with plans among ideators, and only post-enlistment IED is associated with attempts among ideators (OR = 5.0 [95% CI, 1.4-18.0]).

Population-Attributable Risk Proportions

Population-attributable risk proportions (PARPs) were calculated for post-enlistment first suicide attempts among soldiers who never made a pre-enlistment attempt. The PARP estimates are 31.3% for pre-enlistment onset disorders, 41.2% for post-enlistment onset disorders, and 59.9% for all disorders.

Discussion

Four limitations are noteworthy. First, sample vs population discrepancies (exclusions of soldiers in basic training or deployed coupled with incomplete response among target respondents) and the low response rate limit the external validity of the findings. Second, some respondents might have failed to report their mental disorders or suicidal behavior, or they provided inaccurate age-at-onset reports. Third, the Composite International Diagnostic Interview screening scales and self-report FHS are fully structured, thus yielding less textured diagnoses than those based on semistructured clinical interviews, whereas the FHS additionally includes subthreshold cases. Finally, the AAS did not include all potentially relevant *DSM-IV* disorders, thus making the prevalence and PARP estimates conservative.

Within the context of these limitations, 13.9% of US soldiers are estimated to have a history of suicidal ideation, 5.3% are estimated to have a history of suicide plans, and 2.4% are estimated to have a history of suicide attempts, with 47% to 60% of these outcomes first occurring prior to enlistment. It is striking that nearly half of the soldiers who reported lifetime suicide attempts reported their first attempt occurring prior to the age at enlistment because history of suicide attempts is asked about in recruitment interviews, and applicants who report such a history are excluded from service. In the absence of methods to assess history of suicidal behaviors that do not require honest self-reports, the most practical implication of this finding might be that the Army should develop outreach and treatment programs for new soldiers based on the realization that a nontrivial proportion of its new recruits come into the Army with a history of suicidal behavior and mental disorders that are risk factors for suicidal behaviors. It is striking in this regard that the pre-enlistment mental disorders considered herein are associated with approximately one-third of post-enlistment first suicide attempts.

The AAS lifetime suicide ideation and plan prevalence estimates are virtually identical to those in a recent study[24] of suicidal behavior in a nationally representative civilian sample weighted to be sociodemographically comparable to the US Army, although a broader definition of ideation is used herein. Interestingly, the proportions of these outcomes in the AAS beginning prior to enlistment (58.2%-52.9%) are substantially lower than in the civilian sample based on a simulated age-at-enlistment distribution (82.4%-68.4%), whereas post-enlistment onsets are considerably higher in the AAS than the matched civilian sample for ideation (5.8% vs 2.5%) and plans (2.5% vs 1.7%). Post-enlistment first suicide attempts are the same in the AAS (1.3%) and civilian sample (1.2%). The lower AAS pre-enlistment rates of suicidal behavior are consistent with the fact that the Army may reject applicants with a known history of suicidal behavior, although our results show that a meaningful proportion of recruits have a history of suicidal behavior that is not known to the Army, despite the fact that Army recruiters ask about past suicidal behaviors in recruitment screening interviews. The suggestion that post-enlistment first onsets of suicidal ideation and suicide plans are higher among soldiers than civilians is consistent with soldiers being exposed to more severe stressors than civilians.[25] These stressors can lead to suicidal behavior.[26,27] It is less clear, though, why prevalence estimates of post-enlistment nonfatal suicide attempts would be no higher among soldiers than civilians, especially in light of clear evidence that the Army suicide rate has been on the rise in recent years and now exceeds the civilian population rate.[3] One possibility is that the lethality of suicide attempts might be higher among soldiers than civilians, perhaps owing to the fact that a higher percentage of servicemembers (61%) than civilians (50.5%) use firearms to kill themselves.[28,29] This possibility highlights the potential importance of means control (ie, restricting access to lethal means [such as firearms]) as a suicide prevention intervention strategy.

The results regarding sociodemographic[6,30] and Army career[4,31] predictors of suicidal behavior are generally consistent with previous research. One important exception is the lower odds of suicide attempts among unmarried soldiers, which is inconsistent with the lower rates of suicidal behaviors among married vs unmarried civilians.[30,32] This discrepancy might mean that marriage is less protective among soldiers than civilians, a possibility consistent with evidence of special marital stressors among military personnel (eg, deployments and frequent moves)[33] and higher rates of mental illness among married vs unmarried AAS respondents.[12] We need to see if this pattern replicates in additional Army STARRS data and, if so, to investigate why the protective effects of marriage are eroded among soldiers. Our finding of a low number of suicide attempts among Special Operations soldiers may reflect a lower baseline risk of suicidal behavior or high level of resilience among soldiers selected for this command.[34,35]

These results provide a more fine-grained picture than previous studies of the associations between mental disorders and subsequent suicidal behavior among soldiers. It is noteworthy that most post-enlistment-onset disorders were associated with significantly elevated odds of first post-enlistment suicide attempts in bivariate models, but that only MDD and IED remained significant in multivariate models. This reflects the high comorbidity among mental disorders and suggests that only a few disorders are critical predictors of suicidal behavior. Although IED might not be foremost in the minds of clinicians as a risk factor for suicide attempts among new soldiers, it is important to note that it is the most prevalent pre-enlistment disorder of all those assessed, has a strong association with suicide attempts, and has been consistently associated with attempts in prior studies.[7,36,37] Intermittent explosive disorder was also the only pre-enlistment disorder associated with significantly elevated risk of post-enlistment first suicide attempts. These results suggest that screening Army applicants for IED and providing early treatment for new soldiers with IED might be valuable ways to reduce suicidal behaviors among soldiers, especially given that post-enlistment IED is also a significant predictor of post-enlistment suicide attempts.

Disaggregation of the 5 significant associations between mental disorders and post-enlistment suicide attempts revealed that 4 of the 5 associations (ie, pre-enlistment panic disorder and IED and post-enlistment MDD and IED) predict suicidal ideation, but only post-enlistment IED predicts the transition from ideation to suicide attempts. The finding that MDD predicts ideation but not plans or attempts among soldiers with ideation mirrors the results from civilian studies,[7] whereas IED has consistently been found to predict suicide attempts in the few previous studies in which it was considered.[7,36,37]

The finding that pre-enlistment panic disorder and PTSD were both associated with lower odds of post-enlistment first suicide attempts is inconsistent with previous civilian studies,[7,37-39] although one large-scale study of veterans also found a decreased risk of suicide among those with PTSD,[40,41] which was interpreted as being due to the provision of enhanced PTSD treatment for veterans. Importantly, disaggregation herein showed that these significant negative associations were quite consistent in predicting ideation in the total sample, plans among ideators, and attempts among ideators controlling for plans, which argues against the otherwise plausible possibility that 2 significant negative coefficients might have occurred by chance in the examination of such a large number of associations. Another possibility is that pre-enlistment histories of PTSD and panic disorder might be markers of resilience among people who enlist in the Army, even though they are markers of vulnerability in the general population.[7] Although an empirical investigation of this possibility exceeds the scope of the present report, it warrants further examination in future studies given the strength and consistency of these associations.

Conclusions

The lifetime prevalence estimates of suicidal ideation, suicide plans, and suicide attempts among soldiers are 13.9%, 5.3%, and 2.4%, respectively. Most reported cases had pre-enlistment onset, and approximately one-third of post-enlistment suicide attempts are associated with pre-enlistment mental disorders. Several mental disorders emerged as strong predictors of suicide attempts among soldiers, although only IED predicted which ideators went on to make suicide attempts. These results highlight the potential importance of early screening and intervention.

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