
Predicting firearm suicide among US Army veterans transitioning from active service

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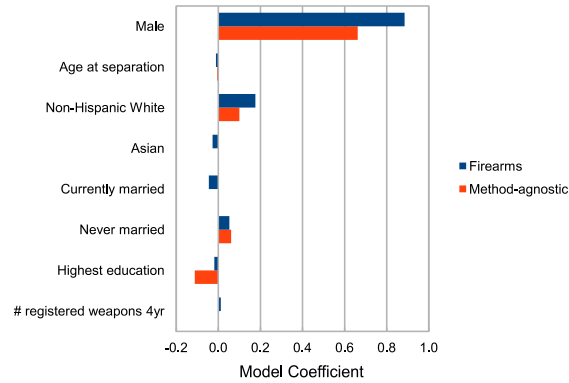
Predicting Firearm Suicide among US Army Soldiers Transitioning from Active Service

Supplementary Information

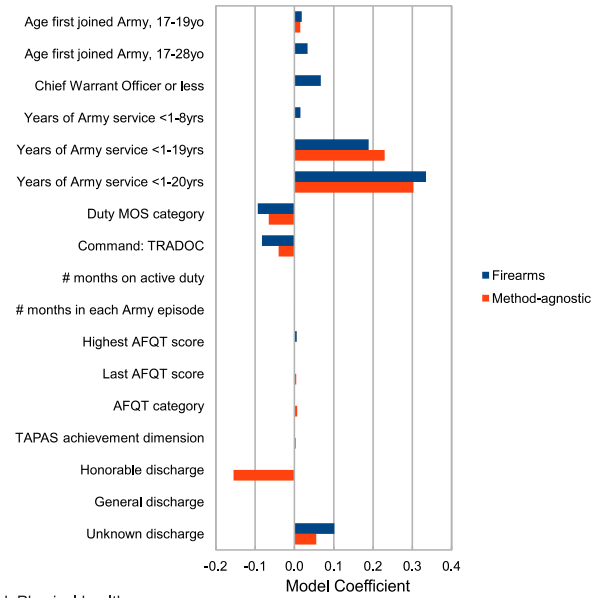
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Supplementary Figure 1. Lasso coefficients of models predicting firearms suicide (n=38,480 person-months)

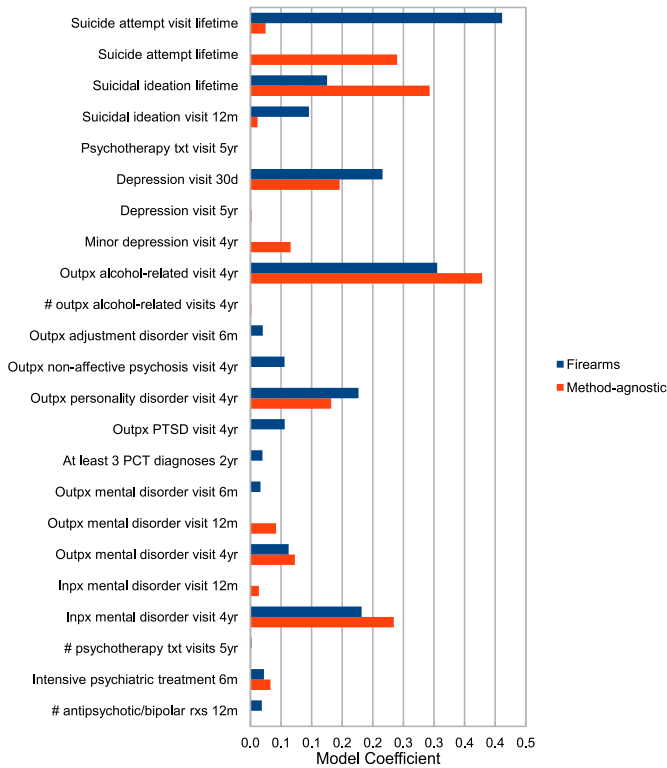
a. Demographics



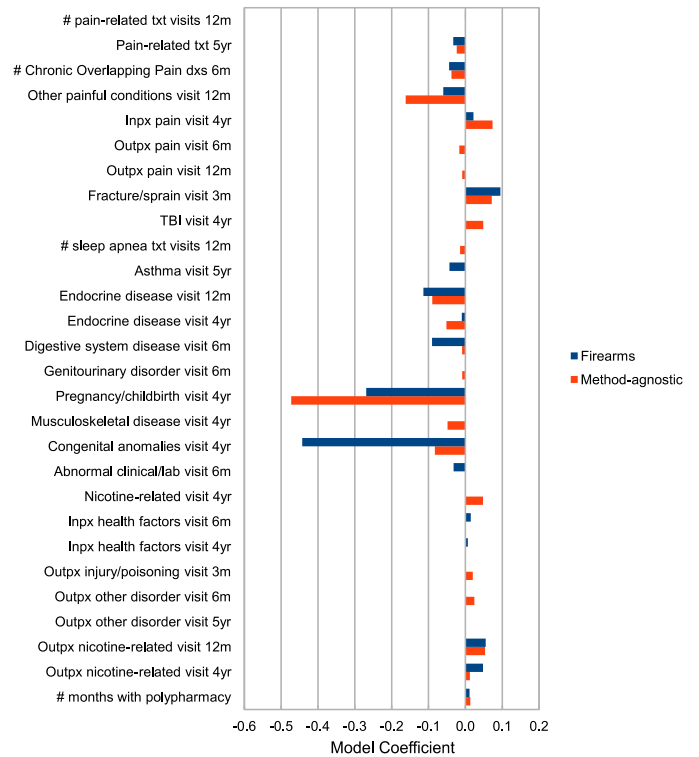
b. Army career



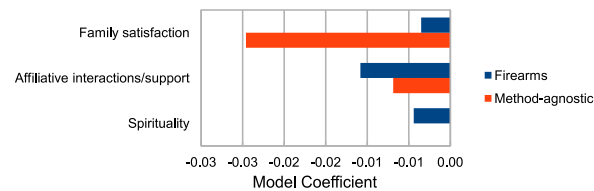
c. Psychopathological risk factors



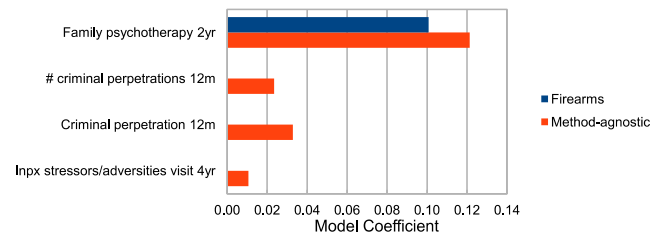
d. Physical health



e. Social network and support



f. Stressors



Supplementary Table 1. Socio-demographic and US Army Career Characteristics Among Firearm and Non-Firearm Suicide Decedents

	Suicide decedents		Other Veterans	Significance of differences			
	Firearm	Non-firearm		(1) v (2)	(1) v (3)	(2) v (3)	(1) v (2) v (3)
	(1) %	(2) %	(3) %	χ^2_1	χ^2_1	χ^2_1	χ^2_2
I. Sex	-	-	-	8.0*	105.8*	30.4*	136.3*
Female	4.4	7.4	15.1				
Male	95.6	92.6	84.9				
II. Age at separation	-	-	-	2.5	111.6*	35.9*	75.1*
Median	25.0	25.0	26.0	-	-	-	-
IQR	(22.0, 29.0)	(22.0, 30.0)	(23.0, 33.0)	-	-	-	-
Range	(18.0, 62.0)	(18.0, 53.0)	(17.0, 77.0)	-	-	-	-
III. Race/Ethnicity							
Non-Hispanic white	75.5	71.5	64.6	3.9*	69.8*	14.2*	84.1*
Non-Hispanic black	12.7	13.0	19.1	0.0	35.5*	16.6*	52.1*
Hispanic	7.0	8.8	10.4	2.2	16.9*	1.9	18.8*
Asian	3.2	4.0	4.4	0.9	5.0*	0.3	5.4
Native American/Alaskan Native	1.2	2.1	1.0	2.5	0.5	8.1*	8.6*
Other	0.4	0.6	0.4	0.5	0.1	0.4	0.5
IV. Marital status							
Currently married	47.1	51.1	55.7	3.0	41.7*	6.2*	47.9*
Divorced	4.1	4.9	5.4	0.6	4.5*	0.4	5.0
Widowed	0.1	0.1	0.1	0.2	0.4	0.0	0.0
Separated	0.0	0.0	0.0	-	-	-	-
Never married	48.7	43.9	38.7	4.3*	57.9*	8.1*	65.9*
V. Education							
Less than high school	3.1	3.6	2.3	0.3	3.7	4.7*	8.4*
High school/GED	86.0	86.7	79.9	0.2	31.0*	19.8*	50.8*
Some college	3.1	2.0	3.8	2.1	1.8	6.0*	7.8*
College or more	7.8	7.7	13.9	0.0	41.9*	21.9*	63.8*
VI. Rank							
Junior enlisted (E1-E3)	33.5	45.6	27.7	29.2*	22.7*	106.8*	129.4*
Non-commissioned officer (E4-E6)	57.9	46.4	56.1	24.6*	1.9	26.5*	28.4*
Senior non-commissioned officer (E7-E9)	3.7	3.4	7.7	0.1	30.1*	17.1*	47.2*
Warrant officer	1.2	0.9	1.3	0.4	0.3	1.2	1.5
Commissioned officer	3.8	3.7	7.1	0.0	22.9*	12.0*	34.9*
VII. Duty MOS							
Direct combat arms	48.6	42.1	33.4	7.9*	139.1*	23.7*	162.7*
Indirect combat arms	3.3	3.1	4.2	0.0	3.3	2.1	5.4
Combat support	20.6	22.8	24.8	1.4	12.7*	1.4	14.1*
Other support	27.5	32.0	37.6	4.4*	58.7*	9.5*	68.2*
VIII. Enlistment episode							
1 st	94.9	91.7	94.8	8.2*	0.1	12.8*	12.9*
2 nd	4.8	7.6	4.9	6.2*	0.0	10.9*	10.9*
3 rd or more	0.2	0.7	0.4	2.7	0.9	2.0	2.9
IX. Months enlisted for current episode	-	-	-	3.2	62.2*	56.6*	59.7*
Median	47.0	45.0	52.0	-	-	-	-
IQR	(32.0, 73.0)	(24.0, 73.0)	(36.0, 85.0)	-	-	-	-
Range	(0.0, 177.0)	(0.0, 163.0)	(0.0, 190.0)	-	-	-	-
X. Years of service	-	-	-	0.0	93.5*	47.5*	72.5*
Median	4.2	4.0	5.0	-	-	-	-
IQR	(3.0, 7.2)	(2.4, 7.1)	(3.3, 9.5)	-	-	-	-
Range	(0.1, 34.1)	(0.1, 30.0)	(0.1, 54.4)	-	-	-	-

Abbreviations: GED, General Educational Development Test; MOS = Military Occupational Specialty.

Note: * p < .05.

Supplemental Table 2. Predictor Variables Among the Training and Test Samples

	Training %	Test %	χ^2
Suicide			
Firearms suicide (per 100k)	28.3	28.9	0.2
Non-firearms suicide (per 100k)	14.2	15.0	0.2
Total (per 100k)	42.6	43.9	0.6
Sex			1.1
Female	14.7	15.1	
Male	85.3	84.9	
Age at separation			0.9
Median	26.0	26.0	
IQR	(23.0, 33.0)	(23.0, 33.0)	
Range	(17.0, 68.0)	(17.0, 68.0)	
Race/Ethnicity			4.2
Non-Hispanic white	64.5	64.2	0.3
Non-Hispanic black	19.3	19.3	0.0
Hispanic	10.4	10.4	0.0
Asian	4.5	4.6	0.2
Native American/Alaskan Native	1.0	1.1	2.2
Other	0.4	0.4	1.9
Marital status			3.5
Currently married	55.8	54.9	2.2
Divorced	5.4	5.3	0.1
Widowed	0.1	0.1	0.8
Separated	0.0	0.0	-
Never married	38.7	39.6	2.9
Education			2.3
Less than high school	2.4	2.4	0.1
High school/GED	80.4	79.8	2.2
Some college	3.8	4.0	0.7
College or more	13.4	13.8	1.3
Rank			2.3
Junior enlisted (E1-E3)	28.6	28.2	0.7
Non-commissioned officer (E4-E6)	55.8	56.5	1.6
Senior non-commissioned officer (E7-E9)	7.4	7.2	0.4
Warrant officer	1.2	1.3	0.4
Commissioned officer	7.0	6.8	0.4
Duty MOS			1.2
Direct combat arms	33.2	33.7	1.1
Indirect combat arms	4.3	4.2	0.2
Combat support	24.7	24.6	0.1
Other support	37.9	37.5	0.4
Enlistment episode			2.0
1st	94.1	94.5	1.8
2nd	5.5	5.1	2.0
3rd or more	0.4	0.4	0.0
Months enlisted for current episode			0.1
Median	52.0	52.0	
IQR	(36.0, 86.0)	(36.0, 85.0)	
Range	(0.0, 188.0)	(0.0, 188.0)	
Years of service			0.2
Median	5.0	5.0	
IQR	(3.3, 9.4)	(3.3, 9.4)	
Range	(0.1, 44.3)	(0.1, 40.0)	
Selected predictors			
Highest AFQT score			0.0
Median	58.0	57.0	
IQR	(43.0, 77.0)	(43.0, 77.0)	
Range	(3.0, 99.0)	(8.0, 99.0)	
Unknown discharge	19.2	18.9	0.4
Command: TRADOC	11.2	11.0	0.4
# months with polypharmacy			0.0
Median	0.0	0.0	
IQR	(0.0, 3.0)	(0.0, 3.0)	
Range	(0.0, 118.0)	(0.0, 95.0)	
# alcohol-related visits 4yr			1.7
Median	0.0	0.0	
IQR	(0.0, 0.0)	(0.0, 0.0)	
Range	(0.0, 317.0)	(0.0, 249.0)	
# mental disorder visits 4yr			0.4
Median	3.0	3.0	
IQR	(0.0, 19.0)	(0.0, 18.0)	
Range	(0.0, 1976.0)	(0.0, 2012.0)	
Suicidal ideation lifetime	6.7	6.3	2.2
Pain-related txt 5yr	42.2	42.3	0.1
Endocrine disease visit 12m	24.5	24.9	1.0
Pregnancy/childbirth visit 4yr	4.8	4.7	0.3

Abnormal clinical/lab visit 6m	46.3	45.8	0.6
Other painful conditions visit 12m	21.8	21.1	3.0
Affiliative interactions/support			9.5*
Median	26.6	26.6	
IQR	(26.0, 27.0)	(26.0, 27.0)	
Range	(10.0, 32.0)	(10.0, 32.0)	
Spirituality			1.9
Median	20.4	20.4	
IQR	(19.0, 20.4)	(19.0, 20.4)	
Range	(5.0, 25.0)	(5.0, 25.0)	
Spirituality Composite			1.8
Median	4.0	4.0	
IQR	(3.8, 4.0)	(3.8, 4.0)	
Range	(1.0, 5.0)	(1.0, 5.0)	
(n)	(57,800)	(13,419)	

* p < .05

Supplemental Table 3. ICD-10 codes used to identify suicide deaths

Firearms suicide

X72	Intentional self-harm by handgun discharge
X73	Intentional self-harm by rifle, shotgun, and larger firearm discharge
X74	Intentional self-harm by other and unspecified firearm discharge

Other Suicide

X60	Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics
X61	Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified
X62	Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified
X63	Intentional self-poisoning by and exposure to other drugs acting on the autonomic nervous system
X64	Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
X65	Intentional self-poisoning by and exposure to alcohol
X66	Intentional self-poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours
X67	Intentional self-poisoning by and exposure to carbon monoxide and other gases and vapours
X68	Intentional self-poisoning by and exposure to pesticides
X69	Intentional self-poisoning by and exposure to other and unspecified chemicals and noxious substances
X70	Intentional self-harm by hanging, strangulation, and suffocation
X71	Intentional self-harm by drowning and submersion
X75	Intentional self-harm by explosive material
X76	Intentional self-harm by smoke, fire, and flames
X77	Intentional self-harm by steam, hot vapours, and hot objects
X78	Intentional self-harm by sharp object
X79	Intentional self-harm by blunt object
X80	Intentional self-harm by jumping from a high place
X81	Intentional self-harm by jumping or lying before moving object
X82	Intentional self-harm by crashing of motor vehicle
X83	Intentional self-harm by other specified means
X84	Intentional self-harm by unspecified means
Y87.0	Sequelae of intentional self-harm

Supplementary Table 4. List and brief descriptions of administrative datasets included in the Army STARRS Historical Administrative Data Study (HADS)

Database Acronym	Description
ACT-SERV	ACTIVE SERVICE TRANSACTION (ACT-SERV): Provides a report on reserve component servicemembers in the Ready Reserve, Standby Reserve, and Retired Reserve ordered to active duty or full-time National Guard duty for mobilization, support, training, or other missions when authorized by the President or the Secretary of Defense and supported by federal funds, or for active duty when authorized by the Secretary of the Department of Homeland Security.
AFMETS	ARMED FORCES MEDICAL EXAMINER TRACKING SYSTEM (AFMETS): Variables include manner and cause of death, including self-inflicted death.
ACR	ARMY CENTRAL REGISTRY (ACR): This is a victim-based registry documenting spouse and child abuse events involving Army servicemembers.
ACMIS	ARMY COURT MARTIAL INFORMATION SYSTEM (ACMIS): Contains data on Soldiers (including Officers) arraigned on court-martial charges at either a special or general court-martial. The database includes the following information: rank, general technical score (if available), SSN, date of birth, where the Soldier was tried, which general court-martial jurisdiction convened the case, the offenses charged, how the accused plead, the findings in the case, as well as the sentence (if any). It includes the location of the offenses and trial and tracks the dates of certain events in the court-martial process. It also contains information concerning cases required to proceed through the appellate court process and outcome in the appellate court system. It does not contain any information concerning whether or not an accused committed suicide.
ALERTS	ARMY LAW ENFORCEMENT REPORTING AND TRACKING SYSTEM (ALERTS): Event level crime record database with entity IDs associated with offenses. Receives, maintains, accounts for, disseminates information from, and disposes of Army crime records; retrieves and correlates data and statistics from the records and provides to authorized recipients; coordinates automation of crime records data and information; and serves as function proponent of electronic imaging of crime records. Includes centralized database of weapons registration. Replaced the Military Police Reporting System (MPRS) module in the Centralized Operations Police Suite (COPS) which came online in April 2015. This also includes Criminal Investigation Division Information Management System/Automated System Crime Record Center (CIMS/ASCRC) that was previously a separate database during Army STARRS.
ASMIS 2.0	ARMY SAFETY MANAGEMENT INFORMATION SYSTEM 2.0 (ASMIS 2.0): Contains incident information data. Components consist of the reporting, analysis, and tracking of data, as well as efforts to provide preventative measures via risk assessments. ReportIT provides for the collection, verification, and timely dissemination of incident investigation and safety inspection data. AnalyzeIT serves as the business intelligence suite designed to identify trends and problem areas via data mining techniques and ad hoc analysis. TrackIT is designed for monitoring recommended controls and logging hazards. PreventIT encompasses risk assessment and guidance tools for units, battalions, commanders, civilians, and contractors.
ASPP	ARMY SUICIDE PREVENTION PROGRAM (ASPP): As an integral component of Army's Ready and Resilient Campaign (R2C), ASPP improves readiness of the Army through the development and enhancement of ASPP policies, training, data collection and analysis, and strategic communications designed to minimize suicide behavior; thereby preserving mission effectiveness through individual readiness and resilience for Soldiers.
ATRRS	ARMY TRAINING AND REQUIREMENTS RESOURCE SYSTEM (ATRRS): A system of record for management of personnel input to training and is the repository for training requirements, programs, personnel data and training costs.
ATMS	ARMY TRAINING MANAGEMENT SYSTEM (ATMS): Combines all training information databases, including the Digital Training Management System (DTMS), Army Training Network (ATN), Unit Training Management (UTM), and Combined Army Training Strategies (CATS), into an integrated online training management resource.
AWCTS	ARMY WARRIOR CARE AND TRANSITION SYSTEM (AWCTS): Captures information about Soldiers participating in the Army Warrior Care and Transition Program. It includes information about the medical care, rehabilitation, professional development, and progress toward personal goals of wounded, ill, or injured Soldiers.
AWTF	ARMY WORKFORCE TRANSACTION FILE (AWTF): Consists of Army active component workforce transaction data to manage the personnel information required for language, Defense Language Aptitude Battery (DLAB), information assurance, and military award information for active duty personnel. The AWTF dataset consists of three tables drawn from the original Defense Manpower Data Center (DMDC) WTF, with data respectively covering language (tested proficiency and DLAB scores), information assurance, and military awards. The AWTF military award table contains additional data regarding the type of military award, the authorized device, the number of authorized military devices, and the calendar date of the approval of the military award.

BHDP	BEHAVIORAL HEALTH DATA PORTAL (BHDP): Collects standardized clinical care data to inform health care provider decisions and to integrate with other data systems to track and optimize individual medical readiness across the Army. Soldier's report data by responding to various standard, validated behavioral health self-report screening tools as part of behavioral health clinic visits.
COPS/MPRS	CENTRALIZED OPERATIONS POLICE SUITE (COPS) / MILITARY POLICE REPORTING SYSTEM (MPRS): Centralized database that contains subsystems supporting the Military Police Corps Army wide. Contains information included in law enforcement reports.
COPS/VRS	CENTRALIZED OPERATIONS POLICE SUITE (COPS) / VEHICLE REGISTRATION SYSTEM (VRS): Provides information on privately owned weapons (and vehicles) of civilians and military personnel utilized at military installations.
CIMS/ACI2	CRIMINAL INVESTIGATION DIVISION INFORMATION MANAGEMENT SYSTEM (CIMS) / AUTOMATED CRIMINAL INVESTIGATION/CRIMINAL INTELLIGENCE (ACI2): Event level crime record database. Separate system from the ASCRC. Entity IDs are associated with offenses.
CIMS/ASCRC	CRIMINAL INVESTIGATION DIVISION INFORMATION MANAGEMENT SYSTEM (CIMS) / AUTOMATED SYSTEM CRIME RECORD CENTER (ASCRC): Receives, maintains, accounts for, disseminates information from, and disposes of Army crime records; retrieves and correlates data and statistics from the records and provides to authorized recipients; coordinates automation of crime records data and information; and serves as functional proponent for the electronic imaging of crime record.
DCIPS	DEFENSE CASUALTY INFORMATION PROCESSING SYSTEM (DCIPS): Casualty data system for Army, Navy, Air Force, and Marines. It contains information on all casualties including deceased active duty members (and cause of death).
DEOMI/DEOCS	DEFENSE EQUAL OPPORTUNITY MANAGEMENT INSTITUTE (DEOMI) / ORGANIZATIONAL CLIMATE SURVEY (DEOCS): A confidential, command-requested organization development survey focusing on issues of equal opportunity and organizational effectiveness. It is managed and administered by DEOMI.
DMDC/CTS	DEFENSE MANPOWER DATA CENTER (DMDC) / CONTINGENCY TRACKING SYSTEM (CTS): Collection of activation, mobilization, and deployment data. Provides information to DoD decision makers and includes a CTS Deployment File used for tracking the location of deployed personnel.
DMDC/DCAS	DEFENSE MANPOWER DATA CENTER (DMDC) / DEFENSE CASUALTY ANALYSIS SYSTEM (DCAS): Collects U.S. casualty information (including war deaths, active duty deaths, wounds, injuries, and illnesses) on warfighters who have fallen in global or regional conflicts involving the U.S. It is maintained by the DMDC. This data is private to Army STARRS.
DMDC/DEERS	DEFENSE MANPOWER DATA CENTER (DMDC) / DEFENSE ENROLLMENT ELIGIBILITY REPORTING SYSTEM (DEERS): A DoD person data repository containing personnel data and data related to DoD affiliation, benefits, employment, and pay.
DMDC/Master Personnel & Transaction Files	DEFENSE MANPOWER DATA CENTER (DMDC) / MASTER PERSONNEL & TRANSACTION FILES: The Active Duty Master File provides an inventory of all individuals on active duty (excluding reservists on active duty for training) at a point in time. It is a standardized and centralized database of present and past members of the active duty force. Personal data elements include name, SSN, education level, home of record, date of birth, marital status, number of dependents, race, and ethnic group. Military data elements include service, pay grade, AFQT percentile (enlisted only), source of commission (officers only), military primary duty and secondary occupation, Unit Identification Code, months of service, duty location, estimated termination of service date, basic active service date, date of current rank, pay entry base date, foreign language ability, and major command code.
DMDC/MEPCOM	DEFENSE MANPOWER DATA CENTER (DMDC) / MILITARY ENTRANCE PROCESSING COMMAND (MEPCOM): Contains transaction records on all individuals processed and examined at Military Entrance Processing Stations (MEPS) since July 1970. Examination data prior to FY 1976 is incomplete. Data elements in the MEPCOM Files are divided into three groups: personal, medical, and administrative. The primary user is the Office of the Undersecretary of Defense (Personnel and Readiness) where ASVAB data provides the basis for aptitude-related studies.
DMDC/Payroll	DEFENSE MANPOWER DATA CENTER (DMDC) / PAYROLL: Contains elements with information such as socio-demographics, special and incentive pays, basic pay and allowances. This file is also used to answer pay-related questions for the General Accounting Office, Military Services research centers, and other government agencies.
DMDC/PERSTEMPO	DEFENSE MANPOWER DATA CENTER (DMDC) / PERSONNEL TEMPO (PERSTEMPO): Provides information on soldier movement. PERSTEMPO is a congressionally mandated definition of time in which servicemembers engaged in official duties spend off-duty time away from housing associated with their garrison duty (time away from home station). The definition also applies to contingency operations such as OIF and OEF.

DOEHRS-IH	DEFENSE OCCUPATIONAL AND ENVIRONMENTAL HEALTH READINESS SYSTEM - INDUSTRIAL HYGIENE (DOEHRS-IH): Allows DoD to manage occupational and environmental health risk data and actively track biological, chemical, physical health hazards and engineered nano-object processes to servicemembers worldwide.
DSAD	DEFENSE SEXUAL ASSAULT INCIDENT DATABASE (DSAD): A centralized, case-level sexual assault database operated by the Sexual Assault Prevention and Response (SAPR) Office. DSAD contains data for each unrestricted and restricted report covered under DoD SAPR policy. It includes servicemembers and dependents 18 years and older. It does not include data on sexual assault cases involving spouses, intimate partners, or dependents under 18 years of age. Replaces the Sexual Assault Data Management System (SADMS), see below.
DODSER	DEPARTMENT OF DEFENSE SUICIDE EVENT REPORT (DODSER): Provides risk and protective factor information for suicide events. This file contains unsuccessful attempts and completed suicide cases.
DTMS	DIGITAL TRAINING MANAGEMENT SYSTEM (DTMS): Contains information on training requirements and standards, training planned and scheduled by Army units, and training accomplished by individuals and units in the Army.
DAMIS	DRUG AND ALCOHOL MANAGEMENT INFORMATION SYSTEM (DAMIS): Includes data from the Army drug and alcohol prevention training and substance abuse program.
eDES	ELECTRONIC DISABILITY EVALUATION SYSTEM (eDES): Formerly known as Physical Disability Case Processing System (PDCAPS), eDES contains information on fitness and applicable disability benefits of Soldiers with duty related impairments, including clinical information of all medical conditions the Soldier manifests to determine whether each condition meets medical retention standards.
e-Profile	ELECTRONIC - PROFILE (e-Profile): The system used to communicate medical recommendations to commanders regarding Soldiers who have a temporary or permanent medical condition that may render them medically not ready to deploy or require restrictions to their usual duties.
FIRST-STEPS	FAST INFORMATIVE RISK AND SAFETY TRACKER - STEPPED TREATMENT ENTRY AND PLANNING SYSTEM (FIRST-STEPS): An electronic case-management tracking tool designed for use by primary care providers and behavioral health care providers. FIRST-STEPS contains records on health care contacts, clinical assessments, psychotropic medication and counseling adherence, engagement in psychoeducation and self-management goals, and the final dispositions of case closures.
ICRS	INTEGRATED CASE REPORTING SYSTEM (ICRS): Used for reporting sexual harassment complaint data (both formal and informal). ICRS provides the Sexual Harassment/Assault Response and Prevention (SHARP) Program an interactive, web-based application that allows users to report and manage sexual harassment cases.
ITAPDB	INTEGRATED TOTAL ARMY PERSONNEL DATABASE (ITAPDB): A consolidated human resource database providing the Army and DoD with a single repository for personnel information for all components of the Army.
MDR	MEDICAL DATA REPOSITORY (MDR): This database contains information about medical, dental, pharmaceutical, and ancillary claims data for both in network and purchased care as well as inpatient and outpatient treatment. Data are collected on both Army personnel and their beneficiaries.
MODS-WT	MEDICAL OPERATIONAL DATA SYSTEM - WARRIOR TRANSITION (MODS-WT): Provides comprehensive monitoring and management of the condition of Soldiers in Warrior Transition Units (WTUs). Includes real-time visibility of socio-demographic, administrative, clinical and transition information, such as information about line-of-duty determination, medical/professional evaluation board status, and disability rating.
MEDPROS/DHA	MEDICAL PROTECTION SYSTEM (MEDPROS) / DEPLOYMENT HEALTH ASSESSMENT (DHA): The DHA cycle begins when a Soldier completes the DD Form 2795 Pre-DHA prior to deployment. Soldiers complete the DD Form 2796 Post-DHA prior to redeployment/demobilization. This triggers their Post-Deployment Health Reassessment (PDHRA) eligibility. 90 days after completion of the DD Form 2796, Soldiers become eligible to participate in a PDHRA screening. The targeted window for PDHRA is 90-180 days after deployment. Once the Soldier is screened, follow-up appointments and treatment will be scheduled as needed.
MEDPROS/PHA	MEDICAL PROTECTION SYSTEM (MEDPROS) / PERIODIC HEALTH ASSESSMENT (PHA): The PHA is an annual physical and consists of two parts. Part one is a self-assessment completed by the Soldier; Part two is the provider assessment. PHA results consist of the health assessment, height, weight, PULHES Factor, and potential for deployability within six months. These items will be entered into MEDPROS at the point of service. The PHA is intended to improve Individual Medical Readiness and to evaluate deployability.
MEDPROS/Readiness	MEDICAL PROTECTION SYSTEM (MEDPROS) / READINESS: The comprehensive Medical Readiness data includes all medical and dental readiness requirements in accordance with AR 600-8-101. They include immunizations, permanent physical profiles/duty limitations, eyeglasses/inserts, blood type, medical warning tags,

	personal deployment medications, pregnancy screening, blood type, and dental status among other data elements.
NDI	NATIONAL DEATH INDEX (NDI): A centralized database of death record information on file in state vital statistics offices. Working with these state offices, the National Center for Health Statistics (NCHS) established the NDI as a resource to aid epidemiologists and other health and medical investigators with their mortality ascertainment activities.
RETAIN	REENLISTMENT/RECLASSIFICATION SYSTEM (RETAIN): The source for reenlistment and extension electronic military personnel office (eMILPO) transactions. RETAIN generates reenlistment and extensions eMILPO transactions upon career counselor confirmation of the reenlistment and extension.
RRPS	RISK AND REDUCTION PROGRAM SYSTEM (RRPS): The RRPS collects data at the unit level that may show that members of the unit are at a higher risk. The Risk Reduction Program collects the number of incidents of high-risk behavior by battalion level or separate company.
SADMS	SEXUAL ASSAULT DATA MANAGEMENT SYSTEM (SADMS): Centralized repository of relevant data regarding the entire lifecycle of sexual assault cases, involving victims and/or alleged offenders.
SFT-GAT	SOLDIER FITNESS TRACKER – GLOBAL ASSESSMENT TOOL (SFT-GAT): Formerly known as the Comprehensive Soldier Fitness Global Assessment Tool (CSF-GAT), this source provides baseline information on strength in four areas: emotional, social, spiritual, and family. Also provides an opportunity to track self-development and growth in these areas over time. The Chief of Staff of the Army required all Soldiers to take the SFT-GAT by May 2010. The object of this program is to enhance performance and build resilience.
SFL-TAP	SOLDIER FOR LIFE – TRANSITION ASSISTANCE PROGRAM (SFL-TAP): Formerly known as the Army Career and Alumni Program (ACAP), this program assists military personnel, DoD civilians affected by reduction in force, and their family members with the employment search process by providing guidance, training, resources, and support during their career transition from federal service. Family members and veterans of all branches of the armed services can utilize SFL-TAP services.
TAPAS	TAILORED ADAPTIVE PERSONALITY ASSESSMENT SYSTEM (TAPAS): An aptitude test given to new recruits to measure fortitude and determination.
TMDS	THEATER MEDICAL DATA STORE (TMDS): Used to track, analyze, view, and manage Soldier medical treatment information recorded on the battlefield. Features of TMDS: accessibility and visibility of deployed medical records, outpatient and inpatient treatment records created in theater facilities, treatment records from other applications, reports on movement of patients, patient status, and injury/illnesses.
URI/R-URI	UNIT RISK INVENTORY (URI) / RE-INTEGRATION – UNIT RISK INVENTORY (R-URI): Command climate surveys that help commanders determine the actual occurrences of high-risk behaviors, based on anonymous self-report by Soldiers in the unit. Commanders administer the URI to all deploying Soldiers at least 30 days before an operational deployment and the R-URI to redeploying Soldiers 30-180 days of their return from deployment. Commanders routinely administer the URI during their incoming change of command and may at other times as needed.
WWAS	WOUNDED WARRIOR ACCOUNTABILITY SYSTEM (WWAS): Integrated applications that support the accurate, timely, and effective tracking and management of warfighters in the Wounded Warrior Lifecycle.

Abbreviations: Army STARRS, Army Study to Assess Risk & Resilience in Servicemembers; SSN, social security number; IDs, identification numbers; DoD, Department of Defense; U.S., United States; AFQT, Armed Forces Qualification Test; FY, fiscal year; ASVAB, Armed Services Vocational Aptitude Battery; OIF, Operation Iraqi Freedom; OEF, Operation Enduring Freedom; DD Form, Department of Defense Form; PULHES Factor, physical capacity/stamina, upper extremities, lower extremities, hearing and ears, eyes, and psychiatric; AR, Army Regulation.

Supplementary Table 5. Administrative predictor variables at age of separation^a

I. Socio-demographics

1. Age
2. Gender: Male
3. Race/ethnicity: Asian; American Indian/Alaskan Native; Hispanic; Non-Hispanic white; Non-Hispanic black; Any other race/ethnicity
4. Marital status: Married; Divorced; Widowed; Legally separated; Previously married (currently divorced, widowed, or legally separated); Never married; Marriage ended during year prior to separation/retirement; Married 3+ times
5. Dependents: Any dependents ages 0-5; Any dependents ages 0-13; Any dependents ages 0-17; Number of dependents (0, 1, 2, 3+)
6. Highest education: Less than high school or GED, high school diploma, some college, college graduate or more

II. Army career characteristics

1. Accession: Age at first Army enlistment; AFQT score (last score; maximum score); AFQT percentile (30th percentile or less, 31-49th percentile, 50-64th percentile, 65-92nd percentile, 93-100th percentile, Officer no AFQT); Indication of psychiatric problems at Army Military Entrance Processing Station (MEPS) evaluation; Indication of illicit drug use at MEPS evaluation; Indication of alcohol use at MEPS evaluation; Any psychiatric problem, drug, or alcohol use at MEPS evaluation; Discharged from Delayed Entry Program without enlistment due to moral disqualification
2. Rank/paygrade: 17-category: Private (E1), Private (E2), Private First Class (E3), Specialist or Corporal (E4), Sergeant (E5), Staff Sergeant (E6), Sergeant First Class (E7), Master Sergeant, Sergeant Major, Command Sergeant Major, or Sergeant Major of the Army (E8-E9), Warrant Officer 1 (WO1), Chief Warrant Officer 2 (CW2), Chief Warrant Officer 3 (CW3), Chief Warrant Officer 4 or Chief Warrant Officer 5 (CW4-CW5), Second Lieutenant (O-1), First Lieutenant (O-2), Captain (O-3), Major (O-4), Lieutenant Colonel, Colonel, Brigadier General, Major General, Lieutenant General, General, or General of the Army (O-5-O-10); 6-category: Private (E1-E2), Private First Class (E3), Specialist or Corporal (E4), Senior Enlisted or Noncommissioned Officer (E5-E9), Warrant Officer (WO1-CW5), Commissioned Officer (O-1-O-10); 4-category: Junior Enlisted (E1-E4), Senior Enlisted or Noncommissioned Officer (E5-E9), Warrant Officer (WO1-CW5), Commissioned Officer (O-1-O-10)
3. Rank promotions & demotions: Promoted during year prior to separation/retirement; Promoted at any time since January 2001; Demoted during year prior to separation/retirement; Demoted at any time since January 2001; Demoted 2+ times since January 2001; Number of demotions during 3 years prior to separation/retirement
4. Major Command: FORSCOM; TRADOC; US Army Service Component Central Command, Northern Command, Southern Command, Europe & Africa Command, or Pacific Command (CENT, EUR-AF, NORTH PAC, SOUTH); Special Operations Command (SOC); MEDCOM; AMC, Other, or Unknown
5. MOS: Direct combat arms/front line, other/indirect combat arms, combat support, combat service support/other support; Special operator
6. Hazardous duty incentive pay: Flying duty; Parachute duty; Demolition duty; Experimental stress duty; Flight deck hazardous duty; Laboratory duty utilizing live dangerous viruses or bacteria; Duty involving exposure to highly toxic pesticides; Duty involving toxic fuels & propellants; Duty involving handling chemical munitions; Any hazardous duty incentive pay
7. Global War on Terror (GWOT) deployments: Deployed in support of GWOT prior to separation/retirement; Deployed in support of GWOT since January 2001; Never deployed in support of GWOT; Number of GWOT deployments during 3 years prior to separation/retirement; Number of GWOT deployments since January 2001; Number of months since last GWOT deployment; Total number of months deployed in support of GWOT
8. Army Warrior Care & Transition Program^b: Assigned to a Warrior Transition Unit (WTU) at separation/retirement; Assigned to a WTU during year prior to separation/retirement; Assigned to a WTU at any time since 2007; Enrolled in the Army Wounded Warrior Program (AW2) at separation/retirement; Enrolled in the AW2 during year prior to separation/retirement; Enrolled in the AW2 Program at any time since 2004
9. Stop Loss^c: Had a temporary, unavoidable, desirable, beneficial, or essential to public interest involuntary extension of service at any time prior to separation/retirement; Had a medical or legal involuntary extension of service at any time prior to separation/retirement
10. Time in service: Total years of service in the Regular Army; Number of episodes^d of service in the Army; Number of months within each episode of service in the Army; Number of months in last episode^d of service in the Army prior to separation/retirement; Total months of active^e service in any component since Army enlistment; Total months of service^f in any component since Army enlistment; Number of months since separation/retirement
11. Service/discharge characterization: Honorable; General Under Honorable Conditions; Honorable or General Under Honorable Conditions; Under Other Than Honorable Conditions; Bad conduct or Dishonorable; Under Other Than Honorable Conditions, Bad conduct, or Dishonorable; Uncharacterized (e.g., entry-level separation, void enlistment/induction, dropping from the rolls); Unknown reason for discharge

III. Psychopathological risk factors

A. Symptoms, diagnoses & disorders

1. Self-reported symptoms: 30-day depression symptom frequency scale^g
2. ICD-9/10-CM diagnoses: Any inpatient treatment, outpatient visit, inpatient or outpatient visit, number of days^h in the hospital, number of outpatient visits^h, & number of days/visits^h with ICD-9/10-CM diagnosis codes for each of the following in the 3 months, 6 months, 12 months, & 4 years prior to separation/retirement: ADHD & learning disorders; Adjustment disorders; Alcohol use disorders; Anxiety disorders; Bipolar disorder; Conduct disorder & ODD; Drug abuse; Drug dependence; Drug-induced mental disorders; Eating disorders; History of prior mental disorders; Impulsivity or risky behavior; Major depression; Minor depression; Major or minor depression; Non-affective psychosis; Organic mental disorders; Other impulse control disorders; Other mental disorders & illnesses; Personality disorders; PTSD; Self-damaging behavior; Sexual disorders; Sleep disorders; Somatoform & dissociative disorders; Stressors & adversities; Suicidal ideation; Tobacco use disorder; Traumatic stress; Any inpatient treatment, outpatient visit, inpatient or outpatient visit, number of days^h in the hospital, number of outpatient visits^h, & number of days/visits^h with any diagnoses in the 4 time periods

3. The Polytrauma Clinical Triad & Depression (PCT-D)^j: Any inpatient or outpatient visit with ICD-9/10-CM codes for The PCT-D (diagnosis of TBI, PTSD, pain, & depression) in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement; Any inpatient or outpatient visit with 3 or more PCT-D diagnoses in the 7 time periods; Any inpatient or outpatient visit with 2 or more PCT-D diagnoses in the 7 time periods; Count of PCT-D diagnoses (out of 4) in the 7 time periods
4. Comorbid Clusters^j: Any inpatient or outpatient visit with ICD-9/10-CM codes for each of the following in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Anxiety/Mood disorder & Substance abuse; The PCT-D^j & Chronic disease
5. Other behavioral problems: Any inpatient or outpatient visit & number of days/visits^h with ICD-9/10-CM code for Homicidal ideation in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement

B. Personality characteristics

1. TAPAS personality dimensions^k: Achievement; Intellectual efficiency; Dominance; Even tempered; Optimism; "Will-do" composite scoreⁱ; "Adaptation" composite scoreⁱ
2. Emotional resilience: Character-strengths scale^m

C. Suicidality

1. Suicidal eventsⁿ: Suicidal ideation during a given month prior to separation/retirement; Suicidal ideation ever since 2004; Number of suicidal ideation records since 2004; Suicide attempt during a given month prior to separation/retirement; Suicide attempt ever since 2004; Number of suicide attempts since 2004; Suicide attempt recorded during medical encounter during a given month prior to separation/retirement; Suicide attempt recorded during medical encounter ever since 2004; Number of suicide attempts recorded during medical encounters since 2004
2. Warrior Transition Unit (WTU) risk assessments^{b,o}: Count of WTU risk assessments in the 12 months prior to separation/retirement; Count of WTU risk assessments per month since 2007; Count of WTU positive suicide risk^p assessments per month in the 12 months prior to separation/retirement; WTU suicide risk^p level

D. Treatments

1. Mental & behavioral health-related encounters: Any inpatient or outpatient visit & number of days/visits^h with CPT/HCPCS codes^q for each of the following treatment or services in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Intensive or crisis outpatient psychiatric treatment & services; Behavioral health residential treatment program; Family psychotherapy or health behavior interventions; Any psychiatric, behavioral health, or psychological treatment, service, assessment, or intervention^r; Electroconvulsive therapy; Screening & diagnosis of severe depression^s; Screening & diagnosis of refractive depression^s; Sleep apnea procedures & treatment^t; Any inpatient or outpatient visit & number of days/visits^h with ICD-9/10-CM code for Counseling or services for marital/partner abuse or problems^u in the 7 time periods
2. Substance-related encounters: Any inpatient or outpatient visit & number of days/visits^h with CPT/HCPCS codes^q for each of the following treatment or services in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Severe alcohol/drug-related treatment, interventions, & services; Any alcohol/drug-related treatment, interventions, & services^v; Nicotine-related counseling & interventions^w
3. Adherence to treatment: Any inpatient or outpatient visit & number of days/visits^h with ICD-9/10-CM code for Noncompliance with medical treatment^x in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement
4. Medications^y: Any of the following prescriptions filled in the 12 months & 4 years prior to separation/retirement: Antianxiety agents; Benzodiazepines; Anticonvulsants; Medications for opioid addiction, withdrawal, & alcoholism; Smoking cessation medications & deterrents; Eating disorder treatment medications; Prazosin (PTSD therapy); Number of prescriptions filled in each of the following categories in the 12 months & 4 years prior to separation/retirement: Antianxiety agents; Sedative-hypnotics; Migraine therapy agents; Antipsychotics & medications for bipolar disorder; Antidepressants; CNS stimulants and ADHD medications; Number of months with 1+ psychotropic or narcotic medication prescription filled in the 12 months & 4 years prior to separation/retirement; Any psychotropic or narcotic medication prescriptions filled in the 12 months & 4 years prior to separation/retirement
5. Polypharmacy: Cumulative count of months since January 2001 with each of the following: 5+ psychotropic medication prescriptions filled in a 3-month period, one being a narcotic; 4+ psychotropic or narcotic medication prescriptions filled in a 3-month period; 3+ ER visits in a 12-month period, one being in the past month, all with a narcotic medication prescription filled within 3 months after the visit

IV. Physical health

A. Symptoms, diagnoses & disorders

1. Physical health problems: TBI diagnosis in the month prior to separation/retirement; TBI diagnosis in the year prior to separation/retirement (not including the month prior); TBI diagnosis in the 4 years prior to separation/retirement (not including the year prior); TAPAS Physical Conditioning score^{k,z}
2. Accidents & disability: Involved in an accident in the 12 months prior to separation/retirement; Number of accidents during those 12 months; Involved in an accident or suffered an injury that caused partial disability in the 12 months & 4 years prior to separation/retirement; Involved in an accident or suffered an injury that caused permanent disability in the 12 months & 4 years prior to separation/retirement
3. Role impairment due to accidents or injuries: Any full days out of role, Partial days out of role, & Days quartered in the 30 days, 12 months, & 4 years prior to separation/retirement; Number of full days out of role, Number of partial days out of role, & Number of days quartered in the 12 months & 4 years prior to separation/retirement
4. ICD-9/10-CM diagnoses: Any inpatient treatment, outpatient visit, & inpatient or outpatient visit with ICD-9/10-CM diagnosis codes for each of the following in the 3 months, 6 months, 12 months, & 4 years prior to separation/retirement: Injury, poisoning, & other consequences of external causes; External causes of morbidity; Factors influencing health & contact with services; Any pain conditions; TBI; Other physical disorders; Any inpatient or outpatient visit with ICD-9/10-CM diagnosis codes for each of the following in the 4 time periods: Neoplasms; Diseases of the blood & blood-forming organs & certain disorders involving the immune mechanism; Endocrine, nutritional & metabolic diseases; Diseases of the nervous system; Diseases of the eye & adnexa; Diseases of the ear & mastoid process; Circulatory system diseases; Respiratory system diseases; Digestive system diseases; Diseases of the skin & subcutaneous tissue; Diseases of the musculoskeletal system & connective tissue; Genitourinary system diseases; Pregnancy, childbirth, & the

puerperium; Certain conditions originating in the perinatal period; Congenital malformations, deformations & chromosomal abnormalities; Symptoms, signs & abnormal clinical & laboratory findings not elsewhere classified; Any inpatient or outpatient visit with any diagnoses in the 4 time periods

5. The 19 High-Risk Physical Disorders: Any inpatient or outpatient visit with ICD-9/10-CM codes for each of the following in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Asthma; Back pain; Cancer; Congestive heart failure; COPD; Diabetes; Epilepsy; Fibromyalgia; Heart disease; HIV/AIDS; Hypertension; Migraines; Multiple sclerosis; Osteoporosis; Parkinson's disease; Psychogenic pain; Renal disease; Sleep disorders; TBI; Count of High-Risk Physical Disorder diagnoses^{aa} in the 7 time periods
6. The 10 Chronic Overlapping Pain Conditions (COPC): Any inpatient or outpatient visit with ICD-9/10-CM codes for each of the following in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Chronic fatigue syndrome; Chronic low back pain; Chronic tension-type headache; Endometriosis; Fibromyalgia; IBS; Interstitial cystitis or bladder pain syndrome; Migraines; Temporomandibular disorder; Vulvodynia; Count of COPC diagnoses^{bb} in the 7 time periods
7. The 13 Pain Condition Crosswalk diagnostic clusters: Any inpatient or outpatient visit with ICD-9/10-CM codes for each of the following in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Abdominal & bowel pain; Headaches; Orofacial, ear, jaw, temporomandibular, & facial pain; Urogenital, pelvic, & menstrual pain; Back pain; Fibromyalgia; Fractures, contusions, sprains, strains, & other conditions commonly associated with acute pain; Limb or extremity pain, joint pain, & any non-systemic non-inflammatory arthritic disorders; Musculoskeletal chest pain; Neck pain; Neuropathy; Other painful conditions; Systemic disorders & diseases causing pain; Count of Pain Condition Crosswalk diagnostic cluster diagnoses^{cc} in the 7 time periods
8. High-risk cancer diagnoses: Any inpatient or outpatient visit with an ICD-9/10-CM diagnosis code for cancer of the bladder, colon, esophagus, head & neck, Hodgkin lymphoma, lung, mesothelioma, pancreas, prostate, stomach, or testis in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement; Count of high-risk cancer diagnoses^{dd} in the 7 time periods; Diagnosed with a high-risk cancer for the very first time in the 7 time periods
9. Other serious & high-risk diagnoses: Any inpatient or outpatient visit & number of days/visits^h with ICD-9/10-CM diagnosis codes for each of the following in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Ankylosing spondylitis or psoriatic arthritis; Hepatitis C; Infectious diseases; Osteomyelitis; Psoriasis
10. Comorbidity: Combined Comorbidity Score^{ee} in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement

B. Treatments

1. Medical procedures & encounters: Any inpatient or outpatient visit & number of days/visits^h with CPT/HCPCS codes^g for each of the following treatment or services in the 30 days, 2 months, 3 months, 6 months, 12 months, 2 years, & 5 years prior to separation/retirement: Pain management & pain-related services & procedures^f; fMRI scans; Any inpatient or outpatient visit & number of days/visits^h with ICD-9/10-CM code for Physical, occupational, vocational, or rehabilitation therapy in the 7 time periods
2. Medicationsⁱ: Number of narcotic analgesic prescriptions filled in the 12 months and 4 years prior to separation/retirement; Number of non-narcotic analgesic prescriptions filled in the 12 months & 4 years prior to separation/retirement

V. Social networks & support

1. Family fitness scales^{gg}: Family/relationship satisfaction; Family support & consistency; Family Fitness Composite Score
2. Social fitness scales^{hh}: Affiliative interactions & emotional support; Organizational trust & engagement; Social Fitness Composite Score
3. Spiritual fitness scalesⁱⁱ: Spirituality; Spiritual Fitness Composite Score

VI. Stressful experiences

1. Military conducted drug tests: Any positive drug test & number of positive tests in the 12 months & 4 years prior to separation/retirement; Number of negative drug tests in the 12 months & 4 years prior to separation/retirement; Number of months since last drug test; Received an unsatisfactory evaluation from Commander on last Army Substance Abuse Program (ASAP) Patient Progress Report^{jj}; Percent of months since last unsatisfactory ASAP evaluation
2. Weapons: Count of guns, pistols, rifles, shotguns, knives, swords, bows, or any other weapon registered for legal possession in the 4 years prior to separation/retirement
3. Criminal records & offenses^{kk}: Found perpetrator & victim of each of the following crimes in the 12 months & 4 years prior to separation/retirement: Major physical violence; Minor physical violence; Verbal violence; Sexual violence; Non-violent offenses; Any criminal offense; Number of found criminal perpetrations & victimizations of each of the criminal offenses in the 12 months & 4 years prior to separation/retirement

Abbreviations: GED, General Educational Development Test; AFQT, Armed Forces Qualification Test; FORSCOM, United States Army Forces Command; TRADOC, United States Army Training and Doctrine Command; US, United States; MEDCOM, United States Army Medical Command; AMC, United States Army Materiel Command; MOS, Military Occupational Specialty; ICD-9/10-CM, International Classification of Diseases, Ninth Revision/Tenth Revision Clinical Modification; ADHD, attention deficit-hyperactivity disorder; ODD, oppositional defiant disorder; PTSD, post-traumatic stress disorder; TBI, traumatic brain injury; TAPAS, Tailored Adaptive Personality Assessment System; CPT, Current Procedural Terminology; HCPCS, Healthcare Common Procedure Coding System; CNS, central nervous system; ER, Emergency Room; COPD, chronic obstructive pulmonary disease; HIV/AIDS, human immunodeficiency virus, acquired immunodeficiency syndrome; IBS, irritable bowel syndrome; fMRI, functional magnetic resonance imaging.

^aSupport for including these variables as potential predictors of suicide comes from a number of prior publication.¹⁻¹⁶ All variables were defined as of separation or retirement from the Regular Army (e.g., administrative or medical discharge or retirement, fulfilled service obligation, reached retired pay eligibility age or 20+ years of qualifying service, released from obligation, transferred to Individual Ready Reserve, Inactive National Guard, or Standby Reserve). See Supplementary Table 2 for a description of the Army/Department of Defense (DoD) administrative data systems used to create the variables. See Stanley et al¹⁷ for a list of the ICD-9/10-CM codes^{18,19} used to create the relevant mental and physical disorder variables, TBI, and pain.

- ^bThe Army Warrior Care and Transition Program (WCTP) facilitates care for wounded, injured, and ill Soldiers by providing medical care, case management, support, and assistance in recovery and in the transition back to military service or to civilian life. Eligible Soldiers are assigned to Warrior Transition Units (WTUs), which are specialized units within military/community treatment facilities that provide and manage the physical, mental, and behavioral health care of Soldiers in the WCTP. Each Soldier has a "Triad of Care" consisting of a platoon sergeant/squad leader, a nurse case manager, and a primary care manager that work together to manage the Soldier's entry into the WTU, treatment, recovery, and transition out of the WTU. The most severely wounded, injured, and ill Soldiers, i.e. those who have been injured in the line of duty after September 10, 2001 and have received or expect to receive a disability rating of at least 30% in one or more specific areas (e.g., blindness, loss of limb, severe hearing loss, severe TBI) or a combined rating of at least 50% for any other combat-related condition qualify for the Army Wounded Warrior Program (AW2). AW2 Soldiers are assigned an AW2 Advocate who works with the "Triad of Care" within the WTU to manage non-clinical aspects of care and who supports the Soldier/Veteran and their family throughout their lifetime.²⁰ As of January 1, 2020, the WCTP was restructured and is now known as the Army Recovery Care Program (ARCP), WTUs were renamed to Soldier Recovery Units (SRUs), AW2 to the Army Recovery Care Coordination (ARCC) Program, and AW2 Advocates to Recovery Care Coordinators (RCC).^{21,22}
- ^cStop Loss is an involuntary extension of active-duty service, beyond the servicemembers original separation/retirement date.²³
- ^dAn episode of service was defined as a continuous period of service in the Regular Army. A break in service for at least 2 months marked the end of an episode and the beginning of a new episode of service. A period with only 1 month break was not considered the start of a new episode of service.
- ^eNumber of months active includes time spent as a Regular Active Duty Servicemember, as a member of the Reserves or National Guard in a full-time active-duty program (e.g., Active Guard Reserve), and time spent activated or mobilized as a Reserve or National Guard member.
- ^fTotal months of service include total time serving as a Regular Active Duty Servicemember and as a member of the Reserves or National Guard, regardless of activation status.
- ^gWe created a depression symptom frequency scale score (10-50 range) using the 10 depression-related items from the Soldier's most recent Global Assessment Tool (GAT). The GAT is a self-report survey administered annually to Soldiers, beginning in 2010, to assess emotional, family, social, and spiritual fitness. The items included in the depression scale ask about frequency of lack of interest, depressed, sleep problems, low energy, appetite problems, anger/irritability, self-blame, concentration problems, frustration, psychomotor agitation/restlessness in the past four weeks.²⁴
- ^hCount of days with the diagnosis code associated with an inpatient stay or outpatient visit. Duplicate diagnosis codes on the same day were only counted once (i.e., if the Soldier had multiple medical encounters/visits on the same day and had the same diagnosis code at each encounter on that same day, it only counted as 1 day/visit with that diagnosis).
- ⁱThe Polytrauma Clinical Triad is the co-occurrence of TBI, PTSD, & pain.^{25,26} The full triad or any combination of the PCT conditions can be present to meet the definition. We also included depression in our triad, based on previous research that is often comorbid with PCT and suicidality.²⁷
- ^jPugh^{28,29} identified 6 comorbid clusters of disorders in US Veterans from Afghanistan and Iraq: Cluster 1 = PCT-D (TBI, PTSD, pain, depression) and chronic disease (cancer, cardiac diseases (e.g., congestive heart failure, heart disease), cerebrovascular disease, cognitive impairment/dementia, diabetes, epilepsy/seizures, hypertension, inflammatory bowel diseases (e.g., Crohn's disease, colitis), obesity, osteoarthritis, other neurological conditions (e.g., Parkinson's, multiple sclerosis), peripheral vascular disease, pituitary disorders, psychosis, rheumatoid arthritis/collagen disease), Cluster 2 = PCT, Cluster 3 = mental health (depression, PTSD, anxiety, bipolar) and alcohol or drug abuse/dependence, Cluster 4 = sleep, amputation, and chronic disease, Cluster 5 = pain and moderate PTSD, Cluster 6 = relatively healthy. We included clusters 1 and 3 in our model to investigate their association with suicidality.
- ^kThe Tailored Adaptive Personality Assessment System (TAPAS) is a non-cognitive assessment administered at the Military Entrance Processing Station (prior to enlistment) to measure personality, temperament, motivation, and other characteristics. It is used to determine eligibility and success in the Army, attrition, work performance, and other work/Army-related outcomes.^{30,31}
- ^lArmy constructed standardized composite scores (mean = 0, standard deviations = 1), created by combining a subset of Tailored Adaptive Personality Assessment System (TAPAS) personality dimensional scales. The "Will-do" composite is used to predict non-cognitive aspects of performance such as physical fitness (e.g., exercising regularly), motivation at work (e.g., working extra hours), and leadership (e.g., supporting peers). The "Adaptation" composite is used to predict retention in the Army by measuring thoughts on separation/retention and perceived fit/adjustment to Army life.^{30,31}
- ^mCreated using items from the Soldier's most recent Global Assessment Tool (GAT), a self-report survey administered annually to Soldiers, beginning in 2010, to assess emotional, family, social, and spiritual fitness. We conducted a factor analysis of the 54 common items across the 3 versions of the GAT; this resulted in 7 scales. Scale scores represent a simple summary score of all individual items within the scale - no standardization of scale scores was performed. 18-items were included in this 0-180 scale to measure character strengths. Soldiers were asked to think about how they acted in actual situations in the past month and indicate how often they showed or used the qualities listed, such as creativity, critical thinking, teamwork, fairness, leadership, self-control, humor, forgiveness, etc. Each item was rated on a 0-10 scale, where 0 = never and 10 = always showed or used these qualities.²⁴
- ⁿSuicidal ideation was defined as the presence of any of the following: 1) a Department of Defense Suicide Event Report (DoDSER) record for suicidal ideation; 2) a DoDSER record for suicide attempt resulting in hospitalization, evacuation from combat theater, or other attempt related action without a DoDSER method recorded (i.e., only missing/unknown method in DoDSER) and no ICD-9/10-CM code for self-harm or suspicious injury within 4 weeks (before/after) of the event; or 3) an ICD-9/10-CM code for suicidal ideation (V62.84 or R45.851) recorded in the medical data. Suicide attempt was identified by any of the following: 1) a Department of Defense Suicide Event Report (DoDSER) record indicating suicide attempt/gesture or self-harm without intent; 2) a DoDSER suicide attempt resulting in hospitalization, attempt resulting in evacuation from combat theater, or other attempt related action and a DoDSER method for the event or an ICD-9/10-CM code for self-harm or suspicious injury within 4 weeks (before/after) of the event; 3) any ICD-9/10-CM code for intentional self-harm (E950-E958 and comparable ICD-10 codes) in the medical data; or 4) ICD-9/10-CM code or NATO Standardization Agreement 2050 (STANAG) Trauma Code 4 indicating intentional self-inflicted injury. ICD-9-CM diagnosis codes E950-E958 and comparable ICD-10-CM codes were used to identify suicide attempt during a medical encounter.³²⁻³⁴
- ^oSoldiers are screened for behavioral health issues and risk of harm or injury to self or others immediately upon reporting to the WTU. A full risk assessment is conducted by the Soldier's social worker, platoon sergeant/squad leader, nurse case manager, and primary care manager several days after arrival and as needed throughout their time in the WTU. Soldiers are assessed for risky behaviors and other behavioral health issues, such as anger/aggression, anxiety, PTSD, self-harm, recent stays in a psychiatric unit, substance abuse, domestic violence, social withdrawal, etc. The WTU commander reviews these assessments, designates the overall risk level (low, moderate-low, moderate, high), and develops a risk mitigation plan, if necessary (e.g., referral to substance abuse program, safety counseling, referral to ER, no alcohol order, etc.).²²
- ^pThe count of WTU positive suicide risk assessments per month during a 12-month period is a 0-60 continuous variable for the number of times each of the following were positive: 1) made a 6-month suicide attempt as indicated by the Soldiers platoon sergeant/squad leader (0=no attempt, 1=6-month attempt), 2) made a 6-month suicide attempt as indicated by the nurse case manager (0=no attempt, 1=6-month attempt), 3) the social

workers' self-harm and suicidal thoughts risk assessment (0=low/moderately low risk, 1=moderate/high risk), 4) commander referral to safety counseling for danger to self or others (0=no, 1=yes), and 5) Commander referral to ER for suicidal ideation (0=no, 1=yes). The WTU suicide risk level is a 0-5 sum of the 5 variables listed above.

^aCPT and HCPCS codes require both a CPT or HCPCS code to indicate the treatment received or service performed and an ICD-9/10-CM diagnosis code to describe why the treatment/service was performed.^{35,36}

^fIncludes Psychotherapy for crisis or interactive complexity, Therapy or training related to the care and treatment of patient's disabling mental health problems, Mental health partial hospitalization, Community psychiatric supportive treatment program, Crisis intervention services, Behavioral health day treatment, Psychiatric health facility service, Intensive outpatient psychiatric services, Therapeutic behavioral services, Mental health clubhouse services, and Medicaid certified community behavioral health clinic services (CPT codes 90785, 90839, 90840 & HCPCS codes G0176, G0177, H0035-H0037, H2011-H2013, H2019-H2020, H2030-H2031, S9480, S9484-S9485, T1040-T1041); hospital and non-hospital residential treatment programs and long-term non-medical, non-acute care in a residential treatment program where stay is typically longer than 30 days (HCPCS code H0017-H0019); Family psychotherapy, health behavior intervention, or adaptive behavior treatment guidance (CPT codes 90846, 90847, 90849, 96167-96171, 97156-97157); or Behavioral and qualitative analysis, Neurobehavioral status exam, Brief emotional/behavioral assessments, Individual psychotherapy, Psychoanalysis, Group psychotherapy, Psychophysiological therapy incorporating biofeedback training with psychotherapy, Hypnotherapy, Counseling for substance abuse treatment options, Behavioral health counseling and therapy, and Other services, Health behavior intervention, Adaptive behavior treatment, and Neuropsychiatric interventions, and Behavioral health and Psychiatric care management (CPT codes 90832-90838, 90845, 90853, 90875, 90876, 90880, 90899, 92524, 96116, 96121, 96127, 96158, 96159, 96164, 96165, 97153-97155, 97158, 99484, 99492-99494, 0373T, 4060F, 4306F, 4320F, 4526F; HCPCS codes G0445, G0502-G0504, G0507, G2214, H0004, H0046).^{37,38}

^gSevere depression = severe major depressive disorder diagnostic or screening processes or results (CPT code 3090F, 3091F); Refractive depression = Adult patients 18 years of age or older with major depression or dysthymia who did not reach remission at 6/12 months (6/12-month PHQ-9 score of less than 5) either because PHQ-9 was not assessed or PHQ-9 score is greater than or equal to 5 (HCPCS codes G9573, G9574, G9510).³⁸

^tContinuous positive airway pressure (CPAP) device (HCPCS codes A7030, CPT codes 94660, 95783, 95811); Electronic positional device (HCPCS code K1001); Mild, moderate, or severe obstructive sleep apnea (HCPCS codes G8848, G8846).

^uICD-9-CM codes for counseling for marital and partner problems or victim or perpetrator of spousal and partner abuse (V61.10-V61.12) or ICD-10-CM codes for encounter for mental health services for spousal or partner abuse problems (victim or perpetrator) or other specified counseling (Z69.1X, Z71.89).³⁹

^vIncluding codes for severe alcohol/drug treatment: definitive drug testing for Opiates and opiate analogs, Office-based treatment for opioid use disorder, including development of the treatment plan, care coordination, individual therapy and group therapy and counseling, Medication assisted treatment (buprenorphine, methadone, naltrexone, naloxone, not otherwise specified), Alcohol and/or drug crisis outpatient intervention, sub-acute detoxification, acute detoxification, ambulatory detoxification, intensive outpatient treatment program, medical intervention in ambulatory setting, or methadone administration and/or service, or Alcohol and/or drug abuse halfway house services or other treatment program (CPT codes 80362-80364; HCPCS codes G2086-G2088, G2213, G2215-G2216, G2067-G2075, G2078-G2080, H0007-H0016, H0020, H2034-H2036) and patient identified as an unhealthy alcohol user when screened for unhealthy alcohol use using a systematic screening method, received brief counseling, or both, Alcohol and/or substance (other than tobacco) misuse structured assessment (e.g., AUDIT) and intervention, Brief face-to-face behavioral counseling for alcohol misuse, 15 minutes, Alcohol and/or drug use intervention service, planned facilitation, Alcohol and/or drug group counseling by a clinician, case management, or brief intervention per 15 minutes, or Alcohol and/or substance abuse family/couple counseling, treatment plan development and/or modification (HCPCS codes G0396, G0397, G0443, G2011, G2196, G2200, G9621, H0005, H0006, H0050, H0022, T1006, T1007).³⁸

^wPatient identified as a tobacco user or documented as a user and received tobacco cessation counseling and/or pharmacotherapy advice to quit, counseling on the benefits of quitting, assistance with or referral to support programs, or current enrollment in smoking or tobacco use cessation program, or Smoking cessation classes (HCPCS Codes G9458, G9906, S9453); Tobacco cessation counseling or pharmacologic therapy (CPT codes 4000F, 4001F); Smoking and tobacco use cessation counseling visits (CPT codes 99406, 99407).

^xNoncompliance with medical treatment/regimen or underdosing, refusal of treatment or not carried out because of patient's decision (ICD-9-CM codes V15.81, V45.12, V62.6, V64.06, V64.07, V64.2; ICD-10-CM codes Z91.1XX, Z28.1, Z28.2X, Z53.1, Z53.2X, Z53.8, Z53.9).⁴⁰

^yNational Drug Codes were collapsed into the designated categories using the First Databank (FDB) Enhanced Therapeutic Classification System™.⁴¹

^zA dimension of the Tailored Adaptive Personality Assessment System (TAPAS), the physical conditioning facet measures engagement and interest in physical activities/fitness, sports, and exercise, with higher scores representing more participation and involvement in physical activities and vigorous sports/exercise.^{30,31}

^{aa}Count of the 19 High-Risk Physical Disorders, ranging from 0-19.⁴²

^{bb}Count of the 10 Chronic Overlapping Pain Condition diagnoses, ranging from 0-10.⁴³⁻⁴⁵

^{cc}Count of the total number of pain-related diagnostic cluster diagnoses from the Pain Condition Crosswalk, ranging from 0-13.⁴⁶

^{dd}Count of the 11 cancers with High-risk for suicide, ranging from 0-11.⁴⁷⁻⁵⁰

^{ee}We used the Gagne method⁵¹ to create a combined comorbidity score by combining the Romano approach⁵² of scoring the 17 conditions in the Charlson Index⁵³ with van Walraven's method⁵⁴ of scoring the 30 conditions used in the Elixhauser Comorbidity Classification system.⁵⁵ Gagne et al. found that this combined comorbidity scale performed better than either the Charlson or the Elixhauser in a study of 120,679 Pennsylvania Medicare enrollees. The conditions included alcohol abuse, any tumors, cardiac arrhythmias, chronic pulmonary disease, coagulopathy, complicated diabetes, congestive heart failure, deficiency anemias, dementia, fluid and electrolyte disorders, hemiplegia, HIV/AIDS, hypertension, liver disease, metastatic cancer, peripheral vascular disorder, psychosis, pulmonary circulation disorders, renal failure, and weight loss.

^{ff}CPT & HCPCS codes from The Pain Source Coding Manual⁵⁶ and HCPCS codes for Professional services for the administration of pain management, Back or leg pain measured by the Visual Analog Scale (VAS) or Numeric Pain Scale (NPS), multimodal pain management was used, pain assessment/screen, or home infusion therapy (codes G0068, G0088, G2137, G2139, G2141, G2147, G2148, G8509, G8730, G9251, M1000, S9325-S9328).⁵⁷

^{gg}Created using items from the Soldier's most recent Global Assessment Tool (GAT), a self-report survey administered annually to Soldiers, beginning in 2010, to assess emotional, family, social, and spiritual fitness. There are 3 different versions of the GAT, so we conducted a factor analysis of the 54 common items across versions 1-3 of the GAT. The Family satisfaction scale included 3 items: 2 about satisfaction with marriage/relationship and family in the past month and an item asking about closeness with family resulting in a 4-14 range scale. The Family support scale also included 3 items and Soldiers were asked to rate on a 1-5 scale how strongly they agreed with each statement: "My family supports my decision to serve in the Army", "The Army meets my family's needs", and "The Army makes it easy for my family to do well". Items were summed for a 3-15 scale - no

standardization of scale scores was performed. The Army constructed Family fitness composite score ranges from 1-5 and was created by taking the mean scores of these scales. Higher scores indicate better Family satisfaction, support, and overall fitness.²⁴

^{hh}Created using items from the Soldier's most recent Global Assessment Tool (GAT), a self-report survey administered annually to Soldiers, beginning in 2010, to assess emotional, family, social, and spiritual fitness. There are 3 different versions of the GAT, so we conducted a factor analysis of the 54 common items across versions 1-3 of the GAT. 7-items were included in the Affiliative interactions and emotional support scale: the number of people the Soldier can count on when faced with serious problems, frequency of feeling left out, feeling close to people, and feeling part of a group, and 3 items about whether they have a best friend, someone to talk to when they feel down, and if they have as much contact with friends and family outside the Army and they want/need. This scale ranges from 10-32 with higher scores indicating positive affiliative interactions and emotional support. The Organizational trust/engagement scale included 8 items to assess overall feelings about their job, engagement with work and trust/respect for leaders and fellow servicemembers. This scale ranges from 8-40 and includes items about work, such as "My work is one of the most important things in my life" and questions about Soldiers and leaders such as "I trust my fellow Soldiers in my unit to look out for my welfare and safety." No standardization of scale scores was performed. The Army constructed Social fitness composite score was created by taking the mean of the above scales for a 1-5 range. Higher scores on all scales indicate better social fitness.²⁴

ⁱⁱCreated using items from the Soldier's most recent Global Assessment Tool (GAT), a self-report survey administered annually to Soldiers, beginning in 2010, to assess emotional, family, social, and spiritual fitness. There are 3 different versions of the GAT, so we conducted a factor analysis of the 54 common items across versions 1-3 of the GAT. Spirituality was measured with 5 items pertaining to the human spirit: "I believe there is a purpose for my life", "I am a spiritual person", "My life has a lasting meaning", "I believe that in some way my life is closely connected to all humanity and all the world", and "The job I am doing in the military has lasting meaning." Soldiers were asked to indicate how well each of the statements described them, where 1 = not like me at all and 5 = very much like me. The items were summed to create a 5-25 spirituality scale. No standardization of scale scores was performed. The Spiritual fitness composite score is an Army constructed score which ranges from 1-5.²⁴

^{jj}A Patient Progress Report⁵⁸ is completed periodically during enrollment in the Army Substance Abuse Program. The Soldier's commander evaluates duty performance and conduct and appraises them as either satisfactory or unsatisfactory and then evaluates their treatment progress and indicates if the Soldier should continue treatment, terminate treatment and return to active duty, or terminate treatment and separate from military service.⁵⁹

^{kk}The National Corrections Reporting Program (NCRP)⁶⁰ was used to categorize criminal offenses. Major physical violence included murder, homicide, manslaughter, kidnapping, aggravated arson, aggravated assault, family-related aggravated assault, and robbery; Non-violent criminal offenses included reckless endangerment, burglary, simple arson, forgery, fraud, theft, property offenses, commercialized vice (illegal substances and other), possession/use/other violation of illegal substance, court-ordered violations, weapon offense, minor traffic offense, drunkenness, vagrancy, disorderly conduct, military specific non-violent offenses, family-related non-violent offenses, and other non-violent offenses (e.g., bribery, contributing to the delinquency of a minor, immigration violations); Any criminal offense included major physical violence and non-violent offenses along with minor physical violence (simple assault, family-related simple assault, and other physical violence), verbal violence (blackmail, extortion, intimidation, rioting, harassment (non-sexual), family-related emotional abuse, sexual verbal violence (sexual harassment), and sexual violence (rape, sodomy, sexual assault, family-related sexual violence).

Supplementary Table 6. Algorithms used in the Super Learner ensemble^a

Algorithm	Description
I. Super Learner	Super Learner is an ensemble machine learning approach that uses cross-validation (CV) to select a weighted combination of predicted outcome scores across a collection of candidate algorithms (learners) to yield an optimal combination according to a pre-specified criterion that performs at least as well as the best component algorithm. R package: <i>Superlearner</i> . ^{61,62}
II. Learners in the Super Learner library	
A. Logistic regression	Maximum likelihood estimation with logistic link function. R package: <i>stats</i> . ⁶³
B. Elastic Net	Elastic net is a regularization method that minimizes the problem of overlap among predictors by explicitly penalizing over-fitting with a composite penalty $\lambda\{MPP \times \text{Plasso} + (1 - MPP) \times \text{Pridge}\}$ mppmmp, where MPP is a mixing parameter penalty with values between 0 and 1 that controls relative weighting between the lasso penalty (Plasso) and the ridge penalty (Pridge). The parameter λ controls the total amount of penalization. The ridge penalty handles multicollinearity by shrinking all coefficients smoothly towards 0 but retains all variables in the model. The lasso penalty allows simultaneous coefficient shrinkage and variable selection, tending to select at most one predictor in each strongly correlated set, but at the expense of giving unstable estimates in the presence of high multicollinearity. The elastic net approach of combining the ridge and lasso penalties has the advantage of yielding more stable and accurate estimates than either ridge or lasso alone while maintaining model parsimony. R package: <i>glmnet</i> . ⁶⁴ Hyperparameters: three ranges of λ were defined as 0.0-0.333, 0.33-0.667, 0.667-1.0. A single random value within each of these three ranges was then selected for each training model, but these values varied across models.
C. Splines Adaptive polynomial splines ^a	Adaptive polynomial splines are like adaptive splines but differ in the order in which basis functions (e.g., linear versus nonlinear) are added to build the final model. R package: <i>pospline</i> . ⁶⁵
D. Neural networks	Connections between predictors and the outcome are modeled as a network. The predictors affect the outcome through intermediate layers. Weights are assigned to connections. Neural networks capture interactions and non-linear associations but have low interpretability. R package: <i>nnet</i> . ⁶⁶ Hyperparameters: We estimated 12 neural networks for each model, with size selected randomly in the range between 1 and the maximum value size could be without causing the number of weights to exceed 1000, and decay varied between 0.000000001 and 0.1.
E. Decision trees – bagging	Random Forest. Independent variables are partitioned (based on contiguous values) and stacked to build decision trees that are combined (ensemble) to create an aggregate “forest”. Random forest builds numerous trees in bootstrapped samples and generates an aggregate prediction by averaging across trees, thereby reducing over-fitting. R package: <i>ranger</i> . ⁶⁷ Hyperparameters: We estimated 12 rangers for each model, with max.depth selected randomly in the range 1-8, num.trees = 1000, mtry selected randomly in the range between 2 and the maximum number of variables based on the screener, and min node size varied randomly between 2 and 20% of the number of outcomes.
F. Decision trees – boosting Extreme Gradient Boosting	A fast and efficient implementation of gradient boosting. R package: <i>xgboost</i> . ⁶⁸ Hyperparameters: We estimated 12 xgboosts for each model, with nrounds = 1000, max_depth selected randomly in the range 1-5, eta selected randomly in the range 0.000-1.000, gamma selected randomly in the range between 0.000-10.000, min_child_weight selected randomly between 1 and 20% of the number of outcomes, colsample_bytree selected randomly in the range 0.000-1.000, and colsample_bynode selected randomly in the range 0.000-1.000.
G. Mean	Arithmetic mean

^aHyperparameters: Default values were used unless otherwise noted.

Measures Supplement

The STARRS Historical Administrative Data Study (HADS) includes Army administrative data from 50 Army/Department of Defense (DoD) administrative data systems (Supplementary Table 2). A review of these data systems led to the selection of 1,775 variables as indicators of previously identified predictors of suicide grouped into the categories: (i) demographics, (ii) Army career characteristics, (iii) psychopathological risk factors (including self-injurious thoughts and behaviors and personality characteristics), (iv) indicators of physical health, (v) social networks and support, and (vi) stressors (Supplementary Table 3). These variables were based on a literature review of meta-analyses, qualitative reviews, and empirical reports on predictors of suicide death and nonfatal suicide attempts among Veterans, active-duty military service members, and the general population. A brief overview of this literature is presented here. See Table 2 for more complete citations.

Missing data

Multiple administrative databases were consulted to address missing data. In cases where data were unavailable across all databases, data were either imputed using a carry forward/carry backward method from the most recent available data point or were coded as missing.

Socio-demographics

Younger baseline age has been associated with increased risk of suicidal behaviors and suicide death in Veterans.⁶¹ Young age at leaving service has also been found to predict increased risk of suicide.⁶² As in the general population, the suicide rate of male Veterans adjusted for age is substantially higher than that of their female counterparts.⁶³ Non-Hispanic White Veterans have a suicide rate approximately double that of Veterans of other races-ethnicities.^{64,65} Associations of education with suicide among Veterans have been inconsistent in prior reports.^{65,66} Prior studies have often, but not always, found that married Veterans are at lower risk of suicide than those who are separated, divorced, or never married.^{65,67-69} Widowhood, in comparison, is sometimes found to be associated with a reduced risk of suicide compared to the married.⁶⁷ Relatedly, an autopsy study on service members found that suicide cases had fewer dependents than control cases.⁷⁰ Based on this literature, we included information on age, age at leaving service, sex, race/ethnicity, education, marital status, and number of dependents along with some other socio-demographic variables in the predictor set.

Army career characteristics

The literature has examined how various dimensions of the Army career might predict suicidal behaviors and suicide death. Among active-duty service members, heightened job-related stress,⁷¹ lower categorical scores on the Armed Forces Qualification Test (AFQT), junior enlisted rank and recent demotion⁷² have been associated with increased suicide death risk. The suicide death risk is notably higher within the initial year following military separation (hazard ratio (HR) = 2.49 [95% CI, 2.12–2.91]) and persists at an elevated level for Veterans who had severed their military ties ≥ 6 years ago (HR = 1.63 [95% CI 1.45–1.82]).⁶⁸ The HR for suicide mortality in Veterans whose military service spanned just 1–2 quarter-years at the point of separation was notably elevated (HR = 12.00 [95% CI, 7.78–18.52]).⁶⁸ Among Veterans with higher suicide death risk, there was a greater proportion with less-than-honorable discharges (dishonorable, inaptitude, misconduct, unfitness, unsuitability), and they typically had earlier discharges and younger enlistment age.^{66,73} Overall, these findings have been attributed to persistent repercussions from demanding military encounters, challenges associated with reintegration into civilian society, or a predisposition toward suicidal behaviors and suicide death before enlistment.

A critical question arising in this literature is whether military service itself or specific elements of military service, especially deployment to a war zone, modify the subsequent suicide death risk among Veterans. Numerous meta-analyses and qualitative reviews have endeavored to consolidate this heterogeneous body of research.⁷⁴⁻⁷⁷ In summary, both early⁷⁵ and more recent⁷⁸ meta-analyses revealed minimal indications of elevated suicidal behaviors and suicide death risk among service members and Veterans who were deployed to conflict zones than their non-deployed counterparts. For instance, a population-based study on service members and Veterans similarly showed a modest association between prior deployment experiences and increased risk of post-service suicide death (HR = 1.09 [95% CI, 0.99–1.20]).⁶⁸ Deployment profiles and occupations exhibited considerable diversity within the Army, Air Force, Marine Corps, and Navy, yet HRs of deployment status predicting suicide death risk consistently had comparable magnitudes across these distinct military branches.⁶⁸ Further, there was no discernible variation in HRs concerning deployment locations, whether it be Afghanistan, Iraq, or other Operation Enduring Freedom (OEF) or Operation Iraqi Freedom (OIF) theaters.^{62,68,79,80}

However, there could be interactions in the association between deployment experiences and suicidal behaviors and suicide death risk in Veterans. For example, among military populations diagnosed with (vs. without) self-inflicted injuries, the suicide death risk was higher in the deployed (HR = 26.25 [95% CI 18.83–36.61]) than the

never-deployed (HR = 4.69 [95% CI 3.49–6.30]),⁶⁸ raising the possibility that the type of deployment experience matters. As another example, a recent study suggested that Veterans with elevated suicide risk were characterized by a higher degree of combat exposure, pronounced experiences of moral injury, and more self-stigmatizing perspectives concerning their military identity than their counterparts with lower suicide risk.⁸¹ Given this literature, we included in our predictor set duty military occupational specialty (MOS) classification, discharge type, time in service, AFQT scores, years of service, military rank at time of leaving active service, enlistment episode duration, age at first Army enlistment, and command affiliation, among other army career characteristics.

Psychopathological risk factors

Extant literature has explored and identified psychopathological risk factors associated with suicide mortality in the general population, such as previous suicidal ideation and suicide attempts.^{82–85} Despite slight differences between the military and general populations, most observed associations between psychopathological risk factors and suicide death risk were similar. Among military populations (Veterans and service members), a recent meta-analytic study showed that presence (vs. absence) of alcohol or substance use disorder (AUD/SUD) (weighted odds ratio [wOR] = 3.63 [95% CI 1.89–6.98]), mania/ bipolar/ psychosis (wOR = 3.33), and self-injurious thoughts and behaviors (wOR = 7.48 [95% CI 3.24–17.26]) predicted suicide death.⁷⁸ Moreover, AUD/SUD and depressive symptoms were more robust predictors of suicide death among military populations (AUD/SUD, wOR = 3.13; depressive symptoms, wOR = 6.51) than the general population (depressive symptoms, wOR = 1.57; AUD, wOR = 1.57; SUD, wOR = 1.18).⁷⁸ Regarding post-traumatic stress disorder (PTSD), a qualitative review implied that comorbid depression along with PTSD could be a stronger predictor of suicide death among Veterans than PTSD alone.⁸⁶ A recent cross-sectional epidemiological study also showed that Veterans with nonsuicidal self-injury disorder (NSSID) faced nearly a fivefold higher risk of a lifetime suicide attempt than their counterparts without NSSID, and the presence of borderline personality disorder (BPD), PTSD, and MDD did not amplify the risk of a lifetime suicide attempt beyond the influence of NSSID.⁸⁷

Specific mental health treatment utilization patterns might predict increased suicide risk. Veteran suicide decedents were notably more likely than others to have received prior referrals for services and to utilize more intensive treatments, such as hospital stays and medications, than propensity-matched controls.⁸⁸ In the month preceding suicide deaths of male Veterans with SUDs, they displayed a recurrence of medical encounters, with most seeking care in general medical settings, but a notable subset availed themselves of specialized mental health services.⁸⁹ Higher suicide death risk was also associated with prior psychiatric hospitalization in Veterans.⁹⁰ Based on this research, we included in our predictor set frequency and duration of inpatient/outpatient visits for AUD/SUD, depression, personality disorders, other mental disorders, tobacco use, cumulative polypharmacy counts, history of suicidal ideation and suicide attempts, number of polytrauma clinical triad diagnoses, and related psychopathology risk factors.

Physical disorders

Myriad physical health conditions have been examined as predictors of suicide death among Veterans and the general population. Among Veterans, a body of consistent evidence indicates that physical illnesses are associated with increased suicide risk.^{90–93} These illnesses include back pain, fibromyalgia, migraine, primary headache or tension headache, and psychogenic pain, with HRs ranging from 1.33 (99% CI, 1.22–1.45) for back pain to 2.61 (99% CI, 1.82–3.74) for psychogenic pain, after accounting for socio-demographic and contextual factors such as age, sex, and Charlson comorbidity score.⁹² Similarly, a recent meta-analysis⁷⁸ and empirical study⁹⁴ highlighted substantially elevated suicide risk associated with traumatic brain injury (TBI) among Veterans. Furthermore, after accounting for medical and psychiatric comorbidity, Veterans with physical activity limitations showed an elevated suicide risk.⁶⁵

In the general population, a large case-control study found that after accounting for age and gender, 17 physical health conditions (asthma, back pain, cancer, congestive heart failure, chronic obstructive pulmonary disorder, diabetes mellitus, epilepsy, human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS), heart disease, hypertension, migraine, Parkinson's disease, psychogenic pain, renal disorder, sleep disorder, stroke, and TBI) were linked to elevated suicide death risk.⁴² Nine of these associations remained significant after adjustment for mental health diagnoses. This study also found that the presence (vs. absence) of three conditions exhibited a greater than twofold increase in suicide death risk (HIV/AIDS, sleep disorders, and TBI) and that multimorbidity was observed in 38.0% of cases compared to 15.5% of controls. Based on this literature, we included in our predictor set measures of medical conditions and health care utilization patterns related to endocrine, congenital anomalies, digestive, musculoskeletal, various pain conditions, number of visits for specific medical procedures, and other physical health risk factors.

Social networks and support

Two theoretical frameworks have been proposed as essential in examining the role of social networks and support in predicting suicidal behaviors and suicide death among Veterans and service members.⁹⁵ First, the interpersonal-psychological theory of suicide (IPTS)⁹⁶ has been applied to investigate suicide death risk among service members, emphasizing its three core elements: suicidal behavior prediction based on thwarted belongingness, perceived burdensomeness, and acquired capability.⁹⁷ Second, the fluid vulnerability theory (FVT) presents an alternative perspective on suicidal behaviors and suicide death risk, suggesting that suicide risk does not follow a linear or static pattern but can rapidly increase due to changing psychological and physical factors.⁹⁸

Consistent with these theories, considerable numbers of service members who died by suicide had experienced a recent intimate relationship failure, with a substantial portion of them encountering such failures in the brief time leading up to their suicide deaths.^{71,99,100} Similar patterns have been observed in Veterans. Veterans recently discharged from inpatient psychiatric care had a reduced likelihood of suicide risk when residing in a closely-knit community.¹⁰¹ The absence of social connections within safety plans predicted heightened suicide death risk among Veterans.¹⁰² Certain variables might also modify the association between social networks/support and suicide risk. In OEF/OIF Veterans, higher satisfaction with their social networks served as a mitigating factor against suicide risk, albeit with reduced protectiveness among those with symptoms of PTSD.¹⁰³ Within the cohort of unmarried individuals who died by suicide at ages younger than 30, Veterans had increased likelihood of reported intimate partner problems than individuals without prior military service.¹⁰⁴ Based on this literature, we included in our predictor set indicators of social support, such as emotional and family support, relationship satisfaction, spirituality, and associated factors, extracted from the Global Assessment Tool (GAT), a survey administered annually to all US Army soldiers.

Stressors

Several stressful experiences have been examined as predictors of suicide death among Veterans. A population-based study showed that sexual trauma is a risk factor for suicide death in both male (HR = 1.69, [95% CI: 0.45-1.97]) and female (HR = 2.27 [95% CI, 1.76-2.94]) Veterans.¹⁰⁵ A recent meta-analysis demonstrated that the presence (vs. absence) of financial and legal problems (*wOR* = 3.35 [95% CI, 0.52–21.44]) predicted suicide death among service members and Veterans.⁷⁸ Additionally, transitioning from military service to civilian life emerged as a risk factor for suicide death among Veterans, even after adjusting for military-related stressors, military identity, quality of life, length of service, and age, presumably due to the stresses associated with this transition.⁸¹ Given this research, we included in our predictor set information about exposure stressors available in the HADS database, such as counts of recent criminal perpetrations, both violent and non-violent, and the utilization of family psychotherapy services within the past two years.

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