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Posttraumatic stress symptom courses in U.S. military veterans: A seven-year, nationally representative, prospective cohort study

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ABSTRACT

The current study examined the nature and correlates of seven-year posttraumatic stress disorder (PTSD) symptom courses in a nationally representative, prospective cohort of U.S. military veterans. Data were analyzed from 2,307 trauma-exposed veterans who completed at least one follow-up assessment over a 7-year period, a subsample of n = 3,157 veterans who participated in the first wave of the National Health and Resilience in Veterans Study. Latent growth mixture modeling (LGMM) was used to identify PTSD symptom courses over four survey waves conducted in 2011, 2013, 2015, and 2018. Sociodemographic, health, and psychosocial variables were examined as potential correlates of symptomatic trajectories. PTSD symptoms were best characterized by three courses: No/Low (89.2%), Moderate Symptom (7.6%), and High Symptom (3.2%). Relative to the No/Low Symptom course, symptomatic courses were positively associated with a greater number of lifetime traumatic events, higher scores on measures of physical health difficulties and lifetime psychiatric history (relative risk ratio [RRR] range = 1.19–2.74), and were negatively associated with time since index trauma, household income, and social connectedness (RRR range = 0.14–0.97). Veterans in the Moderate Symptom course additionally had lower scores on a measure of protective psychosocial characteristics (RRR = 0.78) and were more likely to have received mental health treatment (RRR = 1.62), while those in the High PTSD Symptom course were more likely to be exposed to combat and to more traumas since Wave 1 (RRR range = 1.23–4.63). Three PTSD symptom courses in U.S. veterans were identified, with more than 10% of veterans exhibiting a moderate or high symptom course. Prevention and treatment efforts targeting modifiable correlates, such as social connectedness, may help mitigate symptomatic PTSD symptom courses in this population.

1. Introduction

Posttraumatic stress disorder (PTSD) affects 6–8% of civilian and military populations (Goldstein et al., 2016; Kilpatrick et al., 2013; Smith et al., 2016; Wisco et al., 2016), and is associated with negative mental and physical health sequelae (Pacella et al., 2013; Ramchand et al., 2015). Although there is a growing body of literature examining the longitudinal course of PTSD symptoms (Santiago et al., 2013), the majority of previous studies have analyzed data from convenience or clinical samples (Eid, 2003; Orcutt et al., 2004), or individuals exposed to specific traumatic events (e.g., Cukor et al., 2011). Population-based research on the nature and determinants of PTSD symptoms is limited, and this research is particularly scarce among military veterans. U.S. veterans are older, on average, than the general population, presenting unique clinical considerations (Cook and Simiola, 2017). Further necessitating study of this population is that PTSD symptoms among US veterans are highly prevalent and chronic in nature relative to civilian populations (Thomas et al., 2010). While existing studies have focused on PTSD symptom courses following deployment or combat, the majority of U.S. veterans (> 60%) have never been exposed to combat (Thomas et al., 2017). Characterization of factors contributing to predominant PTSD symptom courses in population-based samples of veterans exposed to a diverse range of potentially traumatic events, which is typical of nationally representative samples comprised of both combat and non-combat-exposed veterans, is thus critical to informing targeted prevention and treatment efforts in this large segment of the

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population.

In studies of PTSD symptom trajectories in military service member and veteran samples, three to six trajectories have typically been identified; these often include variations of resistant/resilient, recovering, worsening, delayed onset, and chronic symptom trajectories (e.g., Bonanno et al., 2012; Dickstein et al., 2010; Donoho et al., 2017; Karstoft et al., 2015; Magruder et al., 2016; Palmer et al., 2019; Polusny et al., 2017; Porter et al., 2017). However, few of these studies have examined nationally representative military samples. While prospective studies of veteran cohorts have identified predominantly resilient or low-symptom courses, a significant minority of veterans continue to have persistent mental and physical health problems for years following service (e.g., Corry et al., 2016; Marmar et al., 2015).

To date, few studies have examined correlates of PTSD symptom courses in population-based samples of military servicemembers and veterans. In a prospective cohort of U.S. military personnel deployed in support of operations in Iraq and Afghanistan, greater trauma exposure (e.g., combat experiences), heavy drinking, and characteristics of military service (e.g., branch, pay grade) were risk factors for symptomatic PTSD trajectories (Bonanno et al., 2012), while combat exposure was also a strong predictor of symptomatic trajectories in another study of deployed U.S. military personnel (Donoho et al., 2017). Younger age, exposure to childhood adversity, alcohol misuse, more time since military service, antisocial behavior, and being in a combat role were associated with symptomatic trajectories in a sample of UK military personnel (Palmer et al., 2019). Additionally, worse familial relationships, more mental health service use, less life satisfaction, and non-specific health complaints were risk factors for severe PTSD symptoms in Vietnam era veterans followed over a 14 year period (Koenen et al., 2003). High combat exposure and more depression and anger also predicted a more chronic course of PTSD in this cohort. Finally, among participants ages 55 years and older in the National Health and Resilience in Veterans Study (NHRVS), greater self-reported cognitive difficulties at baseline were found to independently predict late-life, clinically significant exacerbation of PTSD symptoms decades following trauma exposure (Mota et al., 2016). Other studies in military servicemembers and veterans have identified similar predictors (e.g., Andersen et al., 2014; Dickstein et al., 2010; Fink et al., 2017; Polusny et al., 2017), with a few studies also highlighting the possible roles of neuroticism (Andersen et al., 2014; Polusny et al., 2017), internal locus of control (Karstoft et al., 2015), and certain coping styles (Karstoft et al., 2015) as predictors of symptomatic trajectories. Taken together, results of these studies suggest that combat exposure, baseline psychiatric symptoms, and a history of reduced physical and mental well-being are robust determinants of symptomatic PTSD courses in military personnel and veterans.

Although risk factors associated with PTSD symptom courses have received some attention, factors that may reduce the likelihood of long-term PTSD symptoms remain largely understudied. Available data indicate that community involvement at baseline is associated with a decreased risk of PTSD among Vietnam veterans (Koenen et al., 2003), whereas lower levels of unit cohesion and family social support are associated with a higher risk of PTSD (Wright et al., 2013). Preparedness was also associated with a lower likelihood of being in a new-onset PTSD symptom trajectory relative to a resilient trajectory (Polusny et al., 2017). In the NHRVS, engagement in altruistic behaviors, and higher scores on measures of protective psychosocial characteristics, such as purpose in life, were associated with resilience to PTSD and related symptoms in U.S. veterans (Isaacs et al., 2017). Characterization of factors that buffer against persistent symptoms of PTSD is critical, as it could help identify modifiable targets for prevention and treatment interventions for PTSD thereby reducing suffering among veterans.

The aims of the current study were two-fold: 1) To determine the predominant courses of ongoing PTSD symptoms over seven years in a contemporary, nationally representative cohort of U.S. military veterans exposed to a heterogeneous range of potentially traumatic events across the lifespan; and, 2) To examine the sociodemographic, psychosocial, and clinical risk and protective correlates associated with these symptom courses. Based on prior work (e.g., Bonanno et al., 2012; Magruder et al., 2016), we hypothesized that we would identify four symptom courses (No/Low, High, Increasing, and Decreasing), and that although most veterans would consistently display Low/No PTSD symptoms, there would be a significant proportion revealing persistently high symptoms. We further expected that trauma exposure, psychiatric history, and social support would be associated with symptomatic courses.

2. Methods

2.1. Participants and procedure

The NHRVS sample was drawn from KnowledgePanel®, a probability-based, online survey panel maintained by GfK Knowledge Networks, Inc. (Menlo Park, California), which includes over 50,000 households representing approximately 98% of the U.S. adult population. In total, n = 4,750 veterans were sampled for the NHRVS; of these, 3,408 (71.7%) answered a screening question regarding their military status, 3,188 (93.95%) of these confirmed that they had been on active duty in the past (but not currently), and 3,157 (92.6%) participated in the survey. Wave 1 of the NHRVS was completed in 2011 by 3,157 veterans. A total of 2,157 veterans (68.3% of the Wave 1 cohort) completed Wave 2 in 2013, 1,538 veterans (48.7% of the Wave 1 cohort and 71.3% of the Wave 2 cohort) completed Wave 3 in 2015 and 1,310 veterans (41.5% of the Wave 1 cohort and 85.2% of the Wave 3 cohort) completed Wave 4 in 2018. The procedure included veterans completing an anonymous, 60-min online survey.

The effective sample for the current study included 2,307 trauma-exposed veterans who provided data on PTSD symptoms at baseline and at least one of the follow-up assessments; veterans completed a median of 2 follow-up assessments (mean = 2.2, SD = 0.8) over the 7-year study period. Veterans provided informed consent prior to participation, and the VA Connecticut Health Care System Human Subjects Subcommittee approved this study.

2.2. Assessments

PTSD Symptoms. The PTSD Checklist-Specific (PCL-S; Weathers et al., 1993) was used to assess past-month PTSD symptoms according to the Diagnostic and Statistical Manual for Mental Disorders-IV (DSM-IV; American Psychiatric Association, 2000) in Wave 1 of the NRHVS (17 items, range 17–85, $\alpha = 0.95$). The PTSD Checklist-5 (PCL-5; Weathers et al., 2013) was used to assess past-month PTSD symptoms (20 items, range 0–80) according to DSM-5 (American Psychiatric Association, 2013) in Waves 2 ($\alpha = 0.96$), 3 ($\alpha = 0.95$), and 4 ($\alpha = 0.95$). All symptoms were rated in response to veterans' self-reported 'worst' traumatic event (Carlson et al., 2011), and total scores were standardized at each time-point for analyses.

Independent Variables. The *Trauma History Screen* (THS; Carlson et al., 2011) is a self-report measure that assesses the occurrence of 13 potentially traumatic life events, including motor vehicle accident, natural disaster, childhood sexual and physical abuse, and military trauma. In the NHRVS, an additional potentially traumatic event—life-threatening illness or injury—was added to the THS. Veterans were additionally asked which of these events was worst for them, and what age they were when their index event occurred. Responses were used to create a time since index trauma variable.

Self-reported demographic (age, sex, race/ethnicity, education, marital status, household income, retired status) and military variables (enlisted vs. drafted, combat exposure vs. no exposure, years served) at baseline were assessed, as well as a number of clinical (medical conditions, disability in activities of daily living, history of major depression, PTSD, and substance use disorders) and psychosocial variables

(resilience, gratitude, purpose in life, optimism, curiosity, community integration, social connectedness and engagement, altruisms, religiosity, active lifestyle) using validated measures. A series of exploratory factor analyses were conducted to consolidate these measures into composite factors reflecting common constructs (see Table 3 for factor components and references).

2.3. Data analysis

Latent growth mixture modeling (LGMM) using robust full-information maximum likelihood estimation was used to identify PTSD symptom courses using Mplus version 7.3; this estimation approach is robust to missing data (i.e., PCL scores), which were missing completely at random, as per Little's MCAR test: $X^2 = 12.84$, p = 0.17. One- to six-class solutions were examined for fit based on Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), Lo–Mendell–Rubin adjusted likelihood test, Entropy values, and bootstrap likelihood ratio tests, as well as parsimony, clinical, and theoretical considerations of each solution. Both linear (s) and quadratic (q) terms were included in all models; quadratic slope functions were considered to provide better fit to the data than linear functions if means were statistically significant at the $p < 0.05$ level. Symptom courses were compared on a number of baseline sociodemographic, health, and psychosocial variables, as well as lifetime trauma exposure and trauma exposure since Wave 1 using analysis of covariance (ANOVAs) and t-tests (alpha set to 0.01). The 3-step procedure (Asparouhov and Muthen, 2014) with the 'R3STEP' command in Mplus was used to examine Wave 1 and interim (i.e., traumas since Wave 1) variables associated with membership of the identified PTSD symptom course groups. We then conducted post-hoc analyses of multi-component factors (e.g., physical health difficulties, psychiatric distress, protective psychosocial) that were significantly related to symptomatic PTSD symptom courses to identify specific aspects of these factors that were associated with these trajectories; alpha was set to 0.01 for these analyses to reduce likelihood of Type I error. Post-stratification weights were computed by GfK Knowledge Networks statisticians to render the NRHVS data comparable to the sociodemographic distribution (i.e., gender, age, education, ethnic status, Census region, metropolitan area) of U.S. military veterans from the most contemporaneous U.S. Census Bureau Current Population Survey (U.S. Census Bureau, 2011). These post-stratification weights were applied in inferential data analyses in order to permit generalizability of the current findings to the entire U.S. veteran population.

3. Results

PTSD Symptom Courses. Table 1 shows fit statistics for one- to six-class models. A three-class solution was determined to be the best-fitting model based on lower BIC, SSA-BIC, and AIC, and higher Entropy values, and statistically significant LMR LRT and Bootstrapped LRT *p* values (both *p*'s < 0.01) relative to the 2-class model, non-significant LMR LRT p value relative to the 4-class model ($p = 0.72$), and relatively lower latent class probabilities for two classes in the four-class model (0.867 and 0.900). Average latent class probabilities for likely latent class membership for the 3-class model were 0.992 for the No/Low Symptom class; 0.962 for the High Symptom class; and 0.949 for the Moderate Symptom class. The majority of the sample was in the No/Low Symptom course (89.2%), followed by the Moderate Symptom (7.6%), and High Symptom (3.2%) courses. Linear slopes provided the best fit to PCL scores in the Moderate and High Symptom courses (quadratic vs. linear slope: both *p*'s > 0.12), while a quadratic slope provided the best fit to PCL scores in the No/Low Symptom trajectory (quadratic > linear slope, $p < 0.001$). Fig. 1 displays the three trajectories and intercepts and slopes for each trajectory.

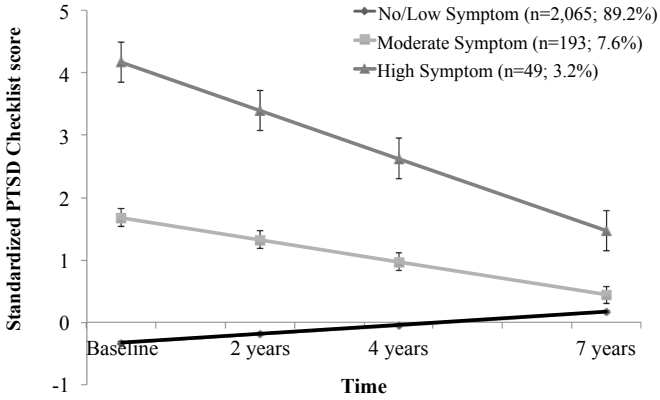

Fig. 1. PTSD symptom courses over the 7-year study period
Note. Error bars represent 95% confidence intervals
No/Low Symptom: intercept = −0.333 (standard error [SE] = 0.012), linear slope = 0.071 (SE = 0.009, p < 0.001)
quadratic slope = −0.007, SE = 0.001,p < 0.001)
ModerateSymptom: intercept = 1.677 (SE = 0.091), linear slope = −0.177 (SE = 0.071, p = 0.012)
High Symptom: intercept = 4.173 (SE = 0.193), linear slope = −0.387 (SE = 0.165; p = 0.019).

Correlates of PTSD Symptom Courses. Table 2 shows the prevalence of lifetime exposure to each traumatic event among veterans within each symptom course. Veterans in the Moderate and High Symptom courses had a higher prevalence of all traumatic events assessed relative to veterans in the No/Low Symptom course, and veterans in the High Symptom courses had a higher prevalence of several events relative to those in the Moderate symptom course. Nature of index trauma did not differ by symptom course, with 8.1% of the No/Low, 4.9% of the Moderate, and 10.4% of the High Symptom groups endorsing an assaultive trauma (e.g., hit or kicked hard enough to injure during childhood) as their index trauma, $X^2(2) = 2.70$, $p = 0.26$.

Table 3 displays sociodemographic, health, and psychosocial profiles of veterans in each of the three symptom courses. Compared to the No/Low Symptom course, veterans in the Moderate and High Symptom courses were younger at baseline, less likely to be Caucasian, married/co-habiting, and retired, more likely to have a college or higher

Table 1
Fit indices for one- to six-class unconditional latent growth mixture models of PTSD symptoms over the 7-year study period.

	BIC	SSA-BIC	AIC	Entropy	LMR LRT p value	Bootstrapped LRT p value
1-class	16829.03	16788.39	16755.03	–	-	-
2-class	15484.23	15430.21	15386.58	0.978	< 0.0001	< 0.0001
3-class	**14920.37**	**14853.65**	**14799.75**	**0.972**	**0.0088**	**< 0.0001**
4-class	14982.71	14902.87	14838.71	0.958	0.72	< 0.0001
5-class	14.040.84	13948.71	13874.28	0.958	0.17	< 0.0001
6-class	14366.40	14261.55	14176.86	0.967	0.44	1.000

Note. BIC = Bayesian Information Criterion; SSA-BIC = sample size-adjusted Bayesian Information Criterion; AIC = Akaike Information Criterion; LMR LRT = Lo-Mendell-Rubin Likelihood Ratio Test.
Best-fitting model is highlighted in bold font.

Table 2
Lifetime potentially traumatic life events at baseline in PTSD symptom courses.

	No/low Symptom n = 2,065 (89.2%) 1	Moderate Symptom n = 193 (7.6%) 2	High Symptom n = 49 (3.2%) 3	Overall test of difference	Pairwise contrasts
	n (weighted %)	n (weighted %)	n (weighted %)		
Life-threatening illness or injury	590 (28.6%)	92 (41.1%)	24 (52.9%)	27.95, < 0.001	2,3 > 1
A really bad car, boat, train, or airplane accident	365 (17.6%)	62 (33.1%)	16 (44.8%)	50.82, < 0.001	2,3 > 1
A hurricane, flood, earthquake, tornado, or fire	712 (33.1%)	88 (44.2%)	24 (52.2%)	17.65, < 0.001	2,3 > 1
A really bad accident at work or home	208 (9.6%)	49 (22.7%)	24 (54.4%)	143.15, < 0.001	3 > 2 > 1
Hit or kicked hard enough to injure – as a child	273 (13.2%)	55 (24.4%)	18 (32.4%)	32.01, < 0.001	2,3 > 1
Hit or kicked hard enough to injure – as an adult	225 (10.6%)	61 (28.5%)	26 (46.3%)	107.98, < 0.001	3 > 2 > 1
Forced or made to have sexual contact – as a child	118 (5.9%)	33 (18.4%)	11 (23.9%)	61.25, < 0.001	2,3 > 1
Forced or made to have sexual contact – as an adult	53 (2.8%)	15 (9.2%)	6 (10.4%)	28.37, < 0.001	2,3 > 1
Attacked with a gun, knife, or weapon	327 (16.5%)	76 (36.8%)	29 (67.2%)	137.83, < 0.001	3 > 2 > 1
During military service - saw something horrible or was badly scared	495 (22.0%)	108 (57.1%)	37 (80.6%)	198.60, < 0.001	3 > 2 > 1
Sudden death of close family member or friend	1196 (58.1%)	154 (76.7%)	42 (85.1%)	39.24, < 0.001	2,3 > 1
Saw someone die suddenly or get badly hurt or killed	681 (31.1%)	115 (56.4%)	40 (76.5%)	97.68, < 0.001	3 > 2 > 1
Sudden move or loss of home and possessions	223 (13.4%)	78 (45.1%)	21 (49.3%)	159.42, < 0.001	2,3 > 1
Sudden abandonment by spouse, partner, parent, or family	278 (15.3%)	95 (49.4%)	26 (62.5%)	189.63, < 0.001	2,3 > 1
Other Criterion A-qualifying trauma	138 (6.1%)	57 (29.8%)	24 (52.9%)	253.05, < 0.001	3 > 2 > 1

education, were exposed to a greater number of lifetime traumas and combat, were more likely to screen positive for depression and anxiety at Wave 1, scored higher on measure of physical health difficulties, lifetime psychiatric, and lifetime substance use disorder histories, and lower on composite variables of protective psychosocial factors, social connectedness and social engagement, and were more likely to have received mental health treatment.

As shown in Table 4, results of the 3-step procedure revealed that, relative to the No/Low Symptom course group, the Moderate Symptom course group was less likely to report an annual household income of ≥$60,000 or more, more likely to have received mental health treatment, and reported more lifetime traumas and less time since exposure to their index trauma. They also scored higher on measures of physical health difficulties and psychiatric history, and lower on measures of protective psychosocial characteristics and social connectedness. Post-hoc analyses revealed that greater somatic complaints (OR = 1.21, 95%CI = 1.14–1.28) and independent activities of daily living (IADL) disability (OR = 2.79, 95%CI = 1.66–4.72), and lower scores on measures of resilience (OR = 0.92, 95%CI = 0.89–0.96), community integration (OR = 0.79, 95%CI = 0.68–0.92), and perceived social support (OR = 0.91, 95%CI = 0.87–0.95), were independently associated with the Moderate Symptom course.

Relative to the No/Low Symptom course, the High Symptom course group was less likely to report an annual household income of ≥$60,000 or more, reported more lifetime traumas, more traumas since Wave 1, and less time since exposure to their index trauma, and were more likely to be combat veterans. They also scored higher on measures of physical health difficulties and psychiatric history, and lower on a measure of social connectedness. Post-hoc analyses revealed that IADL disability (OR = 5.45, 95%CI = 1.85–16.04), greater number of medical conditions (OR = 1.48, 95%CI = 1.10–1.98) and perceived social support (OR = 0.69, 95%CI = 0.60–0.81) were independently associated with the High Symptom course.

Relative to the Moderate Symptom course, the High Symptom course group was less likely to report an annual household income of ≥$60,000 or more, reported more traumas since Wave 1, scored higher on measures of physical health difficulties and psychiatric history, and scored lower on a measure of social connectedness. Post-hoc analyses revealed that IADL disability (OR = 4.40, 95%CI = 1.49–13.04) was positively associated with the High Symptom course, while secure attachment style was negatively associated with this symptom course (OR = 0.06, 95%CI = 0.01–0.32).

4. Discussion

The current study examined the nature and correlates of PTSD symptom courses in a nationally representative, prospective cohort of U.S. military veterans across four time points spanning seven years. Although we hypothesized identifying four symptom courses, we found that a three-symptom course solution provided the best fit to the data, with the vast majority of veterans—nearly 90%—evidencing no/minimal PTSD symptoms over this time period. However, a considerable minority—more than 10%— showed symptomatic courses characterized by moderate and high PTSD symptoms, thus underscoring the burden of PTSD symptoms in U.S. military veterans. Some previous studies have identified additional PTSD symptom courses, such as delayed onset, recovering, and worsening courses. Many of these studies have examined trajectories emerging from deployment-related trauma exposures (e.g., Bonanno et al., 2012; Dickstein et al., 2010). The symptom courses that were identified may differ from previous research on account of our focus on veterans exposed to a heterogeneous range of traumas occurring across the lifespan instead of the same index trauma. In the current study, both the High and Moderate Symptom courses showed a steady, statistically significant decline in PTSD symptom severity over the seven-year study period. This finding may be indicative of the lower prevalence of PTSD typically noted among older adults, consistent with prior studies of general adult (Goldstein et al., 2016; Reynolds et al., 2015) and veteran (Smith et al., 2016) samples. Notably, bivariate analyses indicated that the High and Moderate Symptom courses were more likely to have received mental health treatment than the No/Low Symptom course (82.1% and 53.7% vs. 15.3%), although mental health treatment was related only to the Moderate symptom course in the multivariable model. This finding may suggest that other factors, such as social connectedness, may help promote a greater decline in PTSD symptoms over time in symptomatic veterans.

A number of risk correlates were robustly associated with the Moderate and High PTSD symptom courses. Veterans in the Moderate and High symptom courses were more likely than those in the No/Low Symptom course to have been exposed to more lifetime traumatic events and multiple traumatic event types, and reported less time since exposure to their index trauma. Veterans in the High Symptom course had also been exposed to a greater number of traumatic events since Wave 1 than veterans in the Moderate Symptom course. Additionally, veterans in the High Symptom course were more likely to be combat-exposed than veterans in the No/Low Symptom course. These findings

Table 3
Sociodemographic, military, and psychosocial characteristics of PTSD symptom courses.

	No/Low Symptom n = 2,065 (89.2%) 1	Moderate Symptom n = 193 (7.6%) 2	High Symptom n = 49 (3.2%) 3	Overall test of difference	Pairwise contrasts
	Weighted mean (SE) or n (weighted %)	Weighted mean (SE) or n (weighted %)	Weighted mean (SE) or n (weighted %)		
Psychiatric Distress at Baseline					
Number of lifetime traumas at Wave 1	2.8 (0.1)	5.7 (0.2)	7.9 (0.4)	233.80, < 0.001	3 > 2 > 1
Assaultive index trauma	151 (8.0%)	10 (4.8%)	8 (10.8%)	2.93, 0.23	-
Number of traumas since Wave 1	2.2 (0.1)	3.6 (0.2)	6.7 (0.3)	107.07, < 0.001	3 > 2 > 1
Time since index trauma (years)	23.9 (0.5)	16.5 (1.5)	20.2 (2.4)	11.33, < 0.001	1 > 2
Positive screen for current depression[a]	38 (1.9%)	71 (35.8%)	29 (78.3%)	787.00, < 0.001	3 > 2 > 1
Positive screen for current GAD[a]	53 (2.8%)	55 (29.6%)	28 (75.4%)	617.43, < 0.001	3 > 2 > 1
Demographic characteristics					
Age	62.4 (0.3)	54.9 (1.3)	51.6 (1.6)	39.66, < 0.001	1 > 2,3
Male sex	1893 (92.5%)	157 (79.9%)	42 (91.5%)	30.88, < 0.001	1 > 2
Caucasian race/ethnicity	1764 (79.0%)	150 (68.3%)	31 (44.1%)	53.03, < 0.001	1 > 2 > 3
College or higher education	1754 (66.8%)	175 (81.6%)	46 (88.2%)	27.85, < 0.001	2,3 > 1
Married/living with partner	1666 (76.5%)	130 (62.8%)	37 (58.2%)	25.46, < 0.001	1 > 2,3
Household income ≥ $60,000/year	1140 (47.3%)	78 (38.7%)	19 (34.3%)	8.42, 0.015	-
Retired	1058 (48.3%)	58 (27.4%)	14 (20.6%)	44.37, < 0.001	1 > 2,3
Military characteristics					
Enlisted in military	1757 (86.4%)	172 (91.4%)	43 (83.8%)	3.80, 0.150	-
Combat exposure	676 (30.3%)	90 (47.0%)	33 (68.7%)	59.48, < 0.001	3 > 2 > 1
Years served in military	7.0 (0.18)	7.0 (0.56)	9.2 (1.09)	2.71, 0.07	-
Physical health difficulties factor	−0.13 (0.02)	0.66 (0.12)	1.76 (0.21)	185.22, < 0.001	3 > 2 > 1
Number of medical conditions	2.5 (0.04)	3.2 (0.17)	4.8 (0.30)	55.28, < 0.001	3 > 2 > 1
Any ADL disability[b]	49 (2.0%)	14 (8.0%)	10 (19.4%)	80.59, < 0.001	2,3 > 1
Any IADL disability	159 (7.2%)	58 (36.8%)	30 (64.7%)	331.85, < 0.001	3 > 2 > 1
Psychiatric history factor	−0.20 (0.02)	1.52 (0.12)	2.56 (0.14)	648.10, 0.001	3 > 2 > 1
Lifetime history of major depression[c]	212 (10.3%)	99 (50.3%)	29 (55.9%)	283.57, < 0.001	2,3 > 1
Lifetime history of PTSD	54 (3.0%)	103 (50.6%)	42 (91.5%)	906.14, < 0.001	3 > 2 > 1
Substance use disorder history factor	−0.03 (0.02)	0.33 (0.09)	0.72 (0.17)	25.73, < 0.001	3 > 2 > 1
Lifetime alcohol use disorder[c]	798 (39.6%)	112 (54.3%)	32 (60.3%)	23.71, < 0.001	2,3 > 1
Lifetime drug use disorder[c]	207 (11.2%)	55 (20.1%)	18 (36.8%)	47.32, < 0.001	3 > 2 > 1
Lifetime nicotine dependence[d]	352 (18.7%)	61 (25.0%)	18 (32.8%)	11.37, 0.003	3 > 1
Protective psychosocial factor	0.04 (0.02)	−0.68 (0.12)	−1.57 (0.20)	107.76, < 0.001	1 > 2 > 3
Resilience[e]	30.18 (0.14)	25.66 (0.69)	20.61 (1.51)	89.01, < 0.001	3 > 2 > 1
Dispositional gratitude[f]	6.23 (0.02)	5.53 (0.14)	4.97 (0.23)	65.48, < 0.001	1 > 2 > 3
Purpose in life[g]	21.86 (0.09)	18.50 (0.53)	15.49 (0.80)	108.21, < 0.001	1 > 2 > 3
Dispositional optimism[h]	4.90 (0.03)	4.17 (0.15)	3.40 (0.26)	50.86, < 0.001	1 > 2 > 3
Curiosity and exploration[i]	5.22 (0.03)	5.03 (0.14)	4.26 (0.26)	16.54, < 0.001	1,2 > 3
Community integration	4.40 (0.04)	3.37 (0.16)	2.20 (0.18)	77.90, < 0.001	1 > 3 > 4
Social connectedness factor	0.05 (0.02)	−0.84 (0.09)	−1.65 (0.08)	152.27, < 0.001	1 > 2 > 3
Number of close friends/relatives	8.7 (0.22)	5.8 (0.71)	2.8 (0.37)	19.62, < 0.001	1 > 2,3
Secure attachment[j]	1612 (76.1%)	75 (42.3%)	4 (3.3%)	227.22, < 0.001	1 > 2 > 3
Social support[k]	19.98 (0.11)	15.69 (0.47)	12.81 (0.57)	121.66, < 0.001	1 > 2 > 3
Social engagement factor	0.03 (0.02)	−0.22 (0.08)	−0.33 (0.14)	7.34, 0.001	1 > 2,3
Number of days/week visit family	1.8 (0.05)	1.3 (0.14)	1.7 (0.31)	5.48, 0.004	1 > 2
Number of days/week visit friends	1.9 (0.04)	1.6 (0.15)	0.9 (0.21)	8.97, < 0.001	1,2 > 3
Altruism factor	−0.07 (0.02)	−0.13 (0.08)	−0.17 (0.10)	0.62, 0.541	-
Volunteer on a weekly basis	831 (38.5%)	65 (34.2%)	11 (18.6%)	10.51, 0.005	1 > 3
Altruism more than 10 times/year[l]	846 (39.1%)	86 (39.9%)	23 (50.8%)	3.391, 0.184	-
Religiosity factor	−0.02 (0.02)	−0.21 (0.08)	−0.30 (0.13)	4.72, 0.009	-
Church few times monthly + [m]	855 (39.7%)	63 (31.1%)	14 (20.0%)	13.53, 0.001	1 > 3
Private spiritual once per week + [m]	848 (37.8%)	80 (39.3%)	18 (31.1%)	1.29, 0.524	-
Intrinsic religiosity[m]	10.12 (0.09)	9.27 (0.34)	9.08 (0.51)	5.45, 0.004	1 > 2
Active lifestyle factor	−0.14 (0.02)	−0.14 (0.08)	−0.42 (0.14)	2.24, 0.106	-
Number of days/week sports exercise	2.6 (0.05)	2.3 (0.18)	2.3 (0.37)	1.56, 0.210	-

(*continued on next page*)

Table 3 (*continued*)

	No/Low Symptom n = 2,065 (89.2%) 1	Moderate Symptom n = 193 (7.6%) 2	High Symptom n = 49 (3.2%) 3	Overall test of difference	Pairwise contrasts
	Weighted mean (SE) or n (weighted %)	Weighted mean (SE) or n (weighted %)	Weighted mean (SE) or n (weighted %)		
Number of days/week reading	4.0 (0.06)	4.0 (0.21)	3.9 (0.40)	0.07, 0.935	-
Number of days/week writing	1.2 (0.05)	1.2 (0.15)	1.0 (0.23)	0.35, 0.704	-
Number of days/week use computer	5.9 (0.04)	6.2 (0.13)	5.1 (0.32)	7.57, 0.001	1,2 > 3
Ever received mental health treatment	322 (15.3%)	105 (53.7%)	34 (82.1%)	299.23, < 0.001	3 > 2 > 1

Note.

[a] Kroenke K, Spitzer RL, Williams JB et al. An ultra-brief screening scale for anxiety and depression: the PHQ-4. *Psychosomatics*. 2009; 50:613-621.

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are consistent with previous research in both general and veteran samples, which have identified greater cumulative trauma exposure as risk factors for PTSD and symptomatic trajectories (Greene et al., 2017; Miron et al., 2014; Xue et al., 2015), and highlight the greater vulnerability to a symptomatic PTSD course that emerges from the accumulation of traumatic life events. Clinically, these findings underscore the importance of assessing and monitoring traumatic life events in veterans who are at increased risk for chronic PTSD symptoms.

Consistent with previous research, psychiatric history and physical health difficulties were associated with Moderate and High Symptom courses relative to the No/Low Symptom course, and were also associated with the High Symptom compared to the Moderate Symptom course (Benyamini et al., 2009; Brewin et al., 2000; Koenen et al., 2003; O'Toole et al., 2008). Post-hoc analyses revealed that greater somatic

Table 4
Results of 3-step model of variables associated with PTSD symptom courses.

	Moderate Symptom vs. No/Low Symptom	High Symptom vs. No/Low Symptom	High Symptom vs. Moderate Symptom
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Number of lifetime traumas at Wave 1	1.19 (1.09–1.30)***	1.24 (1.03–1.49)*	1.04 (0.88–1.24)
Traumas since Wave 1	1.02 (0.95–1.09)	1.23 (1.08–1.39)**	1.20 (1.07–1.35)**
Time since index trauma	0.97 (0.96–0.99)***	0.96 (0.93–0.99)*	0.99 (0.96–1.02)
Age	1.00 (0.98–1.02)	1.00 (0.95–1.04)	1.00 (0.95–1.04)
Male sex	0.80 (0.41–1.56)	1.89 (0.45–7.92)	2.36 (0.62–9.01)
Caucasian race/ethnicity	0.75 (0.46–1.22)	0.57 (0.20–1.57)	0.76 (0.29–2.00)
College or higher education	1.49 (0.89–2.51)	3.45 (0.76–15.62)	2.31 (0.52–10.31)
Married/living with partner	1.07 (0.67–1.72)	1.16 (0.41–3.30)	1.08 (0.39–2.97)
Household income > = $60,000/year	0.62 (0.40–0.98)*	0.14 (0.05–0.46)**	0.23 (0.08–0.71)*
Retired	0.97 (0.55–1.70)	2.30 (0.61–8.62)	2.38 (0.56–8.70)
Combat veteran	1.84 (0.98–2.85)	4.63 (1.69–12.66)**	2.52 (0.95–6.67)
Physical health difficulties factor	1.49 (1.25–1.75)***	2.36 (1.73–3.21)***	1.59 (1.19–2.13)**
Psychiatric history factor	1.56 (1.29–1.89)***	2.74 (1.92–3.90)***	1.76 (1.26–2.45)**
Substance use disorder history factor	0.97 (0.80–1.19)	1.02 (0.70–1.49)	1.05 (0.73–1.50)
Protective psychosocial characteristics factor	0.78 (0.61–0.99)*	0.84 (0.56–1.28)	1.08 (0.74–1.58)
Social connectedness factor	0.61 (0.48–0.79)***	0.28 (0.14–0.55)***	0.45 (0.23–0.90)*
Social engagement factor	1.05 (0.83–1.33)	1.08 (0.64–1.80)	1.03 (0.62–1.69)
Religiosity factor	0.98 (0.78–1.24)	0.59 (0.32–1.07)	0.60 (0.33–1.07)
Ever received mental health treatment	1.62 (1.01–2.62)*	1.43 (0.46–4.42)	0.88 (0.29–2.67)

Note. OR = odds ratio; 95%CI = 95% confidence interval.
Significant correlate: *p < 0.05, **p < 0.01, **p < 0.001.

complaints and difficulties with IADLs were independently associated with the Moderate Symptom course, while IADL disability and a greater number of medical conditions were associated with the High Symptom course, relative to the No/Low Symptom course. IADL disability was independently associated with the High Symptom course relative to the Moderate Symptom course. That a psychiatric history increased the risk of current PTSD symptoms is possibly reflective of a persistent course of symptoms beginning prior to the study, or stress sensitization to subsequent traumas (Kendler et al., 2000).

The associations between physical health difficulties at baseline and symptomatic courses are noteworthy; they may be unique to veterans given the aging nature of this population and the increasing prevalence of physical health difficulties with older age. Further, given the higher prevalence of life-threatening illness or injury and IADL disability in the High and Moderate Symptom relative to the No/Low Symptom courses, such experiences may serve as "constant reminders" of having enduring a traumatic life event and thus contribute to the chronicity of PTSD symptoms (Friedman et al., 1994). IADL disability may also exacerbate PTSD symptoms through its links with social isolation (Jang et al., 2016) or cognitive difficulties that deleteriously affect emotion regulation (Mota et al., 2016). Taken together, these findings suggest that veterans experiencing physical health difficulties may require additional support in prevention and treatment efforts for PTSD.

Lower social connectedness was associated with Moderate and High Symptom courses relative to the No/Low Symptom course. Post-hoc analyses revealed that lower perceived social support in particular was an independent correlate of symptomatic courses. Lower social connectedness also distinguished the High from the Moderate Symptom course; a post-hoc analysis revealed that veterans in the High Symptom course were less likely to report a secure attachment style. Previous research has indicated a negative association between social support and PTSD (Dinenberg et al., 2014; James et al., 2013) and social support has been conceptualized as a key component in bolstering resilience to trauma (Sippel et al., 2015). However, PTSD has also been shown to have deleterious effects on social support and social networks in prospective studies, indicating that this association is likely bidirectional (King et al., 2006). It is possible that many veterans have difficulty with forming interpersonal connections due to either existing insecure attachment styles and/or ongoing trauma-related symptoms of avoidance and isolation. Additional research is needed to understand how to optimally enhance social support among veterans at different life stages and who are at risk for the development of PTSD symptoms. One such example is examining the effectiveness of interpersonal skills training, as well as peer support initiatives in this population (Hogan et al., 2002).

Lower scores on a measure of protective psychosocial characteristics were associated with the Moderate Symptom course relative to the No/Low Symptom course. Resilience and community integration emerged as particularly salient factors driving this association. This finding aligns with previous work documenting cross-sectional associations between resilience and community integration and lower odds of probable PTSD (Wisco et al., 2014), as well as longitudinal studies observing an association between higher community involvement and a decreased risk of subsequent PTSD among Vietnam veterans (Koenen et al., 2003). Resilience encompasses the ability to manage, adapt to, and recover from challenge (Campbell-Sills and Stein, 2007), and thus, higher levels of resilience likely mitigate the development of symptoms following trauma exposure. Community integration is likely linked to greater interpersonal connection and social support (Townley et al., 2013), and may also be indicative of higher levels of physical functioning. It is also possible that greater participation in the community positively impacts other psychosocial protective factors, such as increased resilience and a perceived sense of purpose (Pietrzak et al., 2014). Like social support, however, more severe PTSD symptoms have been associated with greater difficulties with community integration (Karstoft et al., 2015), and thus, it is also likely that this association is bidirectional. Social skills training as well as training in improving IADLs have been found to promote community integration among individuals with serious mental illness (Gibson et al., 2011), and may also be beneficial among trauma-exposed veterans as interventions for preventing posttraumatic stress symptoms. Further research is also needed to develop and evaluate programming that might strengthen resilience.

Results of the current study should be interpreted in the context of the following limitations. First, all measures were assessed via self-report as opposed to clinical interview. Second, different versions of the PCL were used in Wave 1 versus in Waves 2 through 4, reflecting changes in versions of the DSM while the NHRVS was in the field; thus, changes in symptom course from baseline to follow-up assessments may, at least in part, be related to differences between PCL versions. Third, the symptom courses in the current study reflect a seven-year "snapshot" of PTSD symptoms rather than trajectories following a single traumatic event, with considerable variability in the nature and time since exposure to index trauma. Fourth, despite the inclusion of numerous potential correlates, there were other relevant factors, such as stressful life events, other mental disorders, and severity and frequency of trauma exposures that were not assessed in the NHRVS and that may be differentially associated with PTSD symptom courses. For example, although history of seeking mental health treatment was assessed, the type and dosing of treatment were not, which may have been differentially associated with certain symptom courses. Fifth, although this dataset comes from a nationally representative sample of U.S. military veterans, the sample was predominantly comprised of older, Caucasian males who were not combat-exposed. Further research in more heterogeneous samples is needed to evaluate the generalizability of results to more diverse samples of veterans and other trauma-affected populations. It is also possible that those veterans who did not participate in subsequent study waves of the NHRVS experienced more severe PTSD symptoms than those who remained in the cohort, which may have affected the nature and correlates of emerging symptom courses.

5. Conclusion

Notwithstanding these limitations, results of the current study suggest that more than 10% of US veterans have a symptomatic elevation of PTSD symptoms that steadily declines over a seven-year period, and that social support and community integration in particular are potentially modifiable factors that are linked to PTSD symptom courses. Future research is needed to better characterize the nature and correlates of PTSD symptom courses over time and during major life transitions, such as post-deployment re-integration, discharge from the military, and retirement; evaluate how biological factors, directly and interactively with psychosocial factors, contribute to symptomatic PTSD symptom courses; and develop and evaluate the effectiveness of interventions focused on bolstering factors such as social support and community integration in promoting resilience to traumatic stress in veterans and other trauma-affected populations.

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