ORIGINAL ARTICLES

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MILITARY MEDICINE, 177, 9:1002, 2012

Projected Rates of Psychological Disorders and Suicidality Among Soldiers Based on Simulations of Matched General Population Data

Anne M. Gadermann, PhD; Stephen E. Gilman, ScD†‡§; Katie A. McLaughlin, PhD‖; Matthew K. Nock, PhD¶; Maria Petukhova, PhD#; Nancy A. Sampson, BA#; Ronald C. Kessler, PhD#*

ABSTRACT Limited data are available on lifetime prevalence and age-of-onset distributions of psychological disorders and suicidal behaviors among Army personnel. We used simulation methods to approximate such estimates based on analysis of data from a U.S. national general population survey with the sociodemographic profile of U.S. Army personnel. Estimated lifetime prevalence of any Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) anxiety, mood, behavior, or substance disorder in this sample was 53.1% (17.7% for mood disorders, 27.2% for anxiety disorders, 22.7% for behavior disorders, and 14.4% for substance disorders). The vast majority of cases had onsets before the expected age of enlistment if they were in the Army (91.6%). Lifetime prevalence was 14.2% for suicidal ideation, 5.4% for suicide plans, and 4.5% for suicide attempts. The proportion of estimated pre-enlistment onsets was between 68.4% (suicide plans) and 82.4% (suicidal ideation). Externalizing disorders with onsets before expected age of enlistment and internalizing disorders with onsets after expected age of enlistment significantly predicted postenlistment suicide attempts, with population attributable risk proportions of 41.8% and 38.8%, respectively. Implications of these findings are discussed for interventions designed to screen, detect, and treat psychological disorders and suicidality in the Army.

INTRODUCTION

Despite considerable information from ongoing surveys about current prevalence of psychological disorders among U.S. Army personnel,[1,2] little is known about lifetime prevalence or about the proportion of lifetime cases that started before age of enlistment. This information could be useful for intervention planning purposes as soldiers are in the age range of onset of many psychological disorders.[3,4] In addition, data are unavailable on associations of lifetime psychological disorders with suicidality in the Army, a topic of considerable importance.[5] Definitive data on these issues would require surveys that assessed lifetime disorders and retrospective age-of-onset reports to differentiate onsets before versus after enlistment. Such surveys are currently underway in the Army Study to Assess Risk and Resilience

*Centre for Health Evaluation and Outcome Sciences, St. Paul's Hospital, University of British Columbia; 620B-1081 Burrard Street, Vancouver, BC, V6Z 1Y6.

†Department of Society, Human Development, and Health, Harvard School of Public Health, 677 Huntington Avenue, Boston, MA 02115.

‡Department of Epidemiology, Harvard School of Public Health, 677 Huntington Avenue, Boston, MA 02115.

§Department of Psychiatry, Massachusetts General Hospital, 55 Fruit Street, Boston, MA 02114.

‖Division of General Pediatrics, Children's Hospital Boston and Harvard Medical School, 300 Longwood Avenue, Boston, MA 02115.

¶Department of Psychology, Harvard University, William James Hall, 1220, 33 Kirkland Street, Cambridge, MA 02138.

#Department of Health Care Policy, Harvard Medical School, 180 Longwood Avenue, Boston MA 02115.

Dr. Kessler has been a consultant for AstraZeneca, Analysis Group, Bristol-Myers Squibb, Cerner-Galt Associates, Eli Lilly & Company, GlaxoSmithKline Inc., HealthCore Inc., Health Dialog, Integrated Benefits Institute, John Snow Inc., Kaiser Permanente, 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, Plus One Health Management and Wyeth-Ayerst; and 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, and Shire US Inc.

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in Service members (Army STARRS; www.armystarrs.org), but it would also be useful to obtain comparable data for general population samples that have the same sociodemographic characteristics as Army personnel in order to understand the base rates of these disorders in the population among the kinds of people who are in the Army. A simulation study of this sort was carried out by Messer et al[6] using data collected in the early 1980s in the epidemiologic catchment area study,[7] a large community epidemiological survey of psychological disorders in five U.S. communities. The authors weighted the epidemiologic catchment area data to have the same sociodemographic distribution as the Army and estimated lifetime prevalence of selected psychological disorders in that sample.

Building on Messer et al, the current report presents results of analyzes using more recent general population survey data to estimate lifetime prevalence and age of onset of DSM-IV psychological disorders and suicidal behaviors (ideation, plans, and attempts) as well as associations of temporally primary psychological disorders, with subsequent suicidal behaviors among people in the general population with the same sociodemographic characteristics as Army personnel. We distinguish between psychological disorders and suicidal behaviors that began before and after expected age of enlistment in this civilian sample by developing a prediction equation that imputes expected age of enlistment from Army administrative data to each civilian in the sample. The survey data used to make these projections come from the National Comorbidity Survey Replication (NCS-R),[8] a national survey of prevalence and correlates of DSM-IV psychological disorders in the U.S. household population.

METHOD

The NCS-R Sample

The NCS-R was a face-to-face household survey conducted between February 2001 and April 2003 in a national sample of U.S. adults (ages 18+ years). A two-part interview was used. Part one, which assessed core DSM-IV psychological disorders, was completed by all 9,282 respondents. Part two, which assessed additional disorders and correlates, was administered to all respondents who screened positive for a part one disorder (n = 4,235) plus a probability subsample of other respondents (n = 1,457). The response rate was 70.9%. Part one was weighted to adjust for differential probabilities of selection. Part two was additionally weighted to adjust for undersampling respondents with no part one disorder. A final poststratification weight was used to match part two with the 2000 Census on a variety of sociodemographic and geographic variables. NCS-R sampling, field, and weighting procedures are discussed in more detail elsewhere.[9]

Sample Matching

We subsampled part two NCS-R respondents and then weighted to create a subsample that matched active duty Army personnel on a range of sociodemographic variables. Subsampling began by limiting NCS-R respondents to those employed in the age range of 18 to 65 years having at least a high school education or General Educational Development (GED) certificate and health insurance to approximate the broad profile of Army personnel. We then excluded NCS-R respondents who would be ineligible for Army service because of: (1) conviction of a felony or serving at least 1 year in prison; (2) handicaps, including deafness, blindness, paralysis, and a missing limb; (3) chronic physical disorders, including cardiovascular disorders (heart attack, stroke, hypertension, heart disease), respiratory disorders (chronic obstructive pulmonary disease [COPD], asthma), diabetes, ulcer, HIV or AIDS, epilepsy or seizure disorder, Crohn's disease, cancer (except skin cancer), severe migraines, and extreme obesity; and (4) severe psychological disorders, including schizophrenia, other nonaffective psychoses, bipolar I disorder, and serious suicide attempts that occurred before the estimated age of enlistment. These exclusions are overinclusive in that they remove people who might have entered the Army with waivers or developed chronic conditions after enlistment.

Once the sample was restricted in these ways, we selected a series of eight weighting variables available in the NCS-R as well as in the Defense Manpower Data Center Master Personnel dataset for Army personnel who were on active duty in December 2007. This information was obtained as part of the Total Army Injury and Health Outcomes Database (TAIHOD), an integrated database constructed by the Injury Epidemiology Research Section, Military Performance Division, of the U.S. Army Research Institute of Environmental Medicine, Natick, MA. These eight variables were ones that we knew both to be significantly related to psychological disorders and to have a significantly different distribution among Army personnel than in the general population. Cross tabulation of these variables from the TAIHOD dataset for active duty Army personnel in December 2007 was used for weighting. The variable distributions in this dataset were calculated as the person-month level for all soldiers in the regular Army who were on active duty at any time during this 5-year period. The eight weighting variables were age in years, sex, race ethnicity (Non-Hispanic Black, Non-Hispanic White, Hispanic, and all others), education (high school graduates including those with a GED, some post-high school education without a bachelor's degree, and bachelor's degree or more education), marital status (married, never married, and previously married, where the latter included separated, divorced, and widowed), citizenship, nativity (born in the U.S. yes/no), and religion (Protestantism, Catholicism, Judaism, Eastern, Other, and Atheist/No Religion). The NCS-R weights were generated by using an exponential weighting function to make the distributions of the eight weighting variables in the adjusted NCS-R sample agree with the distributions in the TAIHOD dataset. (Detailed information is available on request.)

Measures

Psychological Disorders

DSM-IV psychological disorders were assessed with the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI),[10] a fully structured lay-administered interview that generates diagnoses for commonly occurring psychological disorders. The lifetime disorders considered include mood disorders (major depressive episode, dysthymic disorder, bipolar disorder), anxiety disorders (generalized anxiety disorder, panic disorder, agoraphobia without panic disorder, specific phobia, social phobia, post-traumatic stress disorder, separation anxiety disorder), behavior disorders (attention-deficit/hyperactivity disorder, oppositional defiant disorder, conduct disorder, intermittent explosive disorder [IED]), and substance disorders (alcohol and drug abuse with and without dependence, alcohol and drug dependence with a history of abuse). Good concordance was found between CIDI diagnoses and blinded clinical assessments in an NCS-R clinical reappraisal study.[11] All DSM-IV/CIDI disorders were defined with organic exclusions but without diagnostic hierarchy rules. Each disorder module in the WHO-CIDI yields indices of lifetime history, age at first onset, and presence of the disorder in the past year. Diagnoses were assigned based on reports of symptoms, duration, and intensity as specified in the DSM-IV.

Suicidal Behaviors

All part two NCS-R respondents were asked if they had ever seriously thought about killing themselves and, if so, the age when they first had these thoughts. Those who reported suicidal ideation were then asked if they ever made a suicide plan (and, if so, their age when they first did), and if they ever made a suicide attempt (and, if so, their age when they first did). Lifetime attempters were then asked additional questions about the lethality of their intent in their first lifetime attempt by presenting three statements about intent and asking them to say which statement most closely approximated their situation at the time of their first suicide attempt. The three statements were: (A) I made a serious attempt to kill myself, and it was only luck that I did not succeed; (B) I tried to kill myself but knew that the method was not foolproof; and (C) My attempt was a cry for help. I did not intend to die. As noted above, all NCS-R respondents who endorsed statement A for their first lifetime suicide attempt and reported that this attempt occurred at an earlier age than their imputed age of enlistment were excluded from the sample on the grounds that these attempts should be discovered in the course of recruitment screening and, if so, would be deemed ineligible for military service. We did not exclude people from the sample, though, who reported attempts and endorsed statements B or C.

Imputed Age of Enlistment

Regression-based imputation was used to assign an expected age of enlistment to each NCS-R respondent. This was done by estimating a multiple regression equation using the weighting variables from the TAIHOD dataset to predict age of enlistment in the TAIHOD data. The regression coefficients from that equation were then applied to the NCS-R dataset to impute individual-level estimates of age of enlistment to match the TAIHOD distribution conditional on the matching variables.

Analysis Methods

We began by analyzing the weighted NCS-R data to estimate lifetime prevalence and age of onset of each DSM-IV/CIDI disorder. Estimated age of enlistment data were then used to estimate the proportion of all such disorders that began before the respondent would be expected to enlist. We then repeated this exercise for 12-month disorders to determine both the expected prevalence in the past year and the proportion of 12-month cases that first occurred before expected age of enlistment. We next repeated this exercise for lifetime and 12-month suicidal behaviors, bearing in mind that respondents with serious pre-enlistment suicide attempts were excluded from the sample by definition.

Once these descriptive analyzes were completed, we carried out a discrete-time survival analysis with person-year as the unit of analysis in which prior lifetime psychological disorders were used to predict subsequent first onset of suicide attempts among respondents who never made an attempt before expected age of enlistment. In carrying out this analysis, we distinguished between internalizing disorders (mood disorders, anxiety disorders, and IED) and externalizing disorders (the behavior disorders [with the exception of IED] and substance disorders) as these are the two broad groups of common mental disorders most often found to co-occur in the epidemiological literature.[12] IED was included with internalizing disorders because preliminary analysis found it to be more strongly related to phobias than other behavioral disorders among young people. For each type of disorders, we distinguished between lifetime disorders that began before estimated age of enlistment and those that only began subsequent to estimated age of enlistment. These four predictor variables (i.e., number of internalizing and externalizing disorders that began before and subsequent to enlistment) were all included in the same prediction equation to predict suicide attempts that occurred in the years since estimated age of enlistment.

Finally, the population attributable risk proportion (PARP) was calculated for the predictors in the survival equation. A PARP is the proportion of observed outcomes (in this case suicide attempts after enlistment) that would not have occurred if the corresponding independent variable was eliminated and assuming the coefficients in the survival equation were as a result of causal effects of the predictors (e.g., the proportion of suicide attempts that would be prevented if internalizing disorders were eliminated/cured, assuming a causal association between internalizing disorders and suicide attempts). PARPs were calculated using simulation methods to generate individual-level predicted probabilities of the outcome disorders twice from the coefficients in the model: the first time using all the

TABLE I. Simulated Lifetime Prevalence Estimates of DSM-IV/CIDI Disorders Prior and Subsequent to Army Enlistment in the Subsample of NCS-R Respondents Weighted to Approximate the Population of Active Duty Army Personnel (n = 1785)[a]

	Current Lifetime Prevalence		Lifetime Prevalence of a Disorder That Began Before Enlistment		Lifetime Prevalence of a Disorder That Began Only After Enlistment		Proportion of Lifetime Prevalence Because of a Disorder That Began Before Enlistment	
	%	SE	%	SE	%	SE	%	SE
Mood Disorders								
Major Depressive Episode	16.0	3.1	11.1	2.7	5.5	1.7	69.4	8.6
Dysthymic Disorder	3.6	1.8	1.9	1.0	1.7	1.5	53.0	26.0
Bipolar II Disorder	0.4	0.1	0.3	0.1	0.1	0.1	68.6	15.9
Subthreshold Bipolar Disorder	2.8	1.1	2.0	1.1	0.8	0.3	72.1	13.4
Any Mood Disorder	17.7	2.9	12.3	2.5	6.1	1.8	69.7	7.4
Anxiety Disorders								
Generalized Anxiety Disorder	4.3	1.6	3.1	1.6	1.2	0.3	72.2	11.5
Agoraphobia Without Panic Disorder	0.4	0.1	0.4	0.1	0.0	0.0	95.5	3.3
Social Phobia	11.1	2.0	10.7	2.0	0.5	0.4	95.9	2.9
Specific Phobia	8.8	1.5	8.5	1.5	0.4	0.3	95.7	2.9
Post-Traumatic Stress Disorder	3.7	1.7	3.1	1.7	0.6	0.3	83.2	9.7
Separation Anxiety Disorder	9.9	2.3	8.1	2.2	2.0	0.6	81.9	6.2
Panic Disorder	3.3	0.9	2.5	0.9	0.9	0.2	74.9	9.5
Any Anxiety Disorder	27.2	3.6	24.7	3.7	3.4	0.8	90.7	2.7
Behavior Disorders								
Oppositional Defiant Disorder	6.0	1.1	6.0	1.1			100.0	0.0
Intermittent Explosive Disorder	12.2	2.0	11.5	1.9	0.8	0.4	94.2	2.8
Attention-Deficit/ Hyperactivity Disorder	6.1	1.4	6.1	1.4			100.0	0.0
Conduct Disorder	9.2	2.7	9.2	2.7			100.0	0.0
Any Behavior Disorder	22.7	3.5	22.1	3.4	0.7	0.5	97.5	1.5
Substance Disorders								
Alcohol Abuse	13.4	2.0	9.8	1.8	3.9	1.2	73.5	6.8
Alcohol Dependence	4.8	1.4	3.4	1.2	1.5	0.6	71.0	10.4
Drug Abuse	9.0	1.8	7.9	1.5	1.1	0.6	88.4	4.7
Drug Dependence	2.2	0.7	1.5	0.5	0.7	0.5	69.3	17.6
Any Substance Disorder	14.4	2.2	11.2	1.8	3.6	1.1	77.7	5.6
Any Disorder								
Any Disorder	53.1	4.5	48.6	(4.4)	8.7	1.7	91.6	1.5

[a]Respondents were all with ages 18 to 65 at the time of interview, had at least a high school education, and were employed with health insurance to match the broad sociodemographic bound of Army personnel. All NCS-R respondents who were ever convicted of a felony or served at least 1 year in prison were excluded from the sample. All NCS-R respondents with handicaps or physical or psychological disorders that would normally lead to rejection from Army enlistment or discharge were excluded from the sample. The handicaps included deafness, blindness, paralysis (of one or both arms, legs, or sides of the body), and a missing limb (hand, foot, arm, leg). The physical disorders included cardiovascular disorders (heart attack, stroke, hypertension, heart disease), respiratory disorders (COPD, asthma), diabetes, ulcer, HIV or AIDS, epilepsy or seizure disorder, Crohn's disease, cancer (except skin cancer), severe migraines, and extreme obesity. The psychological disorders included schizophrenia and other nonaffective psychoses, bipolar I disorder, and serious suicide attempts that occurred before the imputed age of enlistment.

coefficients and the second time assuming that the coefficients associated with the focal predictors were all zero. The ratio of the predicted prevalence estimates in the two specifications was then used to calculate PARPs. This ratio simulates the potential effects of thorough detection and aggressive early treatment of disorders that cause suicide attempts among Army personnel.

RESULTS

Estimated Lifetime Prevalence of Psychological Disorders

As noted above, the NCS-R sample was restricted by excluding people with severe psychological disorders or a preenlistment history of a serious suicide attempt. Despite these restrictions, the weighted NCS-R data show that the expected lifetime prevalence of DSM-IV/CIDI disorders among people in the general population with sociodemographic profiles of Army personnel is quite high. We estimate that 53.1% of the people in the sample have a lifetime psychological disorder. These include an estimated lifetime prevalence of 17.7% for mood disorders, 27.2% for anxiety disorders, 22.7% for behavior disorders, and 14.4% for substance disorders. (Table I) In addition, the sum of disorder-specific prevalence estimates (127.2%) is more than twice as high as 53.1%, indicating that comorbidity of psychological disorders would be expected to be the norm. Perhaps as striking as the high prevalence of psychological disorders is

TABLE II. Simulated 12-Month Prevalence Estimates of DSM-IV/CIDI Disorders Prior and Subsequent to Army Enlistment in the Subsample of NCS-R Respondents Weighted to Approximate the Population of Active Duty Army Personnel (n = 1785)[a]

	12-Month Prevalence		12-Month Prevalence of a Disorder That Began Before Enlistment		12-Month Prevalence of a Disorder That Began Only After Enlistment		Proportion of 12-Month Prevalence Because of a Disorder That Began Before Enlistment	
	%	SE	%	SE	%	SE	%	SE
Mood Disorders								
Major Depressive Episode	6.2	2.1	4.9	2.1	1.3	0.3	79.3	8.2
Dysthymic Disorder	1.7	1.0	1.7	1.0	0.0	0.0	97.6	1.8
Bipolar II Disorder	0.3	0.1	0.2	0.1	0.1	0.1	69.5	18.9
Subthreshold Bipolar Disorder	1.9	1.0	1.5	1.0	0.4	0.2	81.0	13.4
Any Mood Disorder	8.1	2.2	6.6	2.2	1.6	0.4	81.1	6.5
Anxiety Disorders								
Generalized Anxiety Disorder	3.0	1.6	2.3	1.6	0.7	0.2	78.6	12.7
Agoraphobia Without Panic Disorder	0.3	0.1	0.3	0.1	0.0	0.0	98.4	1.3
Social Phobia	6.1	1.4	6.1	1.4	0.0	0.0	99.9	0.1
Specific Phobia	6.5	1.4	6.1	1.4	0.4	0.3	94.7	3.7
Post-Traumatic Stress Disorder	2.3	1.5	1.8	1.5	0.5	0.3	79.1	16.2
Separation Anxiety Disorder	3.3	1.4	2.3	1.2	1.0	0.8	71.2	20.1
Panic Disorder	1.5	0.5	1.1	0.6	0.4	0.1	77.0	13.3
Any Anxiety Disorder	14.5	2.6	13.2	2.5	1.6	0.4	90.7	2.5
Behavior Disorders								
Oppositional Defiant Disorder	0.1	0.1	0.1	0.1			100.0	0.0
Intermittent Explosive Disorder	5.2	1.1	4.7	1.0	0.5	0.4	90.8	6.3
Attention-Deficit/ Hyperactivity Disorder	2.2	0.8	2.2	0.8			100.0	0.0
Conduct Disorder	0.6	0.5	0.6	0.5			100.0	0.0
Any Behavior Disorder	7.0	1.4	6.6	1.3	0.5	0.4	93.3	4.8
Substance Disorders								
Alcohol Abuse	4.3	1.3	3.0	1.0	1.4	0.9	68.4	15.0
Alcohol Dependence	0.8	0.3	0.4	0.3	0.5	0.2	44.6	19.8
Drug Abuse	2.5	1.2	1.9	1.1	0.6	0.5	76.0	18.6
Drug Dependence	0.3	0.3	0.3	0.3	0.0	0.0	99.8	0.2
Any Substance Disorder	5.9	1.6	4.2	1.3	1.8	1.0	71.0	13.1
Any Disorder								
Any Disorder	27.0	3.1	24.6	3.1	3.2	0.9	91.1	2.5

[a]See footnote 1 to Table I for a description of the sample.

the estimate from the simulated data that the vast majority (91.6%) of people with a history of psychological disorders would already have these disorders at the imputed time of enlistment. This proportion is estimated to range between a low of 53.0% for dysthymic disorder to a high of 100% for the trio of behavior disorders that typically begin in childhood (oppositional defiant disorder, conduct disorder, attention-deficit/hyperactivity disorder), and to average 69.7% for mood disorders, 90.7% for anxiety disorders, 97.5% for behavior disorders, and 77.7% for substance disorders. These results suggest that although seriously impairing illnesses are both exclusions from entry and causes for discharge from the Army, pre-enlistment history of nonserious psychological disorders such as depression, anxiety, and behavioral disorders is likely high among Army personnel.

Turning to psychological disorders present in the past year, we find that the estimated prevalence based on general population distributions remains high. (Table II) Indeed, 27.0% of Army personnel would be expected to have one or more active psychological disorders in the past year based on the prevalence among people with the same sociodemographic profile in the civilian population. We estimate 12-month prevalence to be 8.1% for mood disorders, 14.5% for anxiety disorders, 7.0% for behavior disorders, and 5.9% for substance disorders. As with the lifetime prevalence data, the vast majority of these past-year cases (91.1%) would be expected to have had first onsets before expected age of enlistment. This includes an estimated 81.1% of those with a past-year mood disorder, 90.7% of those with a past-year anxiety disorder, 93.3% of those with a past-year behavior disorder, and 71.0% of those with a past-year substance disorder.

Despite the fact that the simulated sample excluded people who made a serious suicide attempt before their expected age of enlistment, 14.2% of the sample had a history of suicidal ideation, 5.4% had a history of making a suicide plan, and 4.5% made a suicide attempt. (Table III) Predicted prevalence in the past year is considerably lower (0.0%–0.5%), but earlier lifetime history remains important here as well in

TABLE III. Simulated Lifetime and 12-Month Prevalence Estimates of Suicidal Behaviors in the Subsample of NCS-R Respondents Weighted to Approximate the Population of Active Duty Army Personnel (n = 1785)[a]

	Lifetime Prevalence		Proportion of Lifetime Cases With First Onsets Before Enlistment		12-Month Prevalence		Proportion of 12-Month Cases With First Onsets Before Enlistment	
	%	SE	%	SE	%	SE	%	SE
Suicidal Thought	14.2	2.6	82.4	5.8	0.5	0.2	59.5	14.2
Suicide Plan	5.4	1.8	68.4	14.0	0.1	0.1	73.1	18.8
Suicide Attempt	4.5	1.5	72.8[b]	12.7	0.0	0.0	55.8	34.3

[a]See footnote 1 to Table I for a description of the sample. [b]Although the sample excluded respondents who made a serious suicide attempt (defined as an attempt in which the individual seriously intended to die and it was only because of luck that he or she did not die) before the imputed age of enlistment, those who had less serious attempts were not excluded. The 72.8% of lifetime attempters whose first attempt occurred before enlistment are made up exclusively of individuals whose first attempt was classified as not at the highest level of severity in the NCS-R classification scheme.

TABLE IV. Associations of Numbers of Temporally Primary DSM-IV/CIDI Internalizing and Externalizing Disorders That Occurred Either Before or After Enlistment With Subsequent Postenlistment Suicide Attempts in the Subsample of NCS-R Respondents Weighted to Approximate the Population of Active Duty Army Personnel (n = 1785)[a]

	Timing of First Onset of Disorders			
	Before Enlistment		After Enlistment	
	OR	95% Confidence Interval	OR	95% Confidence Interval
Internalizing[b]	0.9	0.5–1.8	4.0*	2.3–7.2
Externalizing[b]	2.4*	1.6–3.8	3.0	0.3–26.3

*Significant at the .05 level, two-sided test. [a]Based on a discrete-time survival model with person-year as the unit of analysis to predict first lifetime onset of a suicide attempt subsequent to the imputed age of enlistment from time-varying measures of number of temporally primary lifetime DSM-IV/CIDI internalizing and externalizing disorders. Controls include age, sex, education, person-year, and imputed age of enlistment. See footnote 1 to Table I for a description of the sample. [b]The measures of internalizing disorders are scored in the range of 0 to 9 and include the count of all mood disorders (major depressive episode or dysthymia and bipolar II or subthreshold bipolar disorder), all anxiety disorders (generalized anxiety disorder, social phobia, specific phobia, agoraphobia or panic disorder, separation anxiety disorder, post-traumatic stress disorder) and IED. The measures of externalizing disorders are scored in the range of 0 to 5 and include the count of three behavior disorders (conduct disorder, oppositional defiant disorder, and attention-deficit/hyperactivity disorder) and substance disorders (alcohol abuse or dependence and drug abuse or dependence). Four measures were included in the equation – two for the numbers of lifetime internalizing and externalizing disorders that had ages of onset before the individual's imputed age of enlistment and two others for comparable lifetime disorders that had ages of onset subsequent to age of enlistment.

TABLE V. Population Attributable Risk proportion of First Suicide Attempts Occurring After Enlistment Associated With Pre-Enlistment and Postenlistment DSM-IV/CIDI Internalizing and Externalizing Disorders in the Subsample of NCS-R Respondents Weighted to Approximate the Population of Active Duty Army Personnel (n = 1785)[a]

	PARP (%)	SE
Externalizing Disorders With Onset Before Enlistment	41.8	10.8
Externalizing Disorders With Onset After Enlistment	8.5	15.9
Externalizing Disorders With Onset Either Before or After Enlistment	47.7	9.6
Internalizing Disorders With Onset After Enlistment	38.8	15.5
Externalizing Disorders With Onset Before + Internalizing After Enlistment	67.0	11.6
Externalizing Disorders With Onset Before or After + Internalizing After Enlistment	70.6	11.6

[a]See footnote 1 to Table I for a description of the sample.

that we estimate that 59.5% of all past-year ideation occurs to people who first began thinking of killing themselves before their expected age of enlistment. The parallel percentage estimates for past-year suicide plans and attempts are 73.1% and 55.8%, respectively.

Survival analysis shows that both internalizing and externalizing DSM-IV/CIDI psychological disorders are powerful predictors of suicide attempts during the years subsequent to expected age of enlistment. (Table IV) In the case of internalizing disorders, though, it is only those that began subsequent to expected age of enlistment that significantly predict postenlistment suicide attempts (odds ratio [OR] = 4.0), whereas internalizing disorders with onsets before expected age of enlistment do not significantly predict attempts that occurred in the years subsequent to expected age of enlistment (OR = 0.9). In the case of externalizing disorders, onsets that occurred before expected age of enlistment significantly predict subsequent suicide attempts (OR = 2.4). Subsequent onsets have an OR of similar magnitude (OR = 3.0), but this association is not statistically significant because of the rarity of externalizing disorders that began after expected age of enlistment.

As shown in the PARP calculations, nearly half of all suicide attempts (47.7%) in the simulated sample are associated with externalizing disorders, with a much higher proportion because of externalizing disorders that began before estimated age of enlistment (41.8%) rather than later (8.5%) (Table V). Although the association between estimated postenlistment externalizing disorders and estimated postenlistment suicide attempts was not statistically significant, it was included in this analysis because of the large OR. Estimated postenlistment internalizing disorders, in comparison, are associated with 38.8% of estimated postenlistment suicide attempts. All three groups of these

psychological disorders considered together are associated with 70.6% of all estimated postenlistment suicide attempts.

DISCUSSION

It is important to recognize that the prevalence estimates reported here are projections based on data from a general population survey. We did not obtain direct estimates of the prevalence of psychological disorders or suicidal behaviors from a representative sample of Army personnel. In addition, the survey data were collected a decade ago (2001–03), and the TAIHOD data were only available to us for a more recent time period (December 2007). These temporal issues limit the extent to which the data are directly relevant to today's Army. In addition, failure to control for the many unmeasured factors that might influence enlistment and retention in the Army and the onset of psychological disorders/suicidal behaviors could lead to bias in the extent to which the results represent the segment of the population that is comparable to the personnel in today's Army. In the absence of directly measured prevalence rates, though, these projections provide a useful approximation of the expected lifetime prevalence of psychological disorders and suicidal behaviors in the segment of the U.S. household population that most closely approximates members of the U.S. Army in terms of the matching and exclusionary variables considered here.

These estimates show that we would expect high prevalence of psychological disorders and suicidal behavior in the Army merely by virtue of the prevalence of these outcomes in the segment of the general population with the same matching-exclusion characteristics as Army personnel. The results also indicate that high proportions of both lifetime and past-year cases of psychological disorders would be expected to have onsets at an age earlier than the age of Army enlistment. The latter result is consistent with more general evidence from epidemiological surveys that most psychological disorders have early ages of onset.[3] It is important to note that our lifetime prevalence estimates are likely conservative given our exclusion of individuals with serious psychological disorders and physical health problems given that at least some individuals with these sorts of conditions are likely to enter the Army with waivers or to develop the condition following enlistment.

The results also suggest that the vast majority of suicide attempts among people sociodemographically similar to Army personnel are expected to be associated with pre-enlistment psychological disorders. The NCS-R results are consistent with much other evidence in this regard in showing that the vast majority of suicidal behavior is linked to psychopathology.[13–17] Recent studies in military samples also indicate that psychiatric disorders are important risk factors for suicide among military personnel.[18,19] For example, Black et al[20] reported that soldiers with a psychiatric diagnosis were 4.7 times more likely to commit suicide than soldiers without a psychiatric diagnosis, whereas Bachynski et al[21] reported that diagnoses of mood, anxiety, substance, and psychotic disorders were associated with more than a 5-fold increase in suicide mortality in the U.S. Army. However, these studies did not establish the timing of disorder onset relative to age at enlistment.

To the extent that pre-enlistment mental disorders are as important for postenlistment suicidality as suggested in our simulation, the question arises whether it might be possible to reduce Army suicides by restricting the enlistment of soldiers with a history of pre-enlistment psychological disorders. The PARP calculations suggest that the answer to this question might be a tentative "yes," as removing externalizing disorders that began before enlistment would be associated with an expected 40% reduction of postenlistment suicide attempts (assuming a causal relation between these constructs). However, there would be two serious practical difficulties in trying to exclude recruits with pre-enlistment externalizing disorders from Army service. The first is that it would be extraordinarily difficult to implement this policy because no archival data exist on the majority of these early-onset disorders, and it is unrealistic to think that applicants would volunteer this information once it became known that it was a basis for rejection. The second is that the absolute risk of suicidal behavior is so small that the costs of this broad-gauged exclusion would far outweigh the benefits even if it were possible.

The issue of the cost-effectiveness of exclusion has been considered in recent years by corporate medical directors who are turning their attention to consideration of health care spending as a corporate human capital investment opportunity. It is becoming clear from these deliberations that the number of people with a history of psychological disorder is much too high to exclude all of them from the corporate workforce. However, the workplace costs of these individuals are substantial enough in terms of lost productivity that corporate medical directors are coming to believe that increased investment in detection, outreach, and best-practices treatment of these workers can have a positive return on investment (ROI) for the corporation.[22] The same set of considerations might lead the Army to decide that targeted expansion of detection, outreach, and treatment efforts for soldiers with certain psychological disorders might have a positive ROI. Suicide prevention would be only one consideration, albeit an important one, in this line of reasoning.

Another important issue to consider is that the high rates of exposure to traumatic events experienced by Army personnel[23–26] almost certainly lead to higher rates of psychological disorders with postenlistment onsets than would be expected in the general population. This probably means that a higher proportion of suicidality in the Army is linked to disorders with postenlistment onsets than estimated in our simulation. This is only speculation, of course, as it is not possible to evaluate this issue in the NCS-R data. To the extent that it is true, though, efforts to limit enlistment of recruits with a history of psychological disorders would be even less productive than suggested above. This being the case, it is important to think more in terms of outreach and treatment of

Soldier psychological problems than in terms of exclusion of people with psychological disorders from the Army.

When thinking about outreach and treatment of psychological disorder as a human capital investment opportunity, our results regarding postenlistment internalizing disorders become especially important. As shown above, the vast majority of the internalizing disorders of people in the general population with sociodemographic profiles similar to those of Army personnel begin in childhood or adolescence, before the time soldiers enlist in the Army. Yet, it is only the small proportion of internalizing disorders that begin in the years after expected age of enlistment that significantly predict subsequent suicide attempts. These internalizing disorders with expected postenlistment onsets, which are estimated to be found in only 6% to 7% of the general population, are associated with 38.8% of all suicide attempts in the general population that occur after expected age of enlistment.

This is a substantially higher concentration of risk than that associated with externalizing disorders, as indicated by the higher OR associated with expected postenlistment internalizing disorders than with either expected pre- or postenlistment externalizing disorders. Given that the simulations did not take into consideration the much higher risks of PTSD and other postenlistment internalizing disorders associated with combat exposure[2] and other stressful experiences that are much more common among soldiers than the general population, it is likely that postenlistment internalizing disorders in the Army actually account for an even higher proportion of suicide attempts among soldiers than suggested in our simulations. Reduction in the onset of these disorders through preventive interventions and increases in the rapid detection and treatment of these disorders once they occur have the potential to reduce the prevalence of Army suicidal behaviors substantially.

However, formidable challenges exist in developing preventive interventions for internalizing psychological disorders that begin postenlistment in a population that is often suffering from comorbid conditions. One aspect of these challenges is that a substantial proportion of these disorders are likely to occur among people who have a history of at least one earlier psychological disorder that started in childhood or adolescence.[4] In such a situation, secondary prevention—that is, the prevention of progression among people who already have a history of psychological illness—is much more the issue than primary prevention, and this usually requires some form of treatment of the primary psychological disorder(s).[27] Treatment as a type of secondary prevention has several advantages over primary prevention, including the fact that people who already have disorders are often more willing to accept preventive interventions than people who have no disorder and that the technology of treatment interventions is more advanced than the technology of preventive interventions.[28] There also are barriers to treatment, though, that have to be addressed if treatment-oriented secondary preventive interventions are to succeed.[29] The Army has focused on addressing the problem of stigma in recent years[30] and is currently carrying out innovative programs to increase the quality of treatment of psychological disorders.[31] The results of the current report suggest that these efforts will have the potential to be of greater importance in reducing Army suicidal behaviors if they focus on recent onset internalizing disorders. However, caution is needed in interpreting this result too precisely in the absence of replication in a sample of Army personnel. As noted in the introduction, such a replication is currently underway in the Army STARRS. It will be of great interest to determine from the Army STARRS data whether the patterns of lifetime prevalence, recent prevalence, and age of onset of psychological disorders and suicidality are similar or different among Army personnel to the patterns found in the simulated general population data.

ACKNOWLEDGMENT

This study was supported by the Department of the Army and funded under cooperative agreement number U01MH087981 with the U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Mental Health (NIH/NIMH).

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