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Optimism, Sociability, and the Risk of Future Suicide Attempt among U.S. Army Soldiers

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ABSTRACT

Introduction:
Most research on suicide attempts among U.S. service members has been focused on risk factors that occur during service. There is an important gap in our understanding of premilitary factors, such as personality characteristics, that may be associated with future suicide attempt risk during service. Of particular importance is identifying risk factors for the 1/3 of suicide attempters who never receive a mental health diagnosis (MH-Dx)–and therefore are not identified as having a mental health problem in the military healthcare system–prior to their suicide attempt.

Materials and Methods:
Using two components of the Army Study to Assess Risk and Resilience in Servicemembers, we examined the association of personality facets from the Tailored Adaptive Personality Assessment System, a computerized instrument administered prior to entering service, with medically documented suicide attempts during service. A 2010–2016 sample of historical administrative records from U.S. Regular Army enlisted soldiers with complete data on 11 commonly administered Tailored Adaptive Personality Assessment System facets was examined using a series of logistic regression analyses to identify the facets associated with future suicide attempt. Significant facets were then applied to data from a longitudinal cohort study of 11,288 soldiers surveyed upon entering basic combat training and followed via administrative records for their first 48 months of service. This research was approved by the Institutional Review Boards at the collaborating institutions.

Results:
Analysis of the historical administrative data (87.0% male, 61.6% White non-Hispanic), found that low Optimism (odds ratio (OR) = 1.2 [95% CI = 1.0-1.4]) and high/low (vs. moderate) Sociability (OR = 1.3 [95%CI = 1.1-1.6]) were associated with suicide attempt after adjusting for other univariable-significant facets and socio-demographic and service-related variables. When examined in the longitudinal survey cohort, low Optimism (OR = 1.7 [95% CI = 1.1-2.4]) and high/low (vs. moderate) Sociability (OR = 1.7 [95% CI = 1.1-2.5]) were still associated with increased odds of documented suicide attempt during service, even after adjusting for each other, socio-demographic and service-related variables, and medically documented MH-Dx. Mental health diagnosis had a significant two-way interaction with Optimism ($F = 5.27$, $p = 0.0236$) but not Sociability. Stratified analyses indicated that low Optimism was associated with suicide attempt among soldiers without, but not among those with, a MH-Dx. Interactions of Optimism and Sociability with gender were nonsignificant. In the full model, population attributable risk proportions for Optimism and Sociability were 15.0% and 18.9%, respectively. Optimism and Sociability were differentially associated with suicide attempt risk across time in service.

Conclusions:
Optimism and Sociability, assessed prior to entering U.S. Army service, are consistently associated with future suicide attempt during service, even after adjusting for other important risk factors. While Sociability is equally associated

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with suicide attempt among those with and without a MH-Dx, Optimism is specifically associated with suicide attempt among soldiers not identified in the mental healthcare system. Risk differences across time in service suggest that Optimism and Sociability interact with stressors and contextual factors in particular developmental and Army career phases.

INTRODUCTION

Suicidal behavior is a significant public health challenge in the U.S. Army. Suicide and suicide attempt rates increased sharply during the wars in Iraq and Afghanistan and remain elevated nearly two decades later.[1–3] Risk among enlisted soldiers is the highest during the early phase of their careers, particularly in the first two years of service.[4,5] Therefore, it is important to identify pre-enlistment factors associated with increased risk for suicidal behavior during service.[6,7] For example, individual differences in impulsivity, emotion reactivity, and risk-taking measured at Army entry are associated with suicide attempt risk among soldiers in their first four years of service.[7]

The Tailored Adaptive Personality Assessment System (TAPAS), a computerized instrument based on the Big Five personality traits,[8] was developed to inform selection of new recruits and predict success during service.[9] The TAPAS has been evaluated in studies of job performance, attrition, and risk of injury among U.S. Army soldiers.[10,11] It has also been examined as a predictor of mental health diagnosis (MH-Dx) and mental healthcare utilization during service, with findings indicating that soldiers who scored the lowest on the facet assessing physical conditioning had elevated odds of subsequent MH-Dx and healthcare utilization, as well as early attrition from service, relative to those with the highest scores.[12] To our knowledge, there are no published reports examining associations between the TAPAS and suicidal behavior.

The current study used data from the Historical Administrative Data Study (HADS) and New Soldier Study (NSS), two components of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS),[13] to examine TAPAS facets (i.e., personality dimensions) as predictors of subsequent, medically documented suicide attempts among U.S. Army enlisted soldiers. We focus on enlisted soldiers because they account for approximately 99% of U.S Army documented suicide attempts.[5] First, Army and DoD administrative records within the HADS were used to systematically identify TAPAS facets associated with suicide attempts before and after adjusting for socio-demographic and service-related characteristics. Significant facets from the HADS analyses were then examined as multivariable risk factors for future suicide attempts in the NSS, a representative sample of soldiers surveyed during their first week of Army service and followed over time via their Army and DoD administrative records. In the NSS, we also examined interactions of TAPAS facets with gender and MH-Dx to determine whether the associations of the facets with suicide attempt differ for women and men, or for those with and without a MH-Dx. There is no administrative documentation of prior MH-Dx in approximately one-third of soldiers who attempt suicide, suggesting

they were not medically identified as having mental health problems before their attempt.[6,14]

METHODS

Sample

The current study analyzes data from two of the Army STARRS component studies: The HADS and the NSS, both of which were approved by the Institutional Review Boards of the Uniformed Services University of the Health Sciences, University of Michigan Institute for Social Research, University of California–San Diego, and Harvard Medical School.

HADS

The HADS is a longitudinal, retrospective cohort study that integrates 40 Army and DoD administrative data systems, including every system that documents suicidal events.[13] The HADS includes individual-level person-month records for all soldiers who were on active duty at some point from January 1, 2004 through December 31, 2016 ($n \approx 3$ million soldiers). For soldiers who were on active duty during this period but began service prior to 2004, records dated back to January 1, 2000. Person-month records were created by coding each month of a soldier's career separately for each administrative variable and allowing values to change over time.[15] The analytic sample for this study included all 829 Regular Army enlisted soldiers who attempted suicide from 2010–2016 and had complete data on the 11 TAPAS facets considered herein (see below), plus an equal-probability sample of 8,738 control person-months in which a documented suicide attempt did not occur. Data were analyzed using a discrete-time survival framework with person-month as the unit of analysis, such that each month in a soldier's career was treated as a separate observational record.[15] Discrete-time survival coefficients can be estimated without bias when control person-months are randomly subsampled and weighted using the logic of case-control analysis.[16] Therefore, we used a 1:20 case:control ratio to reduce computational intensity, selecting an equal-probability sample of control person-months after stratifying the population by sex, rank, time in service, and deployment status (never, currently, or previously deployed). Each control person-month was assigned a weight of 322 (the inverse probability of selection) to adjust for under-sampling.

NSS

The NSS surveyed a representative sample of U.S. Army soldiers entering service and beginning Basic Combat

Training between April 2011 and November 2012. Soldiers were recruited within 48 hours of reporting for duty and following informed consent completed a computerized self-administered questionnaire (see Supplementary material for additional sample details). Of the 21,772 NSS respondents who were Regular Army enlisted soldiers who completed the self-administered questionnaire and agreed to administrative data linkage (77.1% response rate), 11,288 had complete data on the TAPAS facets considered in this analysis. Data were doubly weighted to adjust for differences in survey responses among the respondents who did vs. did not agree to administrative record linkage and differences in administrative data profiles between the latter subsample and the population of all new soldiers. More details on NSS weighting are reported elsewhere.[17] Respondents were followed via their survey-linked administrative person-month data throughout their time on active duty during their first four years of service (up to 48 months).

Measures

Suicide attempt

Administratively documented, non-fatal suicide attempts were identified using DoD Suicide Event Report[18] records and codes from ICD-9 CM (E950-E958; indicating self-inflicted poisoning or injury with suicidal intent)[19] and ICD-10 CM (X71-X83, indicating intentional self-harm; T36-T65 and T71, where the 5th or 6th character indicates intentional self-harm; and T14.91, indicating suicide attempt, not otherwise specified)[20,21] in data systems that capture healthcare encounter information from military and civilian treatment facilities, combat operations, and aeromedical evacuations (Supplementary material Table SI).

Socio-demographic, service-related, and MH-Dx variables

Administrative personnel records (Supplementary material Table SI) were used to identify socio-demographic (gender, race, age, education, and marital status) and service-related (rank and deployment status [never deployed, currently deployed, and previously deployed]) characteristics. Using administrative medical records, an indicator variable for MH-Dx received during Army service was created based on ICD-9 CM and ICD-10 CM mental health diagnostic codes and mental health-related V-codes and Z-codes (e.g., stressors/adversities, marital problems) (Supplementary material Table SII).

TAPAS facets

The TAPAS is an item-response theory-based computerized personality assessment instrument.[9] It utilizes a multidimensional pairwise preference format in which respondents are repeatedly presented with a pair of independent self-descriptors and must choose (i.e., forced-choice) the statement that is most like him/her. The statements, which correspond to different personality dimensions, are computer-selected and paired from a large pool of potential items based on the respondent's previous choices. The large item pool and adaptive and tailored nature of the assessment help ensure that each test is unique. Paired statements are matched for social desirability and worded such that there is no obvious best/worst response. The various psychometric and design features of the TAPAS are intended to make it resistant to faking and other types of test compromise.[9] For the current study, we identified and focused on a subset of TAPAS facets that were most consistently and recently administered, as they were completed by the largest number of soldiers and their use was expected to continue. Those 11 facets include: Achievement ("High scoring individuals are seen as hard working, ambitious, confident, and resourceful."); Adjustment ("High scoring individuals are well adjusted, worry free, and handle stress well."); Attention Seeking ("High scoring individuals tend to engage in behaviors that attract social attention. They are loud, loquacious, entertaining, and even boastful."); Dominance ("High scoring individuals are domineering, 'take charge' and are often referred to by their peers as 'natural leaders.'"); Even Tempered (High scoring individuals tend to be calm and stable. They don't often exhibit anger, hostility, or aggression."); Intellectual Efficiency ("High scoring individuals believe they process information and make decisions quickly; they see themselves (and they may be perceived by others) as knowledgeable, astute, or intellectual."); Non-Delinquency ("High scoring individuals tend to comply with rules, customs, norms, and expectations, and they tend not to challenge authority."); Optimism ("High scoring individuals have a positive outlook on life and tend to experience joy and a sense of well-being."); Order ("High scoring individuals tend to organize tasks and activities and desire to maintain neat and clean surroundings."); Physical Conditioning ("High scoring individuals tend to engage in activities to maintain their physical fitness and are more likely participate in vigorous sports or exercise."); and Sociability ("High scoring individuals tend to seek out and initiate social interactions.").[9] These facets are some of the TAPAS dimensions underlying four of the Big Five personality factors, including Conscientiousness (Achievement, Order, and Non-Delinquency), Emotional Stability/Neuroticism (Adjustment, Even Tempered and, Optimism), Openness (Intellectual Efficiency), and Extraversion (Attention Seeking, Dominance, and Sociability). The Physical Conditioning facet was developed as a "Military Specific" dimension and does not map onto one of the Big Five factors. The Big Five factor of Agreeableness was not represented by any of the 11 facets we selected. Raw facet scores are converted to standardized z-scores with a mean of 0 and standard deviation of 1. Scores were rounded to the nearest whole number to create variables with five categories (−2, −1, 0, 1, and 2).

Analysis Methods

Analyses were conducted using SAS version 9.4.[22] In both the HADS and NSS samples, we began by dichotomizing each TAPAS facet based on the functional form of its association with suicide attempt risk.

Person-month data in the HADS were analyzed using discrete-time survival analysis with a logistic link function.[15] Associations between TAPAS facets and first documented suicide attempt were examined in a series of logistic regression analyses. First, the univariable association of each facet was examined in a separate univariable model. All facets that were significant at the univariable level were then examined simultaneously in a multivariable model that also adjusted for socio-demographic and service-related variables. All logistic regression models using HADS data included a dummy predictor for calendar month and year to control for secular trends.

In the NSS, we considered only those TAPAS facets that were significant in the final multivariable model of the HADS analyses. The association of each facet with suicide attempt during the first four years of Army service was examined before and after adjusting for the other facets, socio-demographic variables, service-related variables, and MH-Dx. The two-way interactions of each facet with gender and MH-Dx were examined separately in models that adjusted for the main effects of the facets and the other covariates. Significant interactions were explored by stratifying the sample and examining the facets as multivariable predictors within each stratum. In addition, population-attributable risk proportions (PARPs)[23] were calculated for significant TAPAS facets. All models using the NSS data accounted for changes in suicide attempt risk across time in service using splines (piecewise linear functions) identified in previous analyses of the NSS cohort.[6]

For both the HADS and NSS analyses, logistic regression coefficients and confidence limits were exponentiated to obtain estimated odds ratios (ORs) and 95% confidence intervals (CIs). For the NSS, which is a complex survey design, standard errors were estimated using the Taylor series method[24] to adjust for the weighting and clustering of the NSS data. Multivariable significance tests in the logistic regression analyses were made using Wald χ^2 tests for HADS analyses and F-tests (adjusted for design effects using the Taylor series method) for NSS analyses. Statistical significance was evaluated using two-sided design-based tests and the 0.05 level of significance.

In order to examine patterns of suicide attempt risk as function of TAPAS facet score and time in service, we used discrete-time survival models to estimate risk (suicide attempters per 100,000 person-months) during each month of service for soldiers with different facet scores. Due to the small number of monthly suicide attempts, monthly risk estimates were averaged to create yearly estimates.

RESULTS

Associations of TAPAS Facets with Suicide Attempt in the HADS

The HADS sample was mostly male (87.0%), White Non-Hispanic (61.6%), 20 years-old or younger (51.8%), high school educated (77.5%), not married (82.6%), E3-E4 rank (70.9%), and never deployed (68.6%) (see Supplementary material Table SIII in the Supplement for more details).

In dichotomizing facet scores based on their functional form, most of the 11 facets received a single cut point indicating high vs. low. The three exceptions to this included Sociability, which had a U-shaped functional form (high/low vs. moderate), and Achievement and Order, which were left as five-level variables ranging from 2 to −2.

Examined separately in univariable models that adjusted only for historical time, 6 of the 11 facets were associated with subsequent suicide attempt: Adjustment, Dominance, Intellectual Efficiency, Optimism, Physical Conditioning, and Sociability. When those six facets were examined together in a model that also adjusted for socio-demographic and service-related variables, Optimism and Sociability remained significant, with increased odds of suicide attempt associated with low Optimism (OR = 1.2 [95% CI = 1.0-1.4]) and high/low (vs. moderate) Sociability (OR = 1.3 [95% CI = 1.1-1.6]) (Table I).

Associations of TAPAS Facets with Suicide Attempt in the NSS

Weighted person-months in the NSS cohort were from soldiers who were mostly male (87.5%), White Non-Hispanic (59.5%), age 21 or older (74.3%), had an educational level of high school diploma or higher (91.4%), not married (61.8%), rank E3 or above (81.0%), and never deployed (73.3%) (Table II).

Guided by the HADS results, we examined associations of Optimism and Sociability with future suicide attempt (n = 124 cases) in the NSS cohort. We first dichotomized the facet scores based on their functional form, the results of which were similar to the HADS: Optimism was categorized as high vs. low, and Sociability was categorized based on a U-shaped functional form (high/low vs. moderate). When examined separately in univariable models that adjusted only for time in service, both facets were associated with suicide attempt. Soldiers scoring either low on Optimism (OR = 1.8 [95% CI = 1.2-2.7]) or high/low (vs. moderate) on Sociability (OR = 1.6 [95% CI = 1.1-2.4]) had increased odds of a future suicide attempt during the first 48 months of service. These associations persisted, mostly unattenuated, when both facets were included together in models that also adjusted for socio-demographic variables, service-related variables, and documented MH-Dx (Table III). There was a signifi-

TABLE I. Associations of TAPAS Facets with Documented Suicide Attempts among Regular Army Enlisted Soldiers from the Army STARRS HADS[a]

TAPAS facet	Univariable[b]		TAPAS facets entered simultaneously and adjusted for socio-demographics and service-related variables[c]	
	OR	(95% CI)	OR	(95% CI)
Achievement				
2	1.0	(0.8–143)		
1	1.1	(0.9–1.3)		
0	1.0	–		
−1	1.1	(0.9–1.3)		
−2	0.9	(0.7–1.3)		
χ^2_4		1.7 ($P = 0.7962$)		
Adjustment				
High (2, 1, 0)	1.0	–	1.0	–
Low (−2, −1)	1.2*	(1.1–1.4)	1.1	(1.0–1.3)
χ^2_1		7.8* ($P = 0.0052$)		2.1 ($P = 0.1428$)
Attention Seeking				
High (2)	1.2	(0.9–1.5)		
Low (−2, −1, 0, 1)	1.0	–		
χ^2_1		1.3 ($P = 0.2482$)		
Dominance				
High (2, 1, 0)	1.0	–	1.0	–
Low (−2, −1)	1.3*	(1.1–1.5)	1.1	(1.0–1.3)
χ^2_1		12.7* ($P = .0004$)		2.6 ($P = .1043$)
Even Tempered				
High (2)	1.2	(0.9–1.5)		
Low (−2, −1, 0, 1)	1.0	–		
χ^2_1		1.4 ($P = .2340$)		
Intellectual Efficiency				
High (2, 1)	1.0	–	1.0	–
Low (−2, −1, 0)	1.2*	(1.1–1.4)	1.0	(0.9–1.2)
χ^2_1		7.6* ($P = .0057$)		0.3 ($P = .6161$)
Non-Delinquency				
High (2, 1)	1.1	(1.0–1.3)		
Low (−2, −1, 0)	1.0	–		
χ^2_1		3.7 ($P = .0548$)		
Optimism				
High (2, 1, 0)	1.0	–	1.0	–
Low (−2, −1)	1.3*	(1.1–1.5)	1.2*	(1.0–1.4)
χ^2_1		9.9* ($P = .0017$)		5.1* ($P = .0242$)
Order				
2	1.1	(0.8–1.5)		
1	0.8*	(0.7–1.0)		
0	1.0	–		
−1	0.9	(0.8–1.1)		
−2	0.8	(0.6–1.1)		
χ^2_4		6.4 ($P = .1681$)		
Physical Conditioning				
High (2, 1, 0)	1.0	–	1.0	–
Low (−2, −1)	1.2*	(1.1–1.4)	1.0	(0.9–1.2)
χ^2_1		7.5* ($P = .0062$)		0.3 ($P = .6058$)
Sociability				
High/Low (−2, 2)	1.3*	(1.1–1.6)	1.3*	(1.1–1.6)
Moderate (−1, 0, 1)	1.0	–	1.0	–
χ^2_1		8.4* ($P = .0037$)		8.0* ($P = .0048$)

[a]This sample of Regular Army enlisted soldiers who were on active duty at some point during 2010–2016 and had complete data on the 11 TAPAS facets considered in this study ($n = 829$ cases, 8,738 unweighted control person-months) is a subset of the total Army STARRS HADS. All control person-months were assigned a weight of 322 to adjust for under-sampling. All models included a dummy predictor variable for calendar month and year to control for secular trends.

[b]Adjusted only for historical time (using a dummy predictor variable for calendar month and year).

[c]Adjusted for socio-demographic variables (gender, race/ethnicity, education, and marital status), service-related variables (rank and deployment status), and historical time (using a dummy predictor variable for calendar month and year).

TAPAS = Tailored Adaptive Personality Assessment System.

*$P < .05$.

TABLE II. Distribution of Socio-demographic, Service-related, and Mental Health Diagnosis Variables among Regular Army Enlisted Soldiers from the Army STARRS NSS with Complete Data on the TAPAS Facets of Optimism and Sociability[a]

	Suicide attempt cases		Total	
	Unweighted person-months (N)	Weighted %	Unweighted Person-months (N)	Weighted %
Gender				
Female	31	23.7	53,211	12.5
Male	93	76.3	382,489	87.5
Race/ethnicity				
White Non-Hispanic	75	56.2	273,802	59.5
Other	49	43.8	161,898	40.5
Current Age (years)				
≤ 20	39	35.3	108,223	25.7
≥ 21	85	64.7	327,477	74.3
Education				
< High school[b]	19	12.7	33,995	8.6
≥ High school	105	87.3	401,705	91.4
Marital status				
Not married	74	59.9	273,359	61.8
Currently married	50	40.1	162,341	38.2
Rank				
E1–E3	84	70.5	214,123	49.4
≥ E4	40	29.5	221,577	50.6
Deployment				
Never deployed	95	73.6	321,520	73.3
Currently deployed	5	5.5	34,722	8.2
Previously deployed	24	20.9	79,458	18.5
Mental health diagnosis				
Yes	81	65.0	88,136	20.5
No	43	35.0	347,564	79.5
Total	124	100	435,700	100

[a]The survey respondents considered here ($n = 11,288$) were Regular Army enlisted soldiers who consented to administrative data linkage and had scores on the TAPAS facets of Optimism and Sociability.

[b]< High School includes: General Educational Development credential (GED), home study diploma, occupational program certificate, correspondence school diploma, high school certificate of attendance, adult education diploma, and other non-traditional high school credentials.

TAPAS = Tailored Adaptive Personality Assessment System.

cant two-way interaction of MH-Dx by Optimism ($F = 5.27$, $P = .0236$), but not Sociability. Stratifying by MH-Dx and adjusting for Sociability and all other covariates revealed that Optimism was significantly associated with suicide attempt among soldiers without (OR = 3.3 [95% CI = 1.7-6.4]), but not with (OR = 1.1 [95% CI = 0.7-1.9]) a MH-Dx. The two-way interactions of gender by Optimism and Sociability were nonsignificant.

PARPs in the NSS

Based on the full multivariable model that included Optimism, Sociability, MH-Dx, and socio-demographic and service-related variables, the PARPs for Optimism and Sociability were 15.0% and 18.9%, respectively.

Suicide Attempt Risk as a Function of TAPAS Facet and Time in Service in the NSS

Using discrete-time survival models, we estimated the risk of suicide attempt by time since entering service for soldiers who score high vs. low on Optimism and high/low vs. moderate on Sociability. Due to the limited number of suicide

attempt cases, risk estimates were averaged over two-year intervals. Risk was higher among soldiers with low vs. high Optimism during the 1st and 2nd years of service ($t = 3.3$, $P = .0013$; 744 vs. 344 per 100,000 person-years) but did not differ during the 3rd and 4th years ($t = 0.8$, $P = .4329$; 363 vs. 284 per 100,000 person-years). In contrast, risk was higher for those with high/low (vs. moderate) Sociability during the 3rd and 4th years of service ($t = 2.4$, $P = .0197$; 456 vs. 221 per 100,000 person-years) but did not differ during the 1st and 2nd years ($t = 1.3$, $P = .1833$; 544 vs. 386 per 100,000 person-years) (Figure 1).

DISCUSSION

Using data from two Army STARRS components, the current study found that the TAPAS facets of Optimism and Sociability, assessed prior to the start of Army service, were associated with future risk of a medically documented suicide attempt during service. Specifically, soldiers with low Optimism or either higher or low (vs. moderate) Sociability were more likely than others to attempt suicide during service. These associations were first identified in the Army STARRS

TABLE III. Associations of TAPAS Facets with Documented Suicide Attempts among a Cohort of Regular Army Enlisted Soldiers from the Army STARRS NSS with Complete Data on the TAPAS Facets of Optimism and Sociability[a]

TAPAS facet	Univariable[b]		TAPAS facets entered simultaneously and adjusted for socio-demographics and service-related variables[c]		TAPAS facets entered simultaneously and adjusted for socio-demographics, service-related variables, and mental health diagnosis[d]	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Optimism						
High (2, 1, 0)	1.0	–	1.0	–	1.0	–
Low (−2, −1)	1.8*	(1.2–2.7)	1.7*	(1.2–2.6)	1.7*	(1.1–2.4)
$F_{1,108}$	9.7* (P = .0023)		7.8* (P = .0061)		6.7* (P = .0113)	
Sociability						
High/Low (2, −1, −2)	1.6*	(1.1–2.4)	1.6*	(1.0–2.3)	1.7*	(1.1–2.5)
Moderate (1, 0)	1.0	–	1.0	–	1.0	–
$F_{1,108}$	6.0* (P = .0156)		4.8* (P = .0305)		6.4* (P = .0131)	

[a]The survey respondents considered here ($n = 11,288$) were Regular Army enlisted soldiers who consented to administrative data linkage and had scores on the TAPAS facets of Optimism and Sociability.

[b]Adjusted only for time in service (spline variables).

[c]Adjusted for time in service (spline variables), socio-demographic variables (gender, race/ethnicity, education, and marital status), and service-related variables (rank and deployment status).

[d]Adjusted for time in service (spline variables), socio-demographic variables (gender, race/ethnicity, education, and marital status), service-related variables (rank and deployment status), and administratively documented mental health diagnosis.

TAPAS = Tailored Adaptive Personality Assessment System.

*$P < .05$.

HADS, and then confirmed in the NSS survey cohort. Interactions indicated that Optimism was associated with suicide attempt only among soldiers who had never received a MH-Dx, whereas Sociability was associated with suicide attempt in both those with and those without a MH-Dx. The findings add to recent studies highlighting the potential importance of premilitary factors in identifying soldiers at increased risk of attempting suicide during Army service, including those who have not been identified as having mental health problems by the military healthcare system.[6,7] PARP analyses indicated that 15.0-18.9% of suicide attempts could be prevented if the risk associated with low Optimism or high/low Sociability could be reduced to that of their respective reference groups (i.e., high Optimism and moderate Sociability), based on the assumption that Optimism and Sociability are causal factors in attempted suicide. We also found that the risk associated with Optimism and Sociability varied across time in service, suggesting that the phase of one's Army career may provide important context for understanding the relation between these personality dimensions and suicide attempt. Given that TAPAS data are currently collected by the Army prior to the start of service, it can aid in identifying opportunities for early education and training that may modify the trajectories of at-risk soldiers.

The finding that low Optimism was associated with future suicide attempts among soldiers contributes to the small body of literature identifying the direct and indirect association of Optimism with suicidal thoughts and behaviors.[25] It is also generally consistent with research on the increased suicide risk associated with hopelessness,[26] which, by definition, is inversely related to Optimism. Low Optimism has been linked to a broad range of negative mental and physical health outcomes.[27,28] It also has been suggested that higher Optimism improves social connectedness,[27] an important consideration given the well-established roles of interpersonal stressors and support in suicide risk.[29]–[31]

We found an interesting bimodal association between Sociability and suicide attempt, with soldiers at both the low and high ends of Sociability at increased risk relative to those in the middle. The elevated risk associated with low Sociability is not particularly surprising. Low Sociability may diminish social connectedness, leading to low levels of social support and increased loneliness, factors associated with adverse mental health outcomes.[32,33] More novel is our finding that high Sociability also increased suicide attempt risk. The reasons for this are not yet known, but it may be that very high Sociability—a strong tendency to seek out and initiate social interactions—is related to having a large number of acquaintances at the expense of more reliable and emotionally supportive interpersonal interactions that can help mitigate distress. Some mental disorders associated with over-sociability or expansiveness (e.g., mania, narcissistic personality disorder, and histrionic personality disorder)[34] are noted for similar lack of enduring and mutual social relatedness. Additional research is needed to replicate this finding and identify the mechanism(s) through which high levels of Sociability may be associated with increased suicide attempt risk.

Importantly, we found that the suicide attempt risk associated with Optimism and Sociability varied as a function
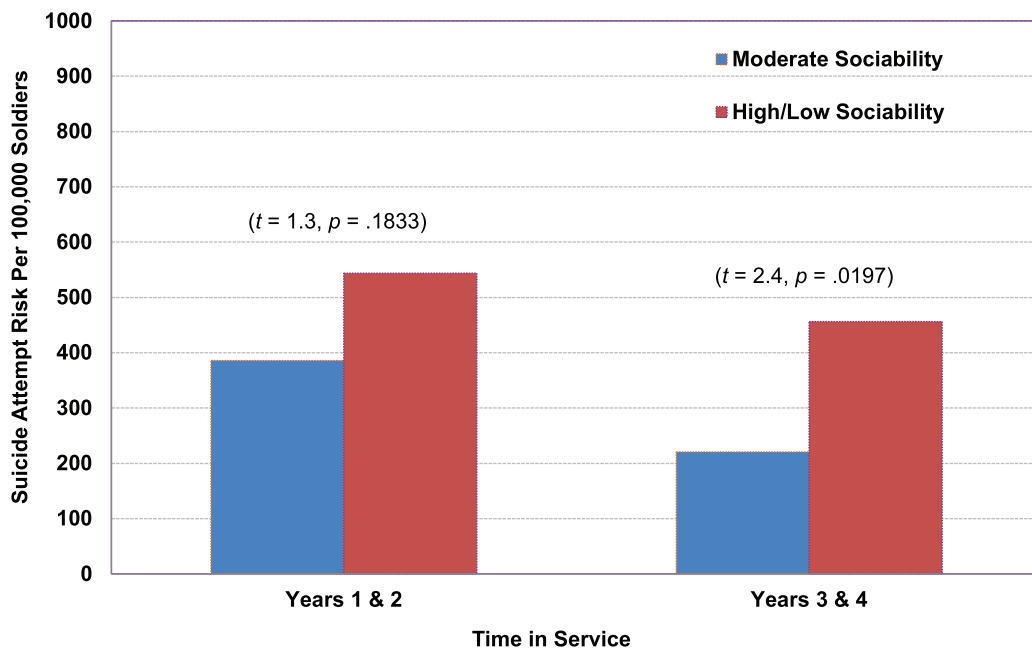
a. Optimism
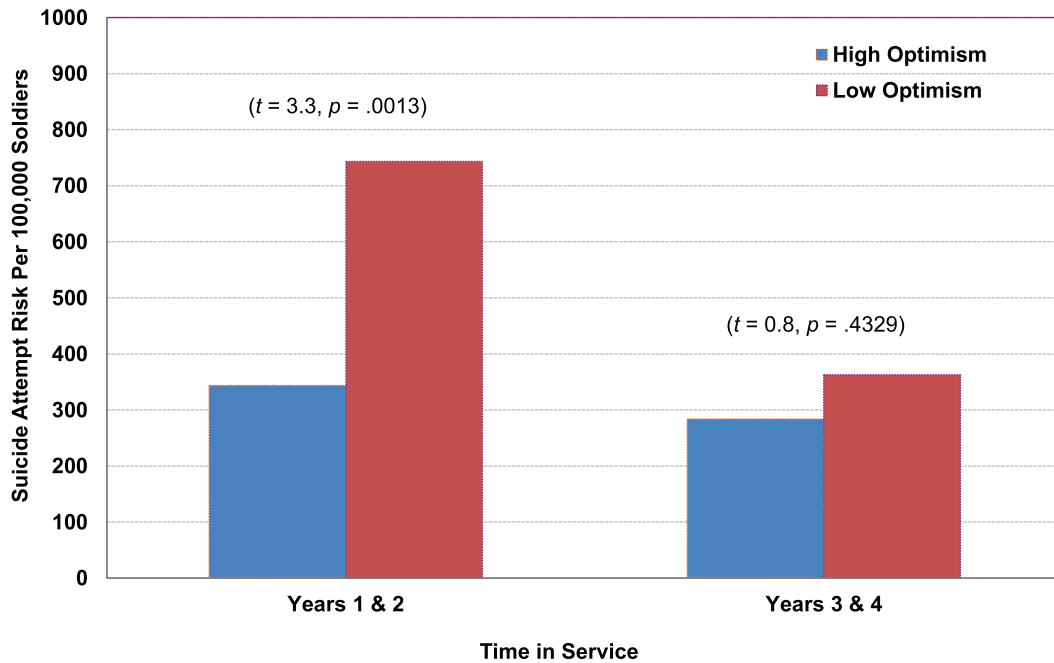
b. Sociability

Figure 1. a. Risk of suicide attempt as a function of the TAPAS Optimism facet and time in service in the Army STARRS NSS. b. Risk of suicide attempt as a function of the TAPAS Sociability facet and time in service in the Army STARRS NSS.

of time in service. While low Optimism was associated with increased risk only among soldiers in their 1st or 2nd year of service, high/low Sociability was associated with elevated risk only among those in their 3rd or 4th year. This variation suggests that Optimism and Sociability may interact with the stressors and contextual factors of particular developmental and Army career phases to increase risk of suicide attempt. Additional research is needed to

identify the specific developmental and environmental circumstances (e.g., related to training, career, or deployment) under which soldiers with low Optimism or high/low Sociability experience heightened suicide attempt risk. Such information can assist in developing and targeting appropriate interventions.

As a source of pre-military assessment data, the TAPAS provides opportunities for early education and training, either before the start of service, such as in the Army's recently established Future Soldier Preparatory Course[35] directed at readying individuals for service, or shortly after the start of service, such as in the Air Force's Wingman-Connect program[36,37] directed at establishing connectedness to improve support and reduce risk of adverse outcomes. The development of early career interventions that are effective at increasing Optimism[38] and strengthening cohesion and social support[39] may help reduce the risk of future suicide attempt during service.

Our finding that Optimism and Sociability were important risk indicators in the prospective NSS survey sample (in addition to the HADS) suggests that assessments conducted at the start of service offer unique opportunities to intervene early and to expand understanding of factors that modify the associations of those facets with future suicide attempt during service. Specifically, the NSS survey allows for examination of self-reported premilitary experiences that are not captured in Army and DoD administrative records.[6,7] Such modifiers could be assessed prior to the start of service to identify subgroups of soldiers who may be at particularly high suicide attempt risk should their TAPAS indicate low Optimism or high/low Sociability. Identification of these subgroups can allow for more targeted interventions.

A valuable aspect of the TAPAS is that, through its design, it ostensibly avoids some of the problems with traditional self-report assessments, such as faking.[9] This is particularly important in a military population where perceptions of stigma and/or concerns about negative career impact may limit willingness to endorse questions about characteristics that may be perceived as negative.[40] It is unknown whether we would have found the same results with more face valid assessments of Optimism and Sociability. However, it is also important to consider that the TAPAS-based assessments of Optimism and Sociability may not capture all dimensions of those constructs. There is a need to further understand the various dimensions of Optimism and Sociability and their associations with suicide attempt risk across time in service.

This study has several limitations: First, administrative data may be incomplete and/or inaccurate. Medical records are unlikely to capture all suicide attempts and mental disorders, and they are subject to errors in clinician diagnosis and coding. Second, our analysis focused on a subset of TAPAS facets that appeared to be the most consistently and recently administered. It is possible that some of the less commonly administered facets we omitted are also associated with suicide attempt risk. Third, the NSS analyses were limited to Regular Army enlisted soldiers who were in their first four years of service during the study period and therefore may not generalize to other service members.

CONCLUSIONS

Our findings indicate that the personality dimensions of Optimism and Sociability, as assessed by the TAPAS prior to the start of Army service, are associated with risk of future suicide attempt among soldiers, including among those never previously identified by the healthcare system as having mental health problems. More research is needed to understand the U-shaped relationship between Sociability and suicide attempt risk, particularly the role of high Sociability. Variation in risk across time in service suggests that Optimism and Sociability interact with the stressors and developmental factors of certain Army career phases. Consistent with other recent studies,[6,7] these findings highlight the potential value of assessing suicide-related risk factors prior to the start military service, providing opportunities for early intervention programs that may modify the trajectories of at-risk soldiers.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

CLINICAL TRIAL REGISTRATION

Not applicable.

INSTITUTIONAL REVIEW BOARD (HUMAN SUBJECTS)

This study analyzes data from two components of the Army STARRS: the Historical Administrative Data Study (HADS) and the New Soldier Study (NSS), both of which were approved by the Institutional Review Boards (IRBs) of the Uniformed Services University of the Health Sciences, University of Michigan Institute for Social Research, University of California–San Diego, and Harvard Medical School. These IRBs determined that analysis of the HADS did not constitute human participant research because it relies entirely on de-identified secondary data.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC)

Not applicable.

CONFLICT OF INTEREST STATEMENT

In the past 3 years, Dr. Kessler was a consultant for Datastat, Inc., Holmusk, RallyPoint Networks, Inc., and Sage Therapeutics. He has stock options in Mirah, PYM, and Roga Sciences. In the past 3 years, Dr. Stein received consulting income from Actelion, Acadia Pharmaceuticals, Aptinyx, atai Life Sciences, Boehringer Ingelheim, Bionomics, BioXcel Therapeutics, Clexio, EmpowerPharm, Engrail Therapeutics, GW Pharmaceuticals, Janssen, Jazz Pharmaceuticals, and Roche/Genentech. Dr. Stein has stock options in Oxeia Biopharmaceuticals and EpiVario. He is paid for his editorial work on Depression and Anxiety (Editor-in-Chief), Biological Psychiatry (Deputy Editor), and UpToDate (Co-Editor-in-Chief for Psychiatry). All other authors have no disclosures.

INDIVIDUAL AUTHOR CONTRIBUTION STATEMENT

R.J.U., M.B.S., and R.C.K. obtained funding. J.A.N., R.J.U., M.B.S., P.A.A., C.S.F., N.A.S., and R.C.K. contributed to acquisition of the data. J.A.N., R.J.U., P.A.A., T.C.K., and R.C.K. were involved in statistical analysis of the data. J.A.N., R.J.U., M.B.S., H.B.H.M., P.A.A., C.S.F., R.S., T.C.K., N.A.S., and R.C.K. assisted in the interpretation of study findings. J.A.N. and R.J.U. drafted the manuscript. J.A.N., R.J.U., M.B.S., H.B.H.M., P.A.A., C.S.F., R.S., T.C.K., N.A.S., and R.C.K. contributed to revision of the manuscript.

DATA AVAILABILITY

For information on data availability, please contact the Uniformed Services University of the Health Sciences Institutional Review Board, 4301 Jones Bridge Road, Bethesda, MD 20,814.

INSTITUTIONAL CLEARANCE

Institutional clearance approved.

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