SUPPLEMENTARY MATERIAL

Borowski et al.
Joint models targeting U.S. Army soldiers at high-risk of post-separation unemployment, homelessness, and suicide-related behaviors

Calculation and interpretation of SHAP Values

We noted in the body of the paper that relative importance of predictors used to develop the models was evaluated using the model-agnostic Shapley Additive Explanations (SHAP) method[1], a general-purpose approach to examine predictor importance in any machine learning (ML) prediction model by calculating marginal contribution to overall model accuracy. A SHAP value is calculated for each predictor variable for each respondent in a given model by using counter-factual logic to determine the extent to which the respondent's predicted probability of the outcome would have changed if the predictor was changed for the respondent's observed score value to the mean score under the model in the entire sample, averaging across all logically possible permutations of each model. Given the computational intensity of calculating SHAP values for ensemble models, SHAP values were calculated only in a random forest model for CV predicted probabilities of the post-separation outcome based on the subset of predictors selected in at least one of the 10 SL folds for one of the types of algorithms.

It is noteworthy that the SHAP value for any individual predictor has an average value of 0 across respondents. As a result, the convention is to calculate the mean of the absolute value of the SHAP value to evaluate variable importance. This kind of absolute value can also be calculated for sets of variables, such as the full set of socio-demographic variables considered in the model, by summing the SHAP values of all predictors in the set at the individual level, calculating absolute values of the sum at the individual level, and then computing the mean of these absolute values. Finally, to provide some perspective on these means, it is possible to

express mean absolute SHAP values of individual predictors and predictor classes as proportions of the mean absolute SHAP value of the entire model, which we refer to as $SHAP_P$. The mean absolute SHAP value of the entire model is obtained by summing SHAP values at the individual level across all predictors, calculating the absolute value of the sum at the individual level, and then computing the mean of these absolute values. This sum tells us the average effect of model variables in changing the predicted value of any individual in the sample from their observed predicted value to the mean predicted value in the total sample. We examined $SHAP_P$ values for overall models and estimated new models based on participants defined as high-risk (e.g., risk of a single outcome only, risk of multiple outcomes). We report $SHAP_P$ for each broad category of predictors considered in the model along with the $SHAP_P$ for the five most important predictors in each category with $SHAP_P$ values of at least 5%.

It is important to realize the influence of a predictor, expressed as a SHAP value, can differ not only in value but also in sign when there are interactions in the model. For example, increasing the score of one respondent with a lower-than-average value on a given predictor to the mean value of the entire sample might be associated with an increased predicted risk of the outcome, whereas for another respondent the same increase in the predictor value might be associated with a decreased predicted risk of the same outcome. However, there is typically, although not always, a dominant direction of association between a given predictor and the outcome. We investigated this by providing bee swarm plots of the sign of the association of each predictor with the outcome for each respondent across important predictors in the SHAP analysis.

Supplementary Table 1. The 130 survey variables used as potential predictors[a]

I. Socio-demographics

1. Age
2. Sex: Female
3. Race/ethnicity: Hispanic; Non-Hispanic white; Non-Hispanic black; Any other race/ethnicity
4. Nativity: Born in US; Number of parents born in US
5. Education[b]: Less than high school; High school diploma/equivalent; Some college; College graduate or more
6. Parental education[b]: High school diploma/equivalent or less; Some college; College graduate or more
7. Relationship status: Married; Separated, divorced, or widowed; Never married; Engaged; Steadily dating; Dating but not steadily; Not dating; Marriage ended 12-months prior to separation/retirement; Married 3+ times
8. Sexual orientation: Non-heterosexual
9. Children & dependents: Any biological children; Any stepchildren; Any children; Any dependents ages 0-5; Any dependents ages 0-13; Any dependents ages 0-17; Number of dependents
10. Religiosity[c]: Religiosity scale; Fundamentalism index

II. Army career characteristics

1. Accession: Age first joined the Regular Army
2. Rank: Junior Enlisted (E1-E4), Senior Enlisted or Noncommissioned Officer (E5-E9), Warrant Officer (WO1-CW5), Commissioned Officer (O-1-O-10)
3. Major Command: Army Forces (FORSCOM); Army Training & Doctrine (TRADOC); Army Service Component Central, Northern, Southern, Europe & Africa, or Pacific (CENT, EUR-AF, NORTH PAC, SOUTH); Special Operations (SOC); Army Medical (MEDCOM); Army Materiel (AMC), Other, or Unknown; Guard or Reserve
4. Military Occupational Specialty (MOS): Combat arms; Combat support; Combat service support
5. Special operator: Assigned as a special operator at any time during Army career
6. 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 since January 2001; Number of months since last GWOT deployment
7. Army Warrior Care & Transition Program[d]: Assigned to a Warrior Transition Unit (WTU) at any time since 2007; Enrolled in the Army Wounded Warrior Program (AW2) at any time since 2004
8. Time in service[e]: Total months of service in any component since Army enlistment
9. Service/discharge characterization: Honorable or General Under Honorable Conditions; 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 or missing

III. Psychopathological risk factors

1. Lifetime psychiatric disorders[f]: ADHD; Alcohol/substance use disorder; Bipolar spectrum disorder; Generalized anxiety disorder; IED; Major depressive episode; Panic disorder; PTSD
2. Dimensional symptom frequency scales[f]: Childhood conduct/oppositional defiant disorder symptom frequency scale
3. Suicidal events[g]: Lifetime suicidal ideation; Suicidal ideation during year of separation/retirement or up to 2 years before; Lifetime suicide plan; Lifetime suicide attempt; Attempt during year of separation/retirement or up to 2 years before; Number of lifetime attempts
4. Personality[h]: Dimensional scales of antisocial traits, borderline traits, dispositional anger-irritability, and perceived psychological resilience

IV. Physical health

1. Physical health problems: Lifetime traumatic brain injury (TBI)[i]; 30-day average pain severity[j]
2. Accidents & disability: Involved in an accident in the 12 months prior to separation/retirement

V. Stressors

1. Childhood abuse & neglect[k]: Physical abuse (Hit by a family member so hard it left bruises; Physically abused at home); Emotional abuse (Felt hated by a family member; Family members said hurtful or insulting things; Emotionally abused at home); Sexual abuse (Forced to touch someone or touched by someone in a sexual; Sexually abused at home); Physical neglect (Had to do difficult/dangerous chores; Did not have adequate care or protection; Lacked food, clothing, and basic needs)
2. Other adverse childhood events[k]: Lived in foster care; Sent to juvenile detention center; Family was on welfare; Family was homeless; Parents separated/divorced; Parent(s) incarcerated for 6+ months; Parent(s) had a mental illness; Parent(s) had substance abuse problem; Parent(s) died; Parent(s) attempted or died by suicide
3. Deployment-related traumatic events[l]: Went on combat patrols or had other dangerous duty; Had a close call; Wounded by the enemy; Fired rounds at the enemy or took enemy fire; Responsible for death of enemy combatant; Responsible for death of non-combatant; Responsible for death of US or ally personnel; Saved the life of a servicemember or civilian; Saw destroyed homes or villages or people begging for food; Exposed to wounded or dying people; Witnessed violence in the local population or mistreatment toward non-combatants; Physically assaulted; Sexually assaulted or raped; Hazed or bullied by unit members; Any other deployment-related event
4. Other lifetime traumatic events[m]: Experienced a life-threatening illness/injury; Physically assaulted; Sexually assaulted or raped; Combined assault (Any physical assault, sexual assault, or rape); Exposed to a natural disaster; Involved in a serious accident; Close friend/relative died; Any other traumatic event; Combined events (Any lifetime traumatic event)
5. Crime[n]: Victim of each of the following crimes in the 12 months & 4 years prior to separation/retirement: Major physical violence; Non-violent offenses; Any criminal offense
6. Chronic stressors[o]: Dimensional scale of 12-month severity of stress in life overall

Abbreviations: US; United States; ADHD, attention deficit-hyperactivity disorder; IED, intermittent explosive disorder; PTSD, post-traumatic stress disorder.

[a]Support for including these variables as potential predictors of suicide attempt and homelessness comes from a number of prior publications[2-18]. 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). 47 of the 130 were administrative variables that we felt could be assessed with self-report survey questions and the remaining 83 were survey variables. See Stanley et al[19] for a list of the ICD-9/10-CM codes[20,21] used to create the relevant ICD-9/10-CM diagnoses group variables, TBI, and pain variables. A larger set of predictors from a separate publication was used in replicating the suicide death risk scores and for calculating the SHAP statistics (Supplementary Table 2). For the full list of predictors see Kennedy et al[22].

[b]Highest education was defined as Less than high school = No secondary school certificate or high school diploma; High school diploma/equivalent = high school diploma, General Educational Development Test (GED) certificate, Army Reserve National Guard Challenge Program, occupational program certificate, home study diploma, etc.; Some college = 1 year of college certificate of equivalency, 1-2 years of college no degree, associate degree, nursing diploma; College graduate or more = Baccalaureate degree, Master's/post-master's degree, doctorate/post-doctorate; highest education of parent was defined as High school diploma/equivalent or less = no education, some elementary school, graduated elementary school, some high school, graduated high school or GED; Some college = Some post high school education without a 4-year college degree; College graduate or more = 4-year college graduate (BA, BS, or equivalent) or Post-graduate education beyond a 4-year college degree.

[c]soldiers were asked how often they usually attend religious services (5=more than once a week, 4=about once a week, 3=2-3 times a month, 2=once a month, 1=less than once a month, 0=never), how religious, and how spiritual they are (3=very, 2=moderately, 1=slightly, 0=not at all). The 3 variables were summed to create a 0-11 continuous Religiosity scale. The Fundamentalism Index (1=yes, 0=no) was based on self-identification as born-again, filled with the Spirit, fundamentalist, evangelical, or part of the Charismatic Movement[23].

[d]The 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[24]. 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)[25,26].

[e]Total months of service includes total time serving as a Regular Active Duty Service member and as a member of the Reserves or National Guard, regardless of activation status.

[f]Met criteria at any survey up to and including the last STARRS survey the soldier took before they separated or retired from the Regular Army, either a baseline STARRS survey or a STARRS-LS survey. The baseline STARRS surveys screened for Diagnostic and Statistical Manual of Mental Disorders (DSM), 4th edition mental disorders while the STARRS-LS surveys screened for DSM 5th edition disorders. In the baseline and STARR-LS surveys, major depression and generalized anxiety were assessed with items from the Composite International Diagnostic Interview-Screening Scales (CIDI-SC)[27] and the World Mental Health-CIDI (WMH-CIDI[23]); the PTSD Checklist[28] was used to screen for PTSD in the baseline STARRS surveys and the PTSD Checklist for DSM-5 (PCL-5)[29] was used in the STARRS-LS surveys; the CIDI-SC and the WMH-CIDI were used to determine probable diagnoses of DSM-IV panic disorder, broad bipolar disorder (i.e., mania, hypomania, subthreshold hypomania), IED, and alcohol/substance use disorders in the baseline surveys; in the STARRS-LS surveys, DSM-5 manic/hypomanic episodes/bipolar I/II disorder, panic disorder, IED, and alcohol/substance use disorders were assessed using questions developed based on DSM-5 criteria[30] and items from the CIDI-SC and the WMH-CIDI; and the Adult Self-Report Scale-V1.1 Screener (ASRS-V1.1[31]) was used to assess 6-month ADHD in the baseline surveys, the LS3, and LS4 survey, while the Adult ADHD Self-Report Screening Scale for DSM-5 (ASRS-5[32]) was used in the LS1 and LS2 surveys. The childhood conduct/oppositional defiant disorder symptom frequency scale was created by summing 12 items for a 0-48 scale. 7 items assessed conduct disorder, taken from the Structured Clinical Interview for DSM-IV Personality Questionnaire (SCID-II[33]) and the remaining 5 were based on items in the WMH-CIDI to assess oppositional defiance.

[g]Endorsed at any survey up to and including the last STARRS survey the soldier took before they separated or retired from the Regular Army, either a baseline STARRS survey or a STARRS-LS survey. Items were adapted from the Columbia-Suicide Severity Rating Scale (C-SSRS[34]) and the Self-Injurious Thoughts and Behaviors Interview (SITBI[35]).

[h]Items were rated on a 0-4 scale; 6 items were included in both the antisocial scale and borderline scale, the anger-irritability scale included 9 items, and 5 were in the resilience scale. See Zuromski et al., 2020[36] for details and sources of items in each scale.

[i]Endorsed a head, neck, or blast injury with loss of consciousness and/or posttraumatic amnesia for 30+ minutes at any survey up to and including the last STARRS survey the soldier took before they separated or retired from the Regular Army, either a baseline STARRS survey or a STARRS-LS survey[37].

[j]Soldiers were asked to rate the severity of their physical pain, on average, over the past 30 days on a 0-10 numeric rating scale where 0=no pain and 10=pain as bad as could be. We took their pain rating from the last survey the soldier took before they separated or retired from the Regular Army[38].

[k]Items were based on questions from other studies[23,39,40]. See[36] for more details.

[l]Deployment-related events that occurred at any survey up to and including the last STARRS survey the soldier took before they separated or retired from the Regular Army, either a baseline STARRS survey or a STARRS-LS survey. Items were based on questions from other studies[37,41-43].

[m]Endorsed at any survey up to and including the last STARRS survey the soldier took before they separated or retired from the Regular Army, either a baseline STARRS survey or a STARRS-LS survey. Items were based on questions from other studies[43,44].

[n]The National Corrections Reporting Program (NCRP)[45] was used to categorize criminal offenses. Major physical violence included murder, homicide, manslaughter, kidnapping, aggravated arson, aggravated assault, family-related aggravated assault, child abuse, and robbery and non-violent criminal offenses included reckless endangerment (e.g., vehicular manslaughter, hit and run driving, driving while intoxicated, Driving Under Influence), burglary, simple arson, forgery, fraud, theft (e.g., auto theft, larceny, embezzlement, stolen property, unauthorized use of vehicle),

property offenses (e.g., destruction of property, trespassing), commercialized vice - illegal substances (e.g., trafficking drugs), commercialized vice – other (e.g., prostitution, gambling, liquor law violation), possession/use/other violation of illegal substance, court-ordered violations (e.g., escape from custody, flight to avoid prosecution, parole violation, contempt of court, offenses against courts, obstruction of law enforcement), weapon offense, minor traffic offense, drunkenness/vagrancy/disorderly conduct, military specific non-violent offenses (e.g., disobey orders, AWOL/desertion/treason), family-related non-violent offenses (e.g., abandonment, domestic disturbance, custody offense), and other non-violent offenses (e.g., bribery, contributing to the delinquency of a minor, immigration violations). Any criminal included the above offenses along with minor physical violence (e.g., simple assault), verbal violence (e.g., blackmail, family-related emotional abuse), and sexual violence (e.g., rape, sexual assault, family-related sexual violence).

[o]Based on the rating of 12-month stress in life overall at the last survey taken before separating or retiring from the Regular Army (either a baseline STARRS survey or a STARRS-LS survey), where 0=no stress, 1=mild, 2=moderate, 3=severe, and 4 = very severe stress[46].

Supplementary Table 2. Algorithms used in the Super Learner ensemble machine learning analysis[a]

Algorithm	Description
I. CV 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: *SuperLearner*[47,48]
II. Learners in the Super Learner library	
A. 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 λ {MPP x Plasso + (1- MPP) X Pridge} \ 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: *glmnet*[49] Hyperparameters: α=(0.1, 0.25, 0.5, 0.75, 0.9)
B. 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: *ranger*[50] Hyperparameters: num.trees = 5000, max.depth = (2,3,4,5), min.node.size = (11,23,30,46,60,121), mtry = (2,3,5,10,14,20)
C. Decision trees – boosting	Extreme Gradient Boosting. A fast and efficient implementation of gradient boosting. R package: *XGBoost*[51] Hyperparameters: ntrees = 5000, max.depth = (2,3,4,5), min.obs.per.node= (11,23,30,46,60,121), shrinkage = (0.001, 0.01, 0.1, 0.2, 0.3), gamma = (0, 0.1, 1, 2, 5), subsample= (0.5, 0.6, 0.7, 0.8), colsample_bytree=(0.5, 0.6, 0.7, 0.8,0.9,1), colsample_bynode=(0.5, 0.6, 0.7, 0.8,0.9,1), early_stopping_rounds=50
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 nonlinear associations but have low interpretability. R package: *nnet*[52] Hyperparameters: size=(1,6,7,10,12,16,27), decay=(0.00000001,0.0000001,0.00001,0.01,0.1)
E. Splines (Adaptive polynomial splines)	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: *polspline*[53].
F. Support Vector Machines	Support vector machines treat independent variables as dimensions in high dimensional space and attempt to identify the best hyperplane (linear, polynomial, radial, or sigmoid kernel) to separate the sample into classes (e.g., cases and non-cases) with maximum distance between classes. R package: *WeightSVM*[54] Hyperparameters: kernel = radial,cost=(1000,10000,1000000,100000000), gamma=(0.00000001,0.000001,0.0001,0.001,0.1,1)

[a]Hyperparameters: Default values were used unless otherwise noted.

Supplementary Table 3. Meta-learner weights in the SuperLearner ensemble

Outcome	Algorithm	Hyperparameters	Number of variables in model	Meta-learner weights SuperLearner model
I. Unemployment			26	0.0299
	I. Elastic net	α=0.25		
		α=0.25	36	0.0407
		α=0.75	26	0.0166
		α=0.75	36	0.0201
		α=0.9	26	0.0200
		α=0.9	36	0.0027
		Subtotal		0.1300
	II. Extremely randomized forest	num.trees=5000, max.depth=2, min.node.size=46, mtry=14	50	0.0136
		num.trees=5000, max.depth=3, min.node.size=11, mtry=3	50	0.0444
		num.trees=5000, max.depth=4, min.node.size=23, mtry=14	50	0.1294
		num.trees=5000, max.depth=5, min.node.size=11, mtry=14	50	0.0043
		num.trees=5000, max.depth=2, min.node.size=46, mtry=10	59	0.0142
		num.trees=5000, max.depth=3, min.node.size=11, mtry=20	59	0.0304
		num.trees=5000, max.depth=4, min.node.size=23, mtry=20	59	0.0591
		num.trees=5000, max.depth=5, min.node.size=46, mtry=10	59	0.0268
		Subtotal		0.3222
	III. Extreme gradient boosting	ntrees=5000, max_depth=2, minobspernode=11, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.7, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0035
		ntrees=5000, max_depth=2, minobspernode=23, shrinkage=0.01, gamma=5, subsample=0.8, colsample_bytree=0.9, colsample_bynode=0.6, early_stopping_rounds=50	59	0.0001
		ntrees=5000, max_depth=2, minobspernode=46, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	25	0.0177
		ntrees=5000, max_depth=2, minobspernode=46, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0049
		ntrees=5000, max_depth=2, minobspernode=46, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	59	0.0054
		ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.8, colsample_bytree=0.5, colsample_bynode=1, early_stopping_rounds=50	59	0.0103
		ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.3, gamma=2, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.7, early_stopping_rounds=50	25	0.0015

	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.3, gamma=2, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.7, early_stopping_rounds=50	59	0.0018
	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.9, early_stopping_rounds=50	59	0.0076
	ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0.1, subsample=0.7, colsample_bytree=1, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0112
	ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0.1, subsample=0.7, colsample_bytree=1, colsample_bynode=0.5, early_stopping_rounds=50	59	0.0029
	ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.3, gamma=5, subsample=0.8, colsample_bytree=1, colsample_bynode=1, early_stopping_rounds=50	59	0.0097
	ntrees=5000, max_depth=5, minobspernode=11, shrinkage=0.2, gamma=1, subsample=0.7, colsample_bytree=0.5, colsample_bynode=0.8, early_stopping_rounds=50	50	0.0093
	ntrees=5000, max_depth=5, minobspernode=11, shrinkage=0.2, gamma=1, subsample=0.7, colsample_bytree=0.5, colsample_bynode=0.8, early_stopping_rounds=50	59	0.0035
	ntrees=5000, max_depth=5, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.8, early_stopping_rounds=50	50	0.0005
	ntrees=5000, max_depth=5, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.8, early_stopping_rounds=50	59	0.0122
	ntrees=5000, max_depth=5, minobspernode=46, shrinkage=0.0001, gamma=2, subsample=0.8, colsample_bytree=0.6, colsample_bynode=0.9, early_stopping_rounds=50	50	0.0178
	ntrees=5000, max_depth=5, minobspernode=46, shrinkage=0.0001, gamma=2, subsample=0.8, colsample_bytree=0.6, colsample_bynode=0.9, early_stopping_rounds=50	59	0.0238
	Subtotal		0.1438
IV. Adaptive polynomial splines	no hyper param	26	0.0059
	no hyper param	36	0.0012
	Subtotal		0.0072
V. Support vector machines	cost=1000,gamma=0.00000001	26	0.0251
	cost=1000,gamma=0.00000001	36	0.0114
	cost=1000000,gamma=0.0001	26	0.0065
	cost=1000000,gamma=0.0001	36	0.0513
	cost=10000,gamma=0.000001	36	0.0071
	cost=10000,gamma=0.000001	36	0.0670
	cost=100000000,gamma=0.1	36	0.0193
	Subtotal		0.1877

II. Homelessness			27	0.0383
	I. Elastic net	α=0.1		
		α=0.1	28	0.0160
		α=0.25	27	0.0878
		α=0.5	27	0.0673
		α=0.75	27	0.0705
		α=0.75	34	0.0490
		α=0.9	27	0.0764
		Subtotal		0.4053
	II. Extremely randomized forest	num.trees=5000, max.depth=4, min.node.size=60, mtry=5	25	0.0045
		num.trees=5000, max.depth=2, min.node.size=121, mtry=14	50	0.0076
		num.trees=5000, max.depth=4, min.node.size=60, mtry=14	50	0.0096
		num.trees=5000, max.depth=5, min.node.size=30, mtry=14	50	0.0074
		num.trees=5000, max.depth=2, min.node.size=121, mtry=10	78	0.0463
		num.trees=5000, max.depth=3, min.node.size=30, mtry=20	78	0.0547
		num.trees=5000, max.depth=4, min.node.size=60, mtry=20	78	0.0661
		num.trees=5000, max.depth=5, min.node.size=121, mtry=10	78	0.0093
		Subtotal		0.2056
	III. Extreme gradient boosting	ntrees=5000, max_depth=2, minobspernode=121, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0062
		ntrees=5000, max_depth=2, minobspernode=121, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	78	0.0020
		Subtotal		0.0082
	IV. Adaptive polynomial splines	No hyper-parameters	27	0.0598
		No hyper-parameters	34	0.0705
		No hyper-parameters	28	0.0528
		Subtotal		0.1831
III. Suicide attempt				
	I. Elastic net	α=0.1	27	0.0464
		α=0.1	34	0.0805
		α=0.25	34	0.0352
		α=0.25	28	0.0290
		α=0.5	34	0.0408
		α=0.9	27	0.0748
		α=0.9	34	0.0261
		α=0.9	28	0.0234

	Subtotal		0.3562
II. Extremely randomized forest	num.trees=5000, max.depth=2, min.node.size=23, mtry=5	25	0.0091
	num.trees=5000, max.depth=3, min.node.size=46, mtry=2	25	0.0350
	num.trees=5000, max.depth=4, min.node.size=23, mtry=5	25	0.0106
	num.trees=5000, max.depth=2, min.node.size=46, mtry=14	50	0.0175
	num.trees=5000, max.depth=5, min.node.size=11, mtry=14	50	0.0048
	num.trees=5000, max.depth=2, min.node.size=46, mtry=10	78	0.0039
	num.trees=5000, max.depth=5, min.node.size=46, mtry=10	78	0.0088
	Subtotal		0.0897
III. Extreme gradient boosting	ntrees=5000, max_depth=2, minobspernode=11, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.7, colsample_bynode=0.5, early_stopping_rounds=50	25	0.0041
	ntrees=5000, max_depth=2, minobspernode=11, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.7, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0033
	ntrees=5000, max_depth=2, minobspernode=11, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.7, colsample_bynode=0.5, early_stopping_rounds=50	78	0.0037
	ntrees=5000, max_depth=2, minobspernode=23, shrinkage=0.01, gamma=5, subsample=0.8, colsample_bytree=0.9, colsample_bynode=0.6, early_stopping_rounds=50	50	0.0005
	ntrees=5000, max_depth=2, minobspernode=23, shrinkage=0.01, gamma=5, subsample=0.8, colsample_bytree=0.9, colsample_bynode=0.6, early_stopping_rounds=50	78	0.0108
	ntrees=5000, max_depth=2, minobspernode=46, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	25	0.0016
	ntrees=5000, max_depth=2, minobspernode=46, shrinkage=0.01, gamma=2, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0001
	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.8, colsample_bytree=0.5, colsample_bynode=1, early_stopping_rounds=50	25	0.0225
	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.8, colsample_bytree=0.5, colsample_bynode=1, early_stopping_rounds=50	50	0.0014
	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.8, colsample_bytree=0.5, colsample_bynode=1, early_stopping_rounds=50	78	0.0100
	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.3, gamma=2, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.7, early_stopping_rounds=50	25	0.0085
	ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.3, gamma=2, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.7, early_stopping_rounds=50	50	0.0022

ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.3, gamma=2, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.7, early_stopping_rounds=50	78	0.0012
ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.9, early_stopping_rounds=50	25	0.0022
ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.9, early_stopping_rounds=50	50	0.0059
ntrees=5000, max_depth=3, minobspernode=23, shrinkage=0.01, gamma=0.1, subsample=0.6, colsample_bytree=0.9, colsample_bynode=0.9, early_stopping_rounds=50	78	0.0074
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0.1, subsample=0.7, colsample_bytree=1, colsample_bynode=0.5, early_stopping_rounds=50	25	0.0020
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0.1, subsample=0.7, colsample_bytree=1, colsample_bynode=0.5, early_stopping_rounds=50	50	0.0298
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0.1, subsample=0.7, colsample_bytree=1, colsample_bynode=0.5, early_stopping_rounds=50	78	0.0018
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0, subsample=0.7, colsample_bytree=0.5, colsample_bynode=0.9, early_stopping_rounds=50	25	0.0389
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.1, gamma=0, subsample=0.7, colsample_bytree=0.5, colsample_bynode=0.9, early_stopping_rounds=50	50	0.0004
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.3, gamma=5, subsample=0.8, colsample_bytree=1, colsample_bynode=1, early_stopping_rounds=50	25	0.0086
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.3, gamma=5, subsample=0.8, colsample_bytree=1, colsample_bynode=1, early_stopping_rounds=50	50	0.0425
ntrees=5000, max_depth=4, minobspernode=23, shrinkage=0.3, gamma=5, subsample=0.8, colsample_bytree=1, colsample_bynode=1, early_stopping_rounds=50	78	0.0015
ntrees=5000, max_depth=5, minobspernode=11, shrinkage=0.2, gamma=1, subsample=0.7, colsample_bytree=0.5, colsample_bynode=0.8, early_stopping_rounds=50	50	0.0052
ntrees=5000, max_depth=5, minobspernode=11, shrinkage=0.2, gamma=1, subsample=0.7, colsample_bytree=0.5, colsample_bynode=0.8, early_stopping_rounds=50	78	0.0044
ntrees=5000, max_depth=5, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.8, early_stopping_rounds=50	50	0.0021
ntrees=5000, max_depth=5, minobspernode=23, shrinkage=0.1, gamma=5, subsample=0.5, colsample_bytree=0.8, colsample_bynode=0.8, early_stopping_rounds=50	78	0.0034

	ntrees=5000, max_depth=5, minobspernode=46, shrinkage=0.0001, gamma=2, subsample=0.8, colsample_bytree=0.6, colsample_bynode=0.9, early_stopping_rounds=50	25	0.0026
	ntrees=5000, max_depth=5, minobspernode=46, shrinkage=0.0001, gamma=2, subsample=0.8, colsample_bytree=0.6, colsample_bynode=0.9, early_stopping_rounds=50	50	0.0039
	ntrees=5000, max_depth=5, minobspernode=46, shrinkage=0.0001, gamma=2, subsample=0.8, colsample_bytree=0.6, colsample_bynode=0.9, early_stopping_rounds=50	78	0.0022
	Subtotal		0.2348
IV. Adaptive polynomial splines	No hyper-parameters	27	0.1279
	No hyper-parameters	34	0.0578
	No hyper-parameters	28	0.0894
	Subtotal		0.2750

Supplementary Table 4. Background characteristics of the analytic samples for post-separation unemployment, homelessness, and suicide attempt

	Unemployment sample						Homelessness sample						Suicide attempt sample					
	Total		UE+		UE-		Total		HL+		HL-		Total		SA+		SA-	
	%	(SE)	%	(SE)	%	(SE)	χ^2	%	(SE)	%	(SE)	%	(SE)	χ^2	%	(SE)	%	(SE)	%	(SE)	χ^2
Age							2.0							36.5*							12.4*
18-21	2.5	(0.3)	3.4	(1.1)	2.3	(0.2)		9.0	(0.6)	15.4	(2.2)	8.8	(0.6)		9.3	(0.6)	19.4	(4.7)	9.2	(0.6)	
22-24	17.5	(1.0)	16.5	(2.3)	17.6	(1.1)		18.9	(0.9)	27.0	(3.1)	18.6	(0.9)		19.2	(1.0)	26.8	(5.3)	19.1	(1.0)	
25-27	16.7	(0.8)	19.4	(2.9)	16.4	(0.9)		18.8	(0.7)	18.9	(3.3)	18.8	(0.7)		18.9	(0.7)	16.2	(3.7)	18.9	(0.7)	
28+	63.4	(1.3)	60.7	(3.4)	63.7	(1.3)		53.3	(1.1)	38.6	(3.4)	53.8	(1.1)		52.7	(1.1)	37.6	(5.7)	52.8	(1.1)	
Sex							0.0							0.0							3.2
Female	15.3	(1.0)	15.1	(2.0)	15.3	(1.1)		15.5	(0.7)	15.2	(1.9)	15.5	(0.7)		15.4	(0.7)	23.4	(5.4)	15.3	(0.7)	
Male	84.7	(1.0)	84.9	(2.0)	84.7	(1.1)		84.5	(0.7)	84.8	(1.9)	84.5	(0.7)		84.6	(0.7)	76.6	(5.4)	84.7	(0.7)	
Race/ethnicity							12.3*							3.5							4.5
Non-Hispanic black	18.6	(1.2)	24.2	(2.6)	18.0	(1.2)		15.9	(0.8)	18.6	(2.2)	15.8	(0.8)		16.0	(0.8)	17.7	(5.1)	16.0	(0.8)	
Non-Hispanic white	62.9	(1.4)	53.8	(3.1)	64.0	(1.4)		66.0	(1.1)	64.8	(3.2)	66.0	(1.1)		66.0	(1.1)	58.2	(5.3)	66.1	(1.1)	
Hispanic	12.1	(0.8)	14.5	(2.5)	11.8	(0.9)		11.8	(0.7)	9.6	(1.7)	11.9	(0.7)		11.6	(0.6)	17.4	(3.5)	11.5	(0.6)	
Other	6.3	(0.6)	7.5	(1.7)	6.2	(0.6)		6.3	(0.6)	7.1	(1.4)	6.3	(0.6)		6.4	(0.6)	6.6	(2.2)	6.4	(0.6)	
Education							4.5							13.4*							31.6*
Less than high school	1.5	(0.2)	2.6	(0.9)	1.4	(0.2)		2.3	(0.2)	2.2	(0.6)	2.3	(0.2)		2.3	(0.2)	1.4	(0.8)	2.3	(0.2)	
High school	65.9	(1.1)	68.4	(3.0)	65.7	(1.3)		70.3	(1.1)	81.5	(2.6)	69.9	(1.1)		70.7	(1.0)	90.6	(2.8)	70.5	(1.0)	
Some college	6.5	(0.5)	7.4	(1.7)	6.4	(0.5)		5.5	(0.4)	3.1	(1.0)	5.6	(0.4)		5.4	(0.4)	0.5	(0.3)	5.5	(0.4)	
College graduate	26.1	(1.1)	21.6	(2.8)	26.6	(1.2)		21.9	(1.0)	13.3	(2.4)	22.2	(1.0)		21.6	(0.9)	7.5	(2.6)	21.8	(0.9)	
Marital status							3.8							4.8							22.1*
Married	67.1	(1.3)	62.5	(3.2)	67.6	(1.4)		60.5	(1.4)	54.2	(3.2)	60.7	(1.4)		60.5	(1.4)	38.0	(4.8)	60.7	(1.4)	
Previously married	6.0	(0.6)	8.4	(1.8)	5.7	(0.6)		5.3	(0.4)	5.7	(1.1)	5.3	(0.4)		5.3	(0.4)	8.5	(3.2)	5.3	(0.4)	
Never married	26.9	(1.2)	29.1	(3.2)	26.6	(1.3)		34.2	(1.4)	40.1	(3.3)	34.0	(1.4)		34.2	(1.4)	53.5	(5.5)	34.0	(1.4)	
Years in service							3.9							42.0*							19.3*
1 or less	0.8	(0.2)	1.5	(0.6)	0.7	(0.2)		9.7	(0.6)	16.2	(2.0)	9.5	(0.6)		10.0	(0.6)	17.4	(3.3)	9.9	(0.6)	
2	2.4	(0.3)	3.4	(1.2)	2.3	(0.3)		5.1	(0.4)	11.0	(3.0)	4.9	(0.4)		5.3	(0.4)	8.8	(3.0)	5.3	(0.4)	
3-4	25.9	(1.1)	24.6	(2.7)	26.0	(1.2)		24.6	(0.8)	30.1	(3.4)	24.4	(0.9)		24.7	(0.8)	36.0	(5.7)	24.6	(0.8)	
5 or more	71.0	(1.2)	70.6	(3.0)	71.0	(1.2)		60.6	(1.0)	42.6	(3.5)	61.2	(1.0)		60.0	(1.0)	37.7	(5.1)	60.2	(1.0)	
Rank							13.1*							57.9*							21.9*
Junior enlisted (E1-E3)	4.7	(0.5)	8.0	(1.6)	4.4	(0.5)		14.4	(0.8)	31.9	(3.3)	13.8	(0.7)		15.1	(0.8)	33.1	(5.0)	14.9	(0.8)	
NCOs (E4-E8)	80.7	(1.0)	82.7	(2.2)	80.5	(1.1)		74.0	(0.8)	63.6	(3.3)	74.4	(0.9)		73.7	(0.8)	62.1	(5.2)	73.8	(0.8)	
Officer (warrant or commissioned)	14.5	(1.0)	9.2	(1.7)	15.1	(1.1)		11.6	(0.8)	4.5	(1.2)	11.8	(0.8)		11.3	(0.7)	4.8	(2.4)	11.3	(0.7)	
Number of combat deployments							1.1							9.1*							9.7*
0	44.4	(1.6)	45.0	(3.8)	44.4	(1.6)		45.8	(1.4)	54.3	(3.4)	45.5	(1.4)		46.0	(1.3)	55.8	(5.7)	45.9	(1.3)	
1	31.3	(1.1)	30.9	(3.2)	31.3	(1.2)		31.8	(1.0)	31.0	(2.7)	31.9	(1.0)		31.8	(1.0)	31.3	(5.4)	31.8	(1.0)	
2	15.9	(0.8)	14.6	(1.8)	16.0	(0.8)		15.8	(0.9)	10.0	(1.7)	16.0	(0.9)		15.6	(0.9)	11.0	(3.6)	15.6	(0.9)	
3+	8.4	(0.6)	9.5	(1.9)	8.3	(0.6)		6.6	(0.6)	4.7	(0.8)	6.6	(0.6)		6.6	(0.5)	2.0	(0.9)	6.6	(0.6)	
Duty-MOS							2.1							6.7							
Direct combat arms	28.7	(1.3)	25.9	(2.8)	29.0	(1.4)		30.3	(1.2)	36.8	(3.4)	30.1	(1.2)		30.4	(1.2)	38.9	(6.1)	30.3	(1.2)	
Indirect combat arms	5.5	(0.6)	4.3	(2.1)	5.7	(0.5)		5.2	(0.6)	5.9	(1.4)	5.2	(0.6)		5.2	(0.6)	8.0	(4.8)	5.2	(0.6)	
Combat support	25.4	(1.2)	28.6	(3.2)	25.0	(1.2)		25.9	(1.0)	24.5	(2.7)	26.0	(1.0)		26.1	(1.0)	20.8	(4.0)	26.1	(1.0)	
Combat service support	40.3	(1.6)	41.2	(3.2)	40.2	(1.7)		38.5	(1.2)	32.8	(3.0)	38.7	(1.2)		38.3	(1.2)	32.2	(5.0)	38.4	(1.2)	
Command							16.8*							12.2							20.0*
FORSCOM	34.2	(1.1)	41.5	(3.5)	33.3	(1.2)		32.8	(1.1)	38.1	(3.1)	32.6	(1.1)		33.1	(1.1)	38.7	(5.4)	33.0	(1.1)	
TRADOC	4.9	(0.6)	5.7	(2.5)	4.8	(0.5)		8.0	(0.8)	9.1	(3.0)	7.9	(0.8)		8.0	(0.8)	10.5	(3.6)	8.0	(0.8)	
Area commands	6.5	(0.5)	10.0	(2.1)	6.1	(0.5)		5.9	(0.5)	8.2	(1.6)	5.8	(0.5)		5.9	(0.5)	9.7	(4.9)	5.8	(0.5)	
Special ops	2.3	(0.4)	2.3	(0.8)	2.3	(0.4)		2.1	(0.4)	1.6	(0.6)	2.1	(0.4)		2.1	(0.3)	0.0	(0.0)	2.1	(0.3)	
MEDCOM	6.6	(0.9)	4.9	(1.1)	6.7	(1.0)		5.4	(0.6)	6.0	(3.3)	5.4	(0.6)		5.4	(0.6)	4.6	(1.5)	5.4	(0.6)	
AMC, unknown	12.3	(1.0)	11.3	(2.5)	12.4	(1.0)		11.7	(0.7)	9.3	(1.8)	11.7	(0.7)		11.5	(0.6)	9.3	(2.5)	11.5	(0.6)	
Guard, Reserve	33.3	(1.0)	24.2	(2.6)	34.4	(1.1)		34.2	(1.0)	27.6	(2.7)	34.4	(1.0)		34.1	(1.0)	27.2	(4.0)	34.2	(1.0)	
(n)	(6,119)		(557)		(5,562)			(18,664)		(606)		(18,058)			(19,641)		(231)		(19,410)		

Abbreviations: %, percent; SE, standard error; SA, suicide attempt; HL, homelessness; UE, unemployed; +, endorsed the outcome; -, did not endorse the outcome; NCOs, Non-commissioned officers; MOS, military occupational specialty; FORSCOM, United States Army Forces Command; TRADOC, United States Army Training and Doctrine Command; MEDCOM, United States Army Medical Command; AMC, United States Army Materiel Command.
*$p<0.05$ based on two-sided chi-square tests

Supplementary Table 5. Top variable importance by category for homelessness, suicide attempt, and multiple-outcome high-risk groups[a,b]

	Overall homelessness		High-risk homelessness only		Overall suicide attempt		High-risk suicide attempt only		High-risk suicide death only		High-risk 2+ outcomes	
	$SHAP_p$ %	Direction[d]	$SHAP_p$ %	Direction[d]	$SHAP_p$[c] %	Direction[d]	$SHAP_p$ %	Direction[d]	$SHAP_p$ %	Direction[d]	$SHAP_p$ %	Direction[d]
I. Socio-demographics	14.3		53.1		13.9		46.8		10.6		14.4	
Married	--		13.6	+	10.3	-	25.4	-	--		6.1	-
1+ biological/stepchild	--		--		5.0	-	--		--		--	
Dating	--		--		2.7	+	13.2	+	3.4	-	3.3	+
# dependents	--		--		--		11.3	-	--		--	
1+ biological child	--		3.4	+	--		7.1	-	--		--	
Engaged	13.7	+	52.3	+	--		5.9	-	--		8.1	+
# parents born in US	11.6	+	6.8	+	--		--		--		5.1	+
II. Army Career	102.9		44.6		25.8		9.4		48.1		39.0	
Months in last Army episode[e]	--		9.2	-	16.2	-	--		--		--	
Years of Army service[f]	--		--		7.4	-	--		--		--	
General discharge[g]	9.2	+	--		4.2	+	--		--		--	
AFQT score[h]	--		--		--		5.3	-	--		--	
Command: Guard or Reserve	--		--		--		3.4	+	10.7	-	--	
Years in Army: 19 or less	5.1	+	--		--		2.3	+	--		--	
Duty MOS[i]	--		--		--		1.7	+	25.4	-	4.8	-
Bad discharge[j]	--		12.8	+	--		--		--		--	
Army rank, 4 category[k]	--		11.3	-	--		--		--		19.0	-
Army rank, 6 category[l]	35.8	-	10.2	-	--		--		--		--	
# months on active duty[m]	14.9	-	--		--				--		--	
Age first joined Army: 17-21	--		8.9	-	--		--		--		--	
Last AFQT score	--		--		--		--		31.9	+	--	
Honorable discharge	--		--		--		--		14.5	-	--	
Age left Army	4.8	-	--		--		--		10.3	+	4.2	-
Months in service[n]	--		--		--		--		--		15.5	-
III. Psychopathological risk factors	75.4		35.4		87.2		80.9		71.3		65.1	
Lifetime suicide attempt			--		26.3	+	21.1	+	9.9	-	8.9	+
Lifetime GAD			--		20.7	+	53.7	+	--		15.6	+
Suicidal ideation dx 4yr[o]			--		16.3	+	--		--		--	
Lifetime panic disorder			9.9	-	15.6	+	30.1	+	--		17.1	+
Depression dx 30d[p]			--		12.3	+	--		--		--	
2+ PCT-D dxs 12m[q]	19.8	+	--		--		--		--		--	
Lifetime suicide ideation	11.0	+	12.0	+	--		--		--		11.2	+
Lifetime broad mania	10.1	+	8.7	+	--		--		--		--	
Inpx major depression dx 4yr[r]	6.2	+	--		--		--		--		--	
Depression dx 12m	5.9	+	--		--		--		--		--	
Lifetime suicide plan	--		11.9	-	--		20.7	+	--		--	
Lifetime IED	--		--		--		9.2	+	--		--	
Lifetime PTSD	--		13.8	+	--		--		--		--	
# outpx alcohol dx visits 4yr[s]	--		--		--		--		30.3	+	--	
Nicotine dependence dx 4yr[t]	--		--		--		--		11.5	+	--	
Outpx alcohol dx 4yr[s]	--		--		--		--		8.8	+	--	
# months w/ polypharmacy[u]	--		--		--		--		8.0	+	--	
Suicide attempt 2yr	--		--		--		--		--		15.1	+
IV. Physical health	4.7		7.9		5.5		3.5		22.4		2.7	
Pain-related txt 12m[v]	--		5.4	+	--		--		--		--	
Outpx pain dx 12m[w]	--		2.7	-	--		--		5.4	-	--	
Musculoskeletal disease dx 12m[x]	--		--		--		--		9.2	-	--	
V. Stressors	61.5		31.9		24.3		25.1		14.8		30.5	

ACEs: Felt hated by family	--		--		20.8	+	24.3	+	9.8	-	14.3	+
# non-violent perpetrations 4yr	--		--		5.1	+	3.0	-	--		--	
ACEs: Insulted by family	20.3	+	--		--		--		3.7	-	7.9	+
ACEs: Bruised by family	14.5	+	11.3	+	--		2.3	-	--		6.5	+
# negative drug tests 12m	11.7	+	4.1	+	--		--		--		--	
# criminal perpetrations 4yr	9.9	+	--		--		--		--		--	
Deployment: Bullied/hazed	4.3	+	11.3	+	--		--		--		5.2	+
Victim of any crime 12m	--		5.4	+	--		--		--		--	

Abbreviations: %, percent; $SHAP_p$, Proportional Shapley Additive Explanations; #, Number of; US, United States; AFQT, Armed Forces Qualification Test; MOS, Military Occupational Specialty; GAD, generalized anxiety disorder; dx, ICD-9/10-CM diagnosis code associated with the outpatient visit/inpatient hospital admission; 4yr, 4 years prior to separation/retirement; 30d, 30 days prior to separation/retirement; PCT-D, The Polytrauma Clinical Triad & Depression; dxs, diagnoses; inpx, inpatient hospital admission with; 12m, 12 months prior to separation/retirement; IED, intermittent explosive disorder; PTSD, post-traumatic stress disorder; outpx, outpatient visit with; w/, with; 2yr, 2 years prior to separation/retirement; txt, treatment; ACEs; adverse childhood experiences.

[a]Person-level data (n=7,188) were used for these analyses.

[b]Top five variables per category are displayed based on proportional SHAP for each outcome. Variables with a proportional SHAP <5% across risk groups were not included in the table.

[c]$SHAP_p$ represents the proportions of the mean absolute SHAP value of the entire model. The mean absolute SHAP value of the entire model is obtained by summing SHAP values at the individual level across all predictors, calculating the absolute value of the sum at the individual level, and then computing the mean of these absolute values. This sum tells us the average effect of model variables in changing the predicted value of any individual in the sample from their observed predicted value to the mean value in the total sample.

[d]Represents the dominant direction of the association between a given predictor and the outcome.

[e]Number of months in last episode of service in the Army prior to separation/retirement. An episode of service was defined as a continuous period of service in the Regular Army. A break in service for at least 2 months indicated 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.

[f]Coded 1 = Less than 1 year, 2 = Less than 1 year to 2 years, 3 = 2 years to 3 years, 4 = 3 years to 4 years, 5 = 4 years to 8 years, 6 = 8 years to 19 years.

[g]Service/discharge characterized as Under Honorable conditions, General.

[h]Coded 0-5, where 0 = 30th percentile or less, 1 = 31-49th percentile, 2 = 50-64th percentile, 3 = 65-92nd percentile, 4 = 93-100th percentile, 5 = Officer no AFQT

[i]4-category job class code: Direct combat arms, Other/indirect Combat Arms, Combat Support, Combat Service Support/Other support.

[j]Service/discharge characterized as Under Other Than Honorable Conditions, Bad conduct, or Dishonorable.

[k]Junior Enlisted (E1-E4), Senior Enlisted (E5-E9), Warrant Officer (WO1-CW5), Commissioned Officer (O1-O10).

[l]Private (E1-E2), Private First Class (E3), Specialist or Corporal (E4), Sergeant (E5-E9), Warrant Officer (WO1-CW5), Lieutenant, Captain, Colonel, or General (O1-O10).

[m]Number of months active includes time spent as a Regular Active Duty Service member, 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.

[n]Number of months of service includes total time serving as a Regular Active Duty Service member and as a member of the Reserves or National Guard, regardless of activation status.

[o]Any outpatient visit or inpatient hospital admission with ICD-9-CM diagnosis code V62.84 or ICD-10-CM diagnosis code R45.851 associated with the visit/admission.

[p]Any outpatient visit or inpatient hospital admission with ICD-9-CM diagnosis codes 296.2X, 296.3X, 296.82, 296.9X, 300.4, 300.5, 309.0, 309.1, 311, 313.1 or ICD-10-CM diagnosis codes F32.XX, F33.XX, F34.1, F34.89, F34.9. F39, F43.21 associated with the visit/admission.

[q]2 or more of the 4 PCT-D diagnoses, which are traumatic brain injury, PTSD, pain, and depression.

[r]Any inpatient hospital admission with ICD-9-CM diagnosis codes 296.2X, 296.3X, 311 or ICD-10-CM diagnosis codes F32.XX, F33.XX associated with the admission.

[s]Any outpatient visit with ICD-9-CM diagnosis codes 291.XX, 303.XX, 305.0X, or ICD-10-CM diagnosis codes F10.10, F10.12X, F10.14, F10.15X, F10.18X, F10.19, F10.2XX, F10.92X, F10.94-F10.99 associated with the visit.

[t]Any outpatient visit or inpatient hospital admission with ICD-9-CM diagnosis codes 305.1 or ICD-10-CM diagnosis codes F17.XXX, Z72.0 associated with the visit/admission.

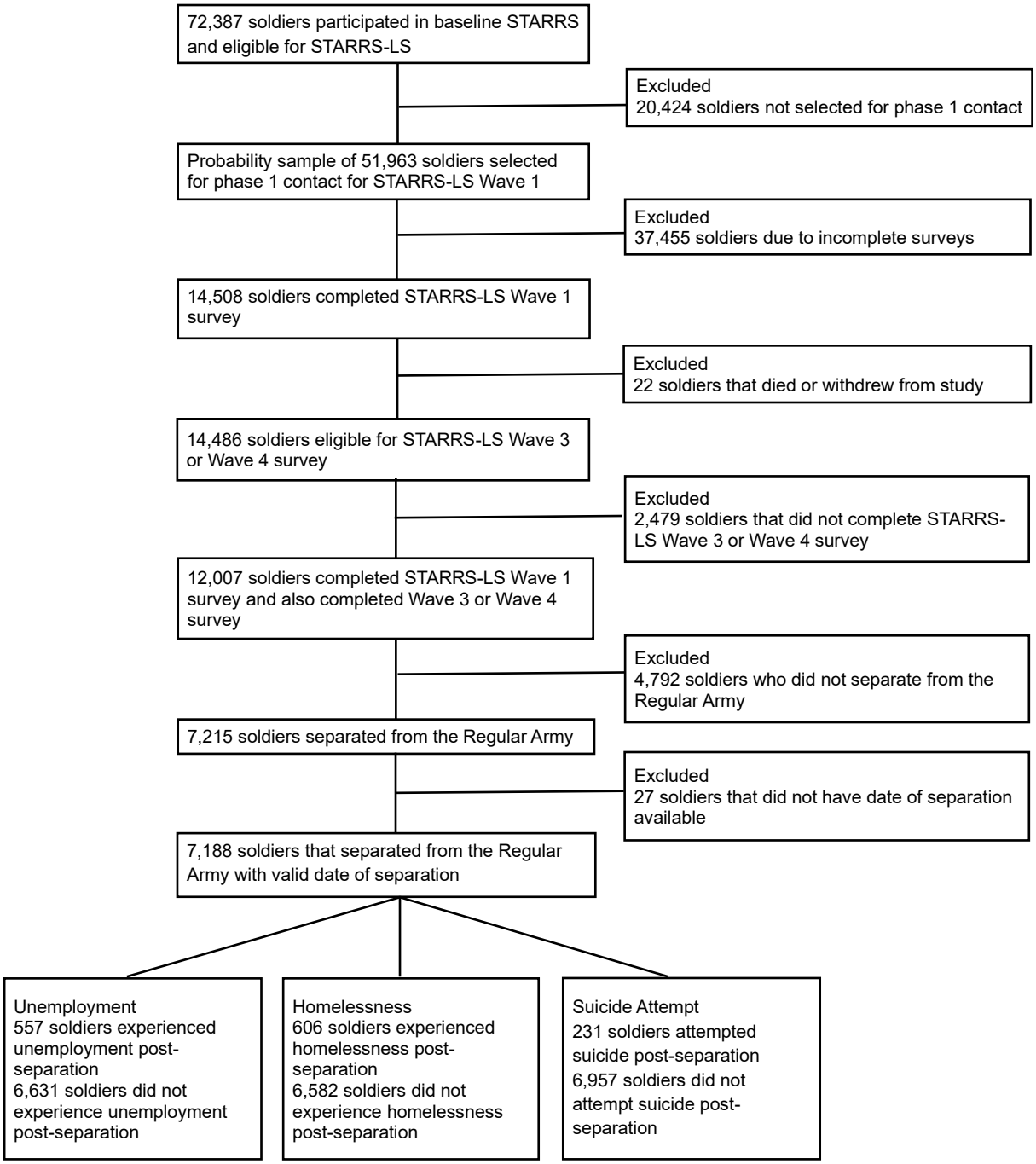
[u]Cumulative count of months since January 2001 with 4+ narcotic or psychotropic medication prescriptions filled in a 3-month period.

[v]Visits for treatment required both a code to indicate the treatment/service performed (i.e., Current Procedural Terminology (CPT) or Healthcare Common Procedure Coding System. (HCPCS) codes) and a diagnosis code to describe why the treatment/service was performed (i.e., ICD-9/10-CM codes).

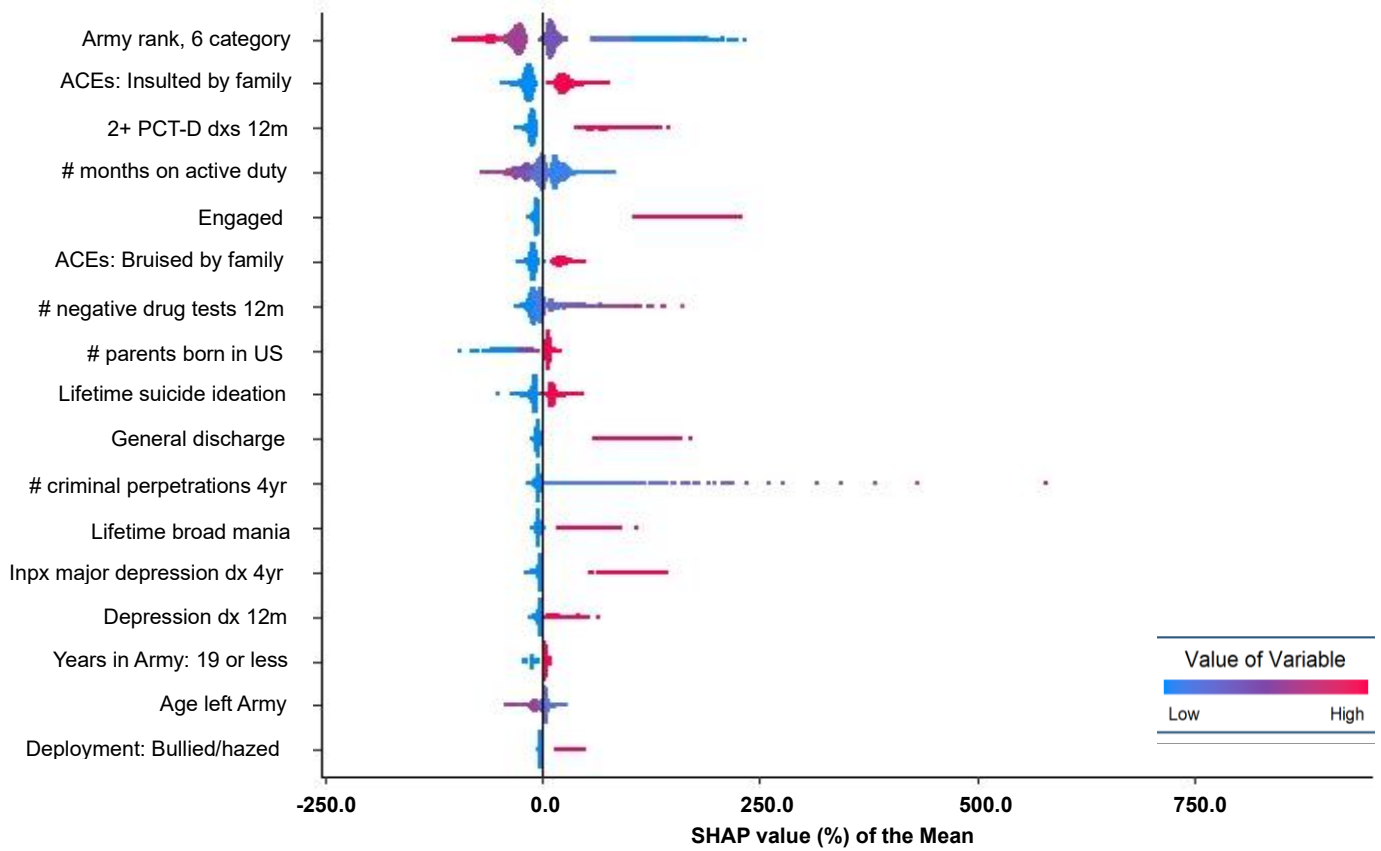
[w]Any outpatient visit with a pain-related ICD-9/10-CM diagnosis code associated with the visit.

[x]Any outpatient visit or inpatient hospital admission with a ICD-9/10-CM "Diseases of the musculoskeletal system and connective tissue" diagnosis code associated with the visit/admission.

Supplementary Figure 1. Participant flow diagram of person-level observations in STARRS-LS unemployment, homelessness, and suicide attempt samples

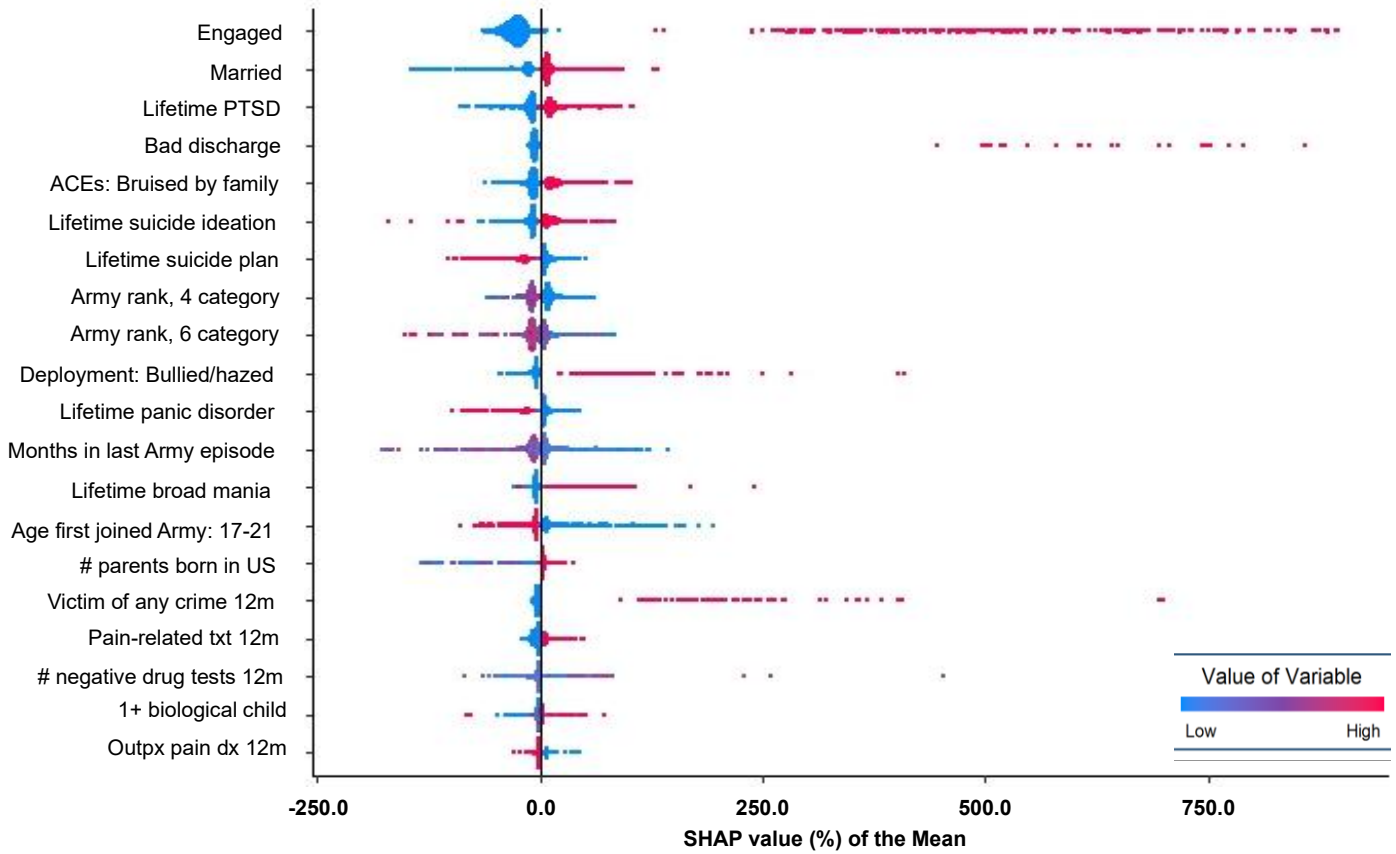


Supplementary Figure 2. Proportional SHAP values for homelessness



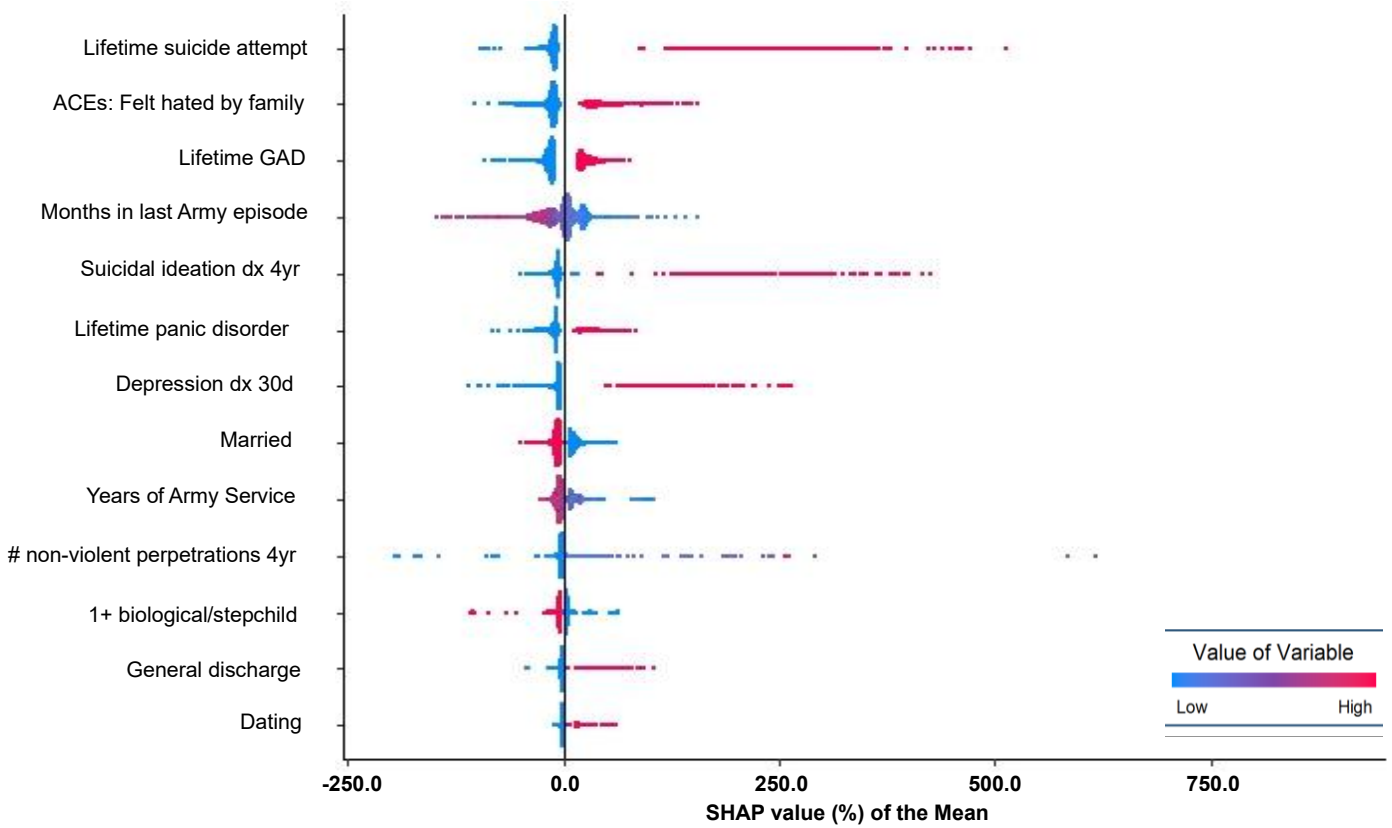
Abbreviations: ACEs; adverse childhood experiences; PCT-D, The Polytrauma Clinical Triad & Depression; dxs, diagnoses; 12m, 12 months prior to separation/retirement; #, number of; US, United States; 4yr, 4 years prior to separation/retirement; inpx, inpatient hospital admission with; dx, diagnosis.

Supplementary Figure 3. Proportional SHAP values for high-risk homelessness only



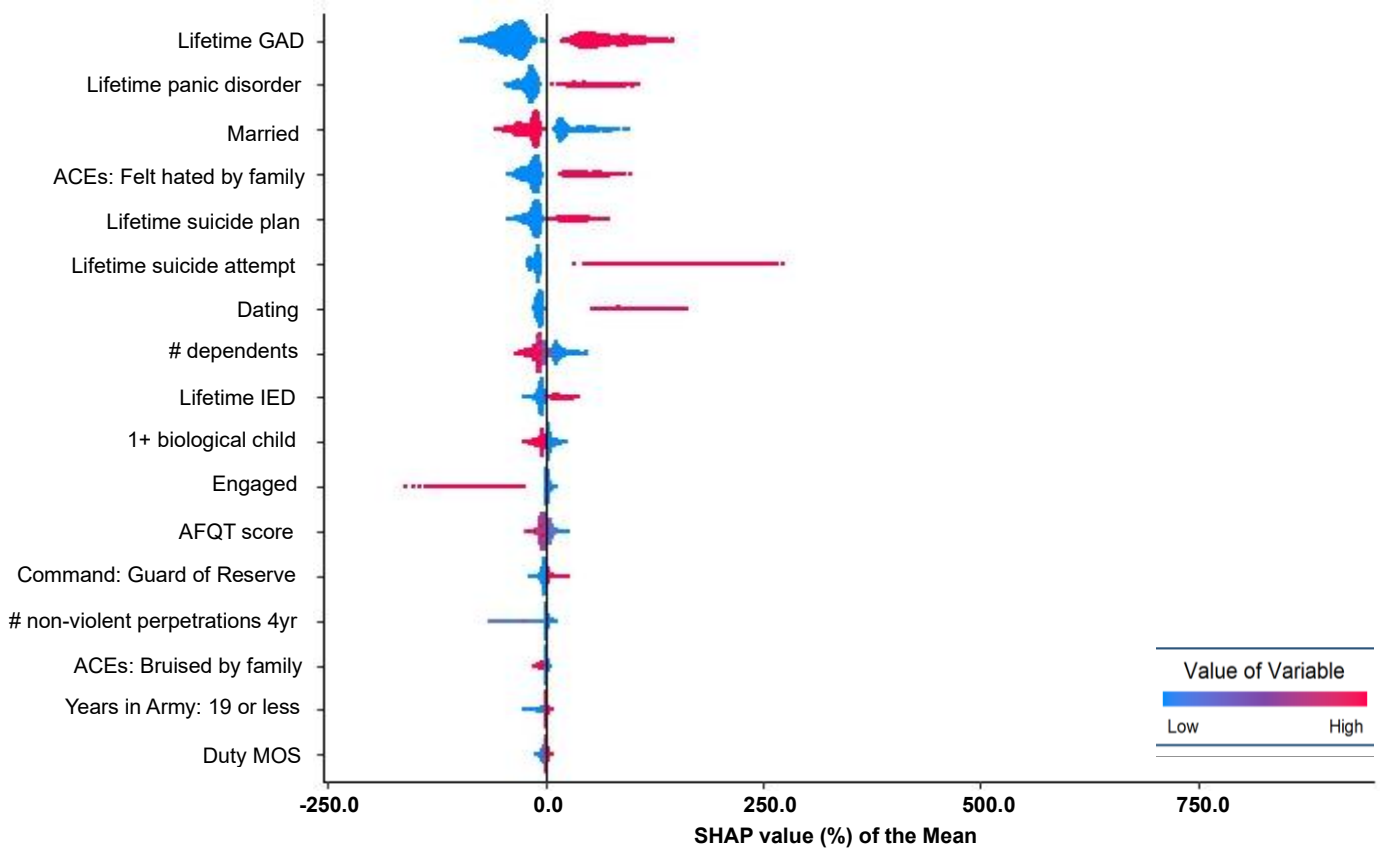
Abbreviations: PTSD, post-traumatic stress disorder; ACEs; adverse childhood experiences; #, number of; US, United States; 12m, 12 months prior to separation/retirement; txt, treatment; outpx, outpatient visit with; dx, diagnosis.

Supplementary Figure 4. Proportional SHAP values for suicide attempt



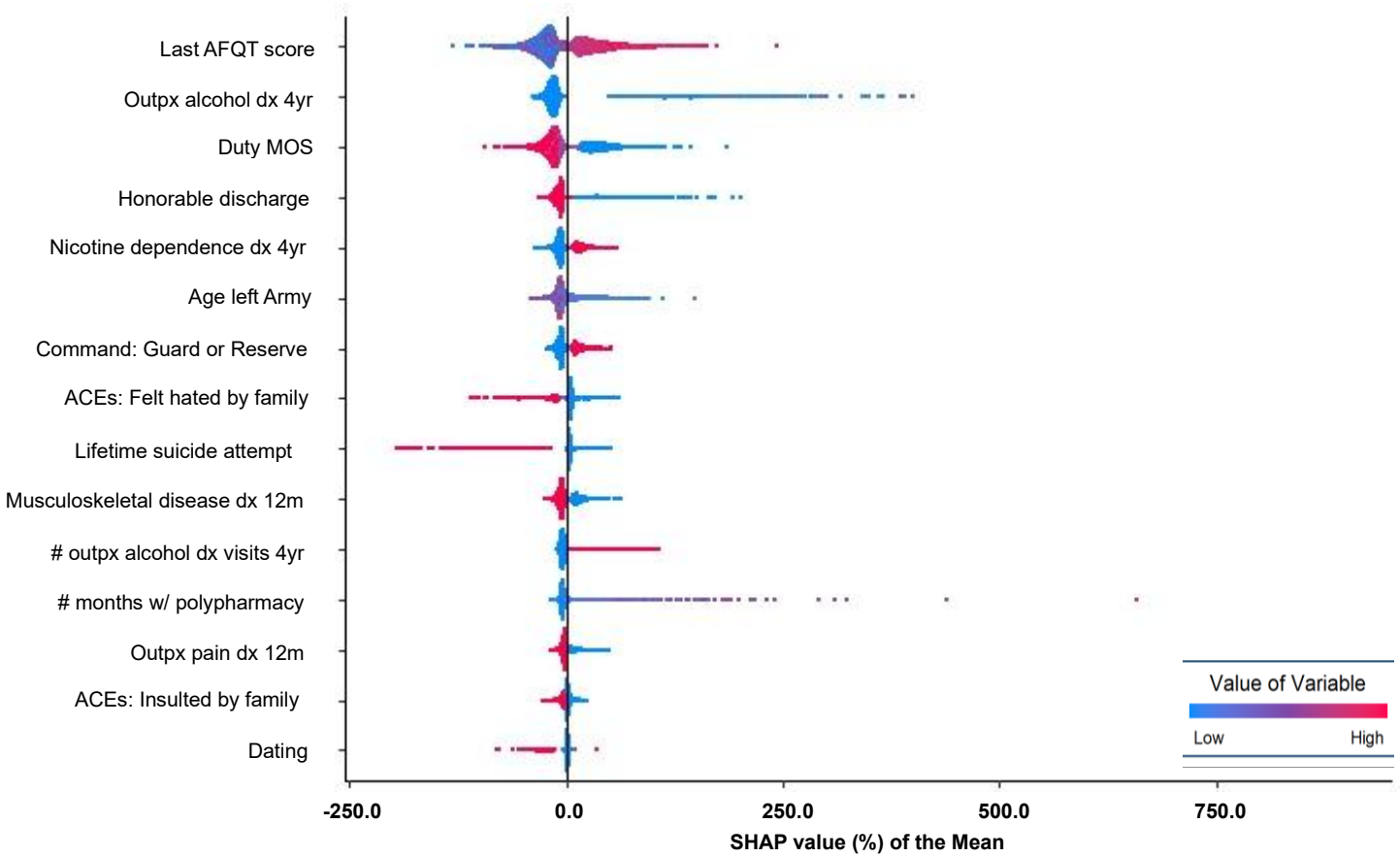
Abbreviations: ACEs; adverse childhood experiences; GAD, generalized anxiety disorder; dx, diagnosis; 4yr, 4 years prior to separation/retirement; 30d, 30 days prior to separation/retirement; #, number of.

Supplementary Figure 5. Proportional SHAP values for high-risk suicide attempt only



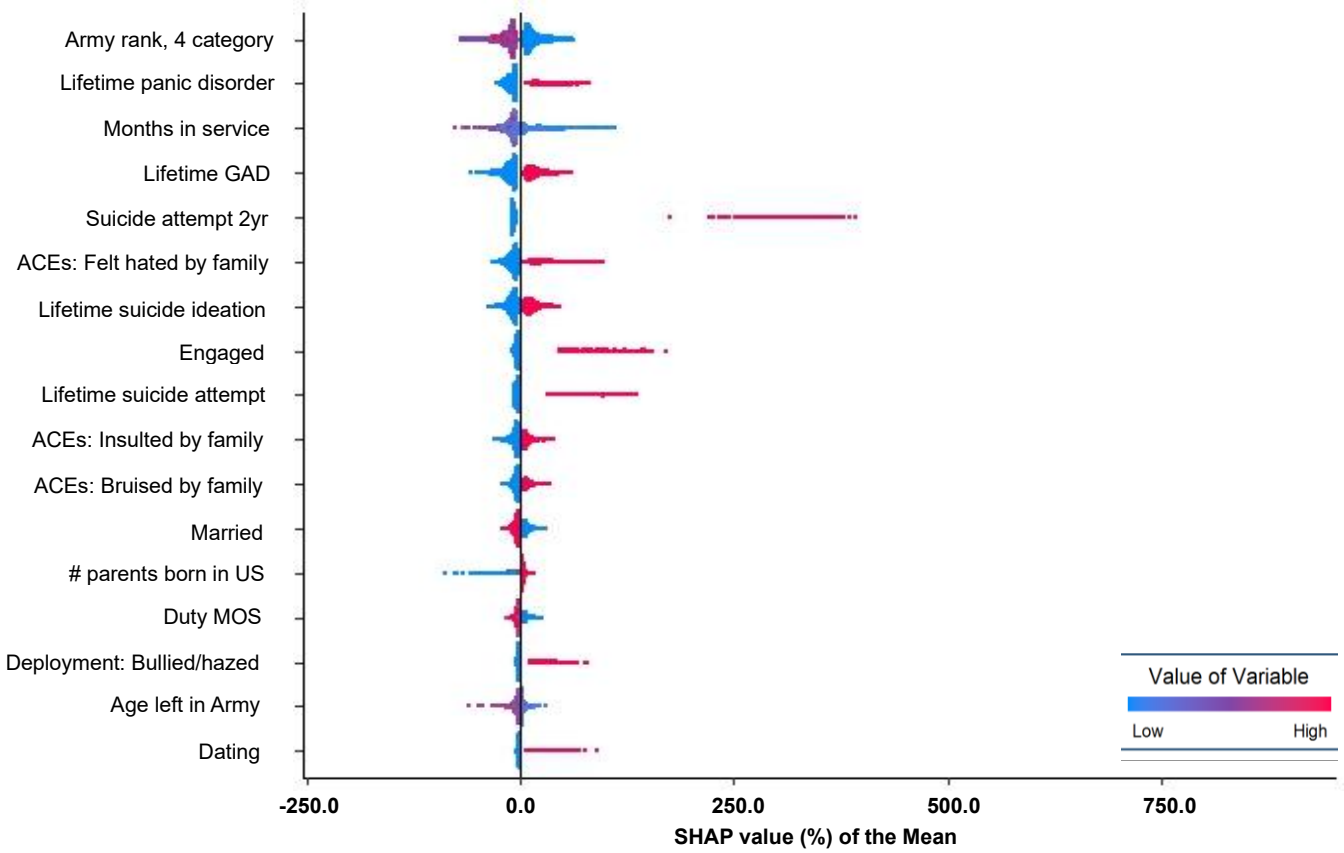
Abbreviations: GAD, generalized anxiety disorder; ACEs, adverse childhood experiences; #, number of; IED, intermittent explosive disorder; AFQT, Armed Forces Qualification Test; yr, year; MOS, Military Occupational Specialty.

Supplementary Figure 6. Proportional SHAP values for high-risk suicide death only



Abbreviations: AFQT, Armed Forces Qualification Test; outpx, outpatient visit with; dx, diagnosis; 4yr, 4 years prior to separation/retirement; MOS, Military Occupational Specialty; ACEs; adverse childhood experiences; 12m, 12 months prior to separation/retirement; #, number of; w/, with.

Supplementary Figure 7. Proportional SHAP values for high-risk for 2+ outcomes



Abbreviations: GAD, generalized anxiety disorder; 2yr, 2 years prior to separation/retirement; ACEs; adverse childhood experiences; #, number of; US, United States; MOS, Military Occupational Specialty.

Supplementary References

1. Lundberg, S., Lee, S.-I., editors. A unified approach to interpreting model predictions. The 31st International Conference on Neural Information Processing Systems (NIPS); Red Hook, NY: (Curran Associates Inc., 2017).
2. Ashrafioun, L., Saulnier, K. G., Allan, N. P., Bishop, T. M. & Stecker, T. Pain intensity trajectories among veterans seeking mental health treatment: Association with mental health symptoms and suicidal thoughts and behaviors. *J. Affect. Disord.* **297**, 586-592 (2022).
3. Berg, J. M., Malte, C. A., Reger, M. A. & Hawkins, E. J. Medical records flag for suicide risk: Predictors and subsequent use of care among veterans with substance use disorders. *Psychiatr. Serv.* **69**, 993-1000 (2018).
4. Borowski, S., Rosellini, A. J., Street, A. E., Gradus, J. L. & Vogt, D. The first year after military service: Predictors of U.S. Veterans' suicidal ideation. *Am. J. Prev. Med.* **63**, 233-241 (2022).
5. Bullman, T., Schneiderman, A. & Bossarte, R. Suicide risk by unit component among veterans who served in Iraq or Afghanistan. *Arch, Suicide Res.* **22**, 1-10 (2018).
6. Gabrielian, S. et al. Factors affecting exits from homelessness among persons with serious mental illness and substance use disorders. *J. Clin. Psychiatry* **76**, e469-476 (2015).
7. Giano, Z. et al. Forty years of research on predictors of homelessness. *Community Ment. Health J.* **56**, 692-709 (2020).

8. Metraux, S., Clegg, L. X., Daigh, J. D., Culhane, D. P. & Kane, V. Risk factors for becoming homeless among a cohort of veterans who served in the era of the Iraq and Afghanistan conflicts. *Am. J. Public Health* **103 Suppl 2**, S255-261 (2013).

9. Nichter, B. et al. Prevalence, correlates, and treatment of suicidal behavior in US Military Veterans: Results from the 2019-2020 National Health and Resilience in Veterans Study. *J. Clin. Psychiatry* **82**, 20m13714 (2021).

10. Nilsson, S. F., Nordentoft, M. & Hjorthøj, C. Individual-level predictors for becoming homeless and exiting homelessness: A systematic review and meta-analysis. *J. Urban Health* **96**, 741-750 (2019).

11. Ramchand, R., Acosta, J., Burns, R. M., Jaycox, L. H. & Pernin, C. G. The war within: Preventing suicide in the U.S. Military. *Rand Health Q.* **1**, 2 (2011).

12. Ravindran, C., Morley, S. W., Stephens, B. M., Stanley, I. H. & Reger, M. A. Association of suicide risk with transition to civilian life among US military service members. *JAMA Netw. Open* **3**, e2016261-e2016261 (2020).

13. Reger, M. A. et al. Risk of suicide among US military service members following operation enduring freedom or operation Iraqi freedom deployment and separation from the US military. *JAMA Psychiatry* **72**, 561-569 (2015).

14. Rubenstein, A. et al. Religion, spirituality, and risk for incident posttraumatic stress disorder, suicidal ideation, and hazardous drinking in U.S. military veterans: A 7-year, nationally representative, prospective cohort study. *J. Affect. Disord.* **295**, 1110-1117 (2021).

15. Ruiz, F., Burgo-Black, L., Hunt, S. C., Miller, M. & Spelman, J. F. A practical review of suicide among veterans: Preventive and proactive measures for health care institutions and providers. *Public Health Rep.* **138**, 223-231 (2022).

16. Stanley, I. H., Rogers, M. L., Hanson, J. E., Gutierrez, P. M. & Joiner, T. E. PTSD symptom clusters and suicide attempts among high-risk military service members: A three-month prospective investigation. *J. Consult. Clin. Psychol.* **87**, 67-78 (2019).

17. Tsai, J. & Rosenheck, R. A. Conduct disorder behaviors, childhood family instability, and childhood abuse as predictors of severity of adult homelessness among American veterans. *Soc. Psychiatry Psychiatr. Epidemiol.* **48**, 477-486 (2013).

18. Tsai, J., Szymkowiak, D. & Pietrzak, R. H. Delayed homelessness after military discharge: Examination of a sleeper effect. *Am. J. Prev. Med.* **59**, 109-117 (2020).

19. Stanley, I. H. et al. Predicting suicide attempts among U.S. Army soldiers after leaving active duty using information available before leaving active duty: Results from the Study to Assess Risk and Resilience in Servicemembers-Longitudinal Study (STARRS-LS). *Mol. Psychiatry* **27**, 1631-1639 (2022).

20. Centers for Disease Control and Prevention. *The International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)*. https://www.cdc.gov/nchs/icd/icd-10-cm.htm (2019).

21. Centers for Disease Control and Prevention. *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*. https://www.cdc.gov/nchs/icd/icd-10-cm/?CDC_AAref_Val=https://www.cdc.gov/nchs/icd/icd-10-cm.htm (2021).

22. Kennedy, C. J. et al. Predicting Suicides Among US Army Soldiers After Leaving Active Service. *JAMA Psychiatry* **81**, 1215-1224 (2024).

23. Kessler, R. C. & Ustün, T. B. The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *Int. J. Methods Psychiatr. Res.* **13**, 93-121 (2004).

24. Association of the United States Army. *Defense Report: Improving Care for Wounded Warriors: Warrior Care and Transition Program (Defense Report 09-1)*. https://www.ausa.org/defense-reports (2025).

25. Reger, M. A. et al. Suicide risk among wounded U.S. service members. *Suicide Life Threat. Behav.* **47**, 242-247 (2017).

26. U.S. Department of the Army. *Army Recovery Care Program: Army Regulation 40-58*. https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN10462_AR40-58_FINAL_WEB.pdf (2020).

27. Kessler, R. C. et al. Clinical reappraisal of the Composite International Diagnostic Interview Screening Scales (CIDI-SC) in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Int. J. Methods Psychiatr. Res.* **22**, 303-321 (2013).

28. Weathers, F.W., Litz, B.T., Herman, D.S., Huska, J.A. & Keane, T.M. The PTSD checklist (PCL): reliability, validity, and diagnostic utility. in *Annual convention of the International Society for Traumatic Stress Studies*, Vol. 462 (San Antonio, TX, 1993).

29. Weathers, F. W. et al. *The PTSD checklist for DSM-5 (PCL-5)*. www.ptsd.va.gov (2013).

30. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-5*. 5 edn, (American Psychiatric Association, 2013).

31. Kessler, R. C. et al. Validity of the World Health Organization Adult ADHD Self-Report Scale (ASRS) Screener in a representative sample of health plan members. *Int. J. Methods Psychiatr. Res.* **16**, 52-65 (2007).

32. Ustun, B. et al. The World Health Organization Adult Attention-Deficit/Hyperactivity Disorder Self-Report Screening Scale for DSM-5. *JAMA Psychiatry* **74**, 520-527 (2017).

33. First, M. B., Gibbon, M., Spitzer, R. L., Williams, J. B., Benjamin, L. S. *Structured Clinical Interview for DSM-IV Personality Questionnaire (SCID-II)*. (American Psychiatric Press, 1997).

34. Posner, K. et al. The Columbia-Suicide Severity Rating Scale: Initial validity and internal consistency findings from three multisite studies with adolescents and adults. *Am. J. Psychiatry* **168**, 1266-1277 (2011).

35. Nock, M. K., Holmberg, E. B., Photos, V. I. & Michel, B. D. Self-Injurious thoughts and behaviors interview: Development, reliability, and validity in an adolescent sample. *Psychol. Assess.* **19**, 309-317 (2007).

36. Zuromski, K. L. et al. Pre-deployment predictors of suicide attempt during and after combat deployment: Results from the Army Study to Assess Risk and Resilience in Servicemembers. *J. Psychiatr. Res.* **121**, 214-221 (2020).

37. Office of the Surgeon General United States Army Medical Command, Office of the Command Surgeon HQ USCENTCOM & Office of the Command Surgeon US Forces Afghanistan (USFOR-A). *The Joint Mental Health Advisory Team 7 (J-MHAT 7) Operation Enduring Freedom (OEF) 2010 Deployment Well-being Survey*. https://armymedicine.health.mil/Reports (2011).

38. Von Korff, M., Ormel, J., Keefe, F. J. & Dworkin, S. F. Grading the severity of chronic pain. *Pain* **50**, 133-149 (1992).

39. Bernstein, D. P. et al. Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse Negl.* **27**, 169-190 (2003).

40. Felitti, V. J. et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am. J. Prev. Med.* **14**, 245-258 (1998).

41. Bray, R. M. et al. *2008 Department of Defense survey of health related behaviors among active duty military personnel: A component of the Defense Lifestyle Assessment Program (DLAP)*. http://prhome.defense.gov/Portals/52/Documents/RFM/Readiness/DDRP/docs/2009.09%202008%20DoD%20Survey%20of%20Health%20Related%20Behaviors%20Among%20Active%20Duty%20Military%20Personnel.pdf (2009).

42. Hoge, C. W. et al. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N. Engl. J. Med.* **351**, 13-22 (2004).

43. Vogt, D., Smith, B. N., King, D. W. & King, L. A. *The Deployment Risk and Resilience Inventory-2 (DRRI-2)*. https://www.ptsd.va.gov/professional/assessment/documents/drri2manual.pdf (2012).

44. Gray, G. C. et al. The millennium cohort study: A 21-year prospective cohort study of 140,000 military personnel. *Mil. Med.* **167**, 483-488 (2002).

45. United States Department of Justice, Office of Justice Programs & Bureau of Justice Statistics. *National Corrections Reporting Program Series*. https://www.icpsr.umich.edu/web/NACJD/search/studies?q=&SERIESFULL_FACET_Q=38%7Cnational%20Corrections%20Reporting%20Program%20(NCRP)%20Series (2024).

46. Kessler, R. C., Hamilton, L., Mickelson, K. D., Walters, E. E. & Zhao, S. in *How Healthy are we? A National Study of Well-Being at Midlife* (eds O. G. Brim, C. D. Ryff, & R. C. Kessler) 227-251 (University of Chicago Press, 2003).

47. Polley, E., LeDell, E., Kennedy, C., Lendle, S. & van der Laan, M. *SuperLearner: super learner prediction [R package]. version 2.0-29*. https://cran.r-project.org/web/packages/SuperLearner/SuperLearner.pdf (2024).

48. van der Laan, M. J., Polley, E. C. & Hubbard, A. E. Super learner. *Stat. Appl. Genet. Mol. Biol.* **6**, Article 25 (2007).

49. Friedman, J., Hastie, T. & Tibshirani, R. Regularization Paths for Generalized Linear Models via Coordinate Descent. *J. Stat. Softw.* **33**, 1-22 (2010).

50. Wright, M. N. & Ziegler, A. ranger: A Fast Implementation of Random Forests for High Dimensional Data in C++ and R. *J. Stat. Softw.* **77**, 1 - 17 (2017).

51. Chen, T. & Guestrin, C. Xgboost: a scalable tree boosting system. in *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining* 785-794 (Association for Computing Machinery, New York, NY, 2016).

52. Venables, W. & Ripley, B. *nnet: Feed-Forward Neural Networks and Multinomial Log-Linear Models v. 7.3-20.* https://CRAN.R-project.org/package=nnet (CRAN, 2025).

53. Kooperberg, C., Moler, C. & Dongarra, J. *polspline: Polynomial Spline Routines v. 1.1.25.* https://CRAN.R-project.org/package=polspline (CRAN, 2024).

54. Xu, T., et al. *WeightSVM: Subject Weighted Support Vector Machines.* https://CRAN.R-project.org/package=WeightSVM (CRAN, 2024).