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ORIGINAL PAPER

Posttraumatic Growth in U.S. Military Veterans: Results from the National Health and Resilience in Veterans Study

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Abstract

Despite increasing recognition that positive psychological changes or posttraumatic growth (PTG) may develop after highly stressful or traumatic events, contemporary population-based data on the epidemiology of PTG in high-risk samples such as U.S. military veterans are lacking. Additionally, in light of emerging evidence suggesting an 8-factor model of posttraumatic stress disorder (PTSD) symptoms, an up-to-date characterization of how these symptom clusters relate to PTG can help inform efforts to help promote PTG. Data were analyzed from the 2019–2020 National Health and Resilience in Veterans Study (NHRVS), which surveyed a nationally representative sample of 3,847 trauma-exposed U.S. veterans. Participants completed assessments of potentially traumatic events, PTSD symptoms, and PTG, as well as a broad range of sociodemographic, military, trauma, health, personality, and psychosocial characteristics. Results revealed that 63.2% of trauma-exposed veterans and 86.4% of veterans who screened positive for PTSD endorsed moderate-or-greater PTG; these prevalences are higher than those reported in an independent U.S. veteran sample in 2011 (50.1% and 72.0%, respectively). An inverted U-shaped association was observed between PTSD symptom severity and PTG levels, with scores of 31 to 51 on the PTSD Checklist for DSM-5 associated with the highest likelihood of PTG. Intrinsic religiosity and internally- and externally-generated intrusive symptoms of PTSD were identified as the strongest correlates of PTG. Results suggest that prevention and treatment efforts to mitigate severe PTSD symptoms, and help promote intrinsic religiosity, and more deliberate and organized rumination about traumatic experiences may help foster PTG in veterans.

Keywords Intrusions · Posttraumatic Stress Disorder · Psychological Growth · Spirituality

Extended author information available on the last page of the article

Introduction

Posttraumatic growth (PTG) refers to positive psychological changes that may develop after an individual experiences highly stressful or traumatic life events [1, 2]. PTG can be characterized by positive changes in multiple domains, including greater appreciation of life, improved interpersonal relationships, new possibilities for one's life, greater sense of personal strength, and spiritual changes [1]. PTG has been studied in numerous trauma-exposed populations, including individuals with life-threatening medical conditions [3], refugees and displaced people [4], victims of violence [5–7], and military veterans [8]. PTG may be especially relevant to veterans given their greater exposure to traumatic events (e.g., combat, military sexual trauma; [9, 10]), as well as higher rates of mental disorders such as posttraumatic stress disorder (PTSD) relative to non-veterans [11, 12].

PTG is a relatively common phenomenon. A recent meta-analysis on the prevalence of PTG revealed that 52.3% of trauma-exposed individuals developed moderate-to-high levels of PTG following exposure to various types of traumas [13]. Similarly, in our prior study of a nationally representative veteran sample conducted in 2011, 50.1% of veterans with a history of trauma exposure and 72.0% of veterans who screened positive for PTSD reported moderate-to-high levels of PTG [14]. Collectively, these findings suggest that a considerable proportion of trauma-exposed individuals may experience PTG following exposure to trauma, particularly those who endorse clinically significant PTSD symptoms.

To date, most research examining PTG in military veterans has relied on PTSD assessments that used the *Diagnostic and Statistical Manual for Mental Disorders-fourth edition (DSM-IV)* symptoms [14–19], which has been out-of-date since 2013 with the publication of the DSM-5. Given these changes and prior evidence suggesting that the trajectory of PTG can change over time [19], a more up-to-date estimate of the prevalence and correlates of PTG is needed to gain a better understanding of the epidemiology of PTG in contemporary, population-based samples of veterans.

Previous studies have examined a broad range of factors associated with PTG. These have included sociodemographic variables such as gender [20], race/ethnicity [21], and marital status [22]; personality variables such as extraversion [23, 24], openness to experience [24, 25], conscientiousness [26], and agreeableness [24, 25]; military variables such as combat exposure [22]; mental health variables such as depression [27], anxiety [27], and substance use [28]; and protective psychosocial characteristics variables such as secure attachment [29], purpose in life [30], social support [31], optimism [31–33], and religiosity/spirituality [31, 34]. In our study of U.S. veterans, we found that non-Caucasian race/ethnicity, lower household income, greater lifetime trauma, protective psychosocial characteristics, social connectedness, and spirituality were associated with greater PTG scores [14]. While these findings help inform factors that may help promote PTG in veterans, they did not examine the relative importance (i.e., strength) of these factors in predicting PTG. Such information may help inform targets for prevention and treatment initiatives designed to help promote PTG in veterans and other trauma-exposed populations.

One consistent correlate of PTG is PTSD symptom severity [14, 35], as supported by the initial conceptualization that PTSD symptoms serve as an impetus for the development of PTG [1]. Prior cross-sectional and longitudinal studies have consistently observed a curvilinear and inverted U-shaped relationship between PTSD symptom severity and PTG, whereby moderate-to-high levels of PTSD symptoms are associated with the greater levels

of PTG [14, 16, 35, 36]. Recently, Na and colleagues [35] performed a receiver operating characteristic (ROC) curve analysis, which revealed that moderate severity scores on the 4-item PTSD Checklist for DSM-5 (PCL-5; i.e., cut score of 3 on the 4-item PTSD Checklist for DSM-5 and a score of 2 for avoidance symptoms, one of the PTSD symptom clusters) were optimal for identifying veterans who endorsed PTG in relation to the COVID-19 pandemic. While ROC curve analyses provide insight regarding optimal thresholds of PTSD symptom severity associated with PTG, this finding is limited to pandemic-related PTSD symptoms assessed using a 4-item version of the PCL-5. Further research in general population- and mixed trauma-samples that utilizes full versions of commonly used PTSD assessment instruments (e.g., PCL-5) is needed to identify optimal thresholds of PTSD symptoms for PTG endorsement in U.S. veterans. Furthermore, in light of emerging research suggesting that PTSD symptoms may be best characterized by eight symptom clusters instead of four as in the DSM-5 (i.e., internally-generated intrusions, externally-generated intrusions, avoidance, negative affect, anhedonia, externalizing behaviors, anxious arousal, dysphoric arousal; [37, 38]), further work is needed to determine how specific PTSD symptom clusters may be linked to PTG.

To address these gaps, we analyzed data from the 2019–2020 National Health and Resilience in Veterans Study (NHRVS) to evaluate the following four aims: (1) estimate the prevalence of PTG in U.S. military veterans overall, as well as by PTSD screening status; (2) characterize the nature of the association between PTSD symptom severity and PTG; (3) identify the optimal threshold of PTSD symptom severity associated with endorsement of PTG; and (4) identify and quantify the relative importance of key correlates of PTG.

Methods

Sample

Data were analyzed from the National Health and Resilience in Veterans Study (NHRVS), a nationally representative survey of 4,069 U.S. veterans, the majority of whom were 60 years and older. The NHRVS was administered between 11/18/19 and 3/8/20 (median completion date: 11/21/19) and all participants completed an anonymous, 50-minute, web-based survey. The NHRVS sample was ascertained from KnowledgePanel®, a research panel maintained by the survey research firm Ipsos, which maintains more than 50,000 households. KnowledgePanel® is an online, probability-based, non-volunteer access survey panel of U.S. adults that covers approximately 98% of U.S. households. Panel members are recruited through national random samples, originally by telephone but now almost exclusively by postal mail. KnowledgePanel® recruitment uses dual sampling frames that include both listed and unlisted telephone numbers, telephone and non-telephone households, and cell-phone-only households, as well as households with and without Internet access. To permit generalizability of study results to the entire population of U.S. veterans, the Ipsos statistical team computed post-stratification weights using the benchmark distributions of age, gender, race/ethnicity, Census region, metropolitan status, education, annual household income, branch of military service, and years of military service of U.S. military veterans from the most contemporaneous (August 2019) Current Veteran Population Supplemental Survey of the U.S. Census Bureau's American Community Survey. An iterative proportional fitting

(raking) procedure was used to produce the final post-stratification weights. The current study focused on 3,847 veterans who endorsed one or more potentially traumatic events on the Life Events Checklist for DSM-5 (see below).

Measures

Potentially Traumatic Exposures

The Life Events Checklist for DSM-5 (LEC-5; [39]) assesses exposure to 17 potentially traumatic events (PTEs; e.g., physical assault, life-threatening illness or injury) in one's lifetime. For each PTE, participants indicate their exposure type (i.e., whether the event "happened to me" or they "witnessed it", "learned about it happening to a close family or friend", and/or were "exposed to it as part of my job"). As part of the LEC-5 data collection, participants were asked to identify a single "worst stressful experience" (i.e., index traumatic event). Questions about PTSD symptoms and posttraumatic growth were assessed in relation to this event. Disaster/accident was defined as endorsement of any of the 5 following items as one's worst event: natural disaster, fire or explosion, transportation accident, other serious accident, or exposure to toxic substance. Interpersonal violence was defined as endorsement of any of 4 following items as one's worst event: physical assault, assault with a weapon, sexual assault, or other unwanted sexual activity. Combat/captivity was defined as endorsement of either "combat or exposure to a war-zone" or "captivity" as one's worst event. Illness/injury was defined as endorsement of any of following 4 items as one's worst event: life-threatening illness or injury, severe human suffering, sudden violent death, or sudden accidental death. Harm others was defined as endorsement of the item "serious injury, harm, or death you caused to someone else" as one's worst event.

Posttraumatic Stress Disorder

A modified lifetime version of the PTSD Checklist for DSM-5 (PCL-5; [40]) was used to assess PTSD symptoms. The 20-item PCL-5 assesses the extent to which an individual is bothered each DSM-5 PTSD symptom (Cronbach's $\alpha = 0.96$); sample item: "*Thinking about your worst stressful experience, indicate how much you have been bothered by repeated, disturbing, and unwanted memories of the stressful experience in your lifetime?*" (0 = Not at all to 4 = Extremely). Total scores range from 0 to 80, with a score of 33 or higher indicative of a positive screen for PTSD [41]. Using the eight-factor model of PTSD symptoms [37, 38], we computed symptom clusters using the following items: internally-generated intrusions (items 1–3); externally-generated intrusions (items 4 and 5); avoidance (items 6 and 7); negative affect (items 8–11); anhedonia (items 12–14); externalizing behaviors (items 15 and 16); anxious arousal (items 17 and 18); and dysphoric arousal (items 19 and 20).

Posttraumatic Growth

The Posttraumatic Growth Inventory-Short Form (PTGI-SF; [42]) was used to assess PTG (Cronbach's $\alpha = 0.92$). The 10-item PTGI-SF assesses the five core domains of PTG: personal strength (Cronbach's $\alpha = 0.83$), new possibilities (Cronbach's $\alpha = 0.78$), relating to others (Cronbach's $\alpha = 0.77$), appreciation of life (Cronbach's $\alpha = 0.74$), and spiritual change

(Cronbach's α = 0.88). Sample items include, "*Please indicate the degree to which you experienced these changes in your life as a result of your worst stressful experience: I am able to do better things with my life*" (0 = Did not experience to 5 = Experienced to a very great degree). Scores range from 0 to 50. While the operationalization of positive endorsement of PTG varies across previous studies, we followed the recommendation from a meta-analysis on PTG [13] and defined it as endorsement of moderate-or-greater PTG, which is a minimum 60% of the total PTGI-SF score (i.e., mean score of 3 to 5; [13]).

As described in Supplemental Tables 1, a broad range of sociodemographic (e.g., age, sex), personality (e.g., extraversion), military (e.g., years of service), trauma (e.g., adverse childhood experiences [ACEs]), mental health (e.g., lifetime major depressive disorder [MDD]), physical health (e.g., number of medical conditions), and psychosocial (e.g., gratitude, intrinsic religiosity) characteristics were examined in relation to PTG scores.

Data Analysis

Data analyses proceeded in seven steps. First, chi-square analyses were conducted to compare endorsements of PTG between veterans with and without a positive screen for PTSD. Second, to examine the nature of the association between severity of PTSD symptoms and PTG, we fitted linear and quadratic functions between the severity of PTSD symptoms and PTGI-SF scores; an analysis of variance was then used to determine which function provided the best fit to these data and explained the most variance in PTGI-SF scores. Third, we conducted a receiver operating characteristic (ROC) curve analysis to identify the optimally specific (i.e., specificity > 0.95) threshold of PTSD symptom severity associated with endorsement of PTG (i.e., score of moderate-or-greater PTG on any item on the PTGI-SF); and the PCL-5 score range associated with the highest likelihood of endorsing PTG (i.e., false positive rate (FPR) < 0.05 for lower bound and true positive rate (TPR) < 0.05 for the upper bound of PCL-5 scores). Fourth, Spearman correlations were conducted to examine bivariate associations between sociodemographic, personality, military, trauma, mental health, physical health, and psychosocial and protective characteristics, and PTGI-SF scores. Fifth, variables correlated with PTGI-SF scores at the $p < .01$ level were then entered into a multivariable linear regression model using backward elimination to identify independent correlates of total PTGI-SF scores. Sixth, post-hoc analyses adjusted for variables that were independently associated with PTGI-SF scores were conducted to examine whether particular PTSD symptom clusters from the four-factor DSM-5 and newly developed eight-factor model drove the association between PTSD symptoms and PTG. The latter analysis was based on emerging research suggesting the factor of PTSD is best represented by an 8-factor model: internally-generated intrusions (e.g., nightmares), externally-generated intrusions (e.g., physiological reactions), avoidance, negative affect (e.g., strong negative beliefs), anhedonia (e.g., difficulty experiencing positive emotions), externalizing behaviors (e.g., irritable behavior), anxious arousal (e.g., hypervigilance), and dysphoric arousal (e.g., sleep disturbances; [38]). Finally, significant main effects ($p < .05$) were entered into a relative importance analysis [43] to quantify the relative variance in PTGI-SF scores explained by each of the statistically significant variables after accounting for intercorrelations among these variables.

Results

Sample Characteristics

Of the total 4,069 veterans who participated in the NHRVS, 3,847 (93.3%) endorsed exposure to at least one PTE on the LEC-5 and were included in analyses. The average age of the sample was 62.0 (SD = 15.7; range = 22–98). Most veterans were male (N = 3,356; 89.8%) and non-Hispanic White (N = 3,133; 78.2%). Other racial/ethnic groups included non-Hispanic Black (N = 270; 10.8%), Hispanic (N = 299; 6.9%), or multiracial/other race/ethnicity (N = 145; 4.2%) veterans.

The most commonly endorsed index traumatic events were disaster/accident (42.6%), illness/injury (29.2%), and interpersonal violence (14.3%), with the remainder of the sample endorsing combat/captivity (13.1%) and injury/harm/death to other (0.8%) as their worst event. A total of 449 veterans (13.4%) screened positive for PTSD.

Prevalence of PTG

Figure 1 shows the prevalence of PTG in the full sample, as well as by PTSD screening status. Results revealed that 63.2% of the full sample endorsed at least one domain of PTG, the most prevalent of which were personal strength (44.5%), appreciation of life (42.5%), and new possibilities (32.2%). Relative to veterans who did not screen positive for PTSD (59.5%), those who screened positive were significantly more likely to endorse any PTG (86.4%; $\chi^2 = 133.53$, $p < .001$) and all PTG domains except Relating to Others (all χ^2's > 51.59, all p's < 0.001).

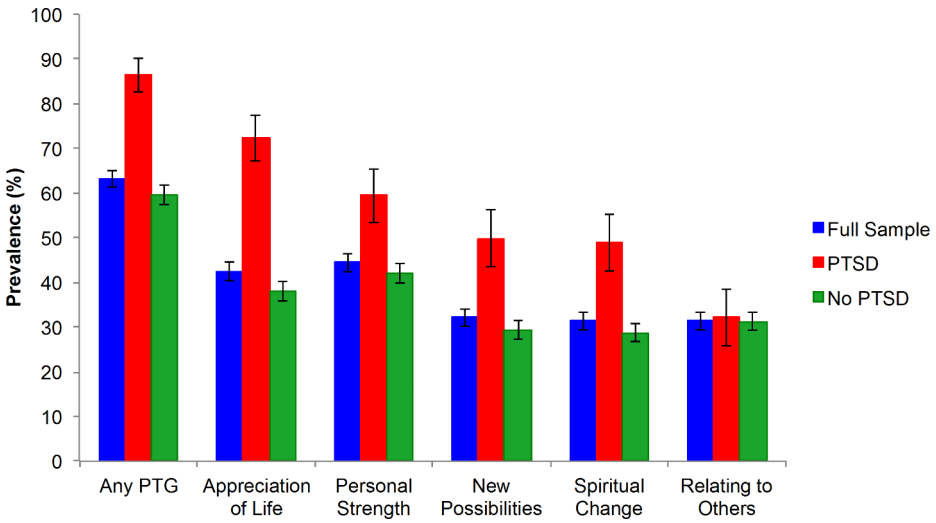

Fig. 1 Prevalence of posttraumatic growth among U.S. military veterans
Note. PTG, posttraumatic growth; PTSD, posttraumatic stress disorder
Error bars represent 95% confidence intervals

Index Trauma Type and PTG

PTGI-SF scores were significantly higher among veterans who reported combat/captivity or illness/injury as their worst event (mean score of 16.8 ± 0.6 and 16.5 ± 0.4, respectively, vs. 12.9 ± 0.4 for disaster/accident, 13.6 ± 0.5 for interpersonal violence, and 15.6 ± 1.9 for injury/harm/death to other; all p's < 0.001). Accordingly, endorsement of combat/captivity or illness/injury vs. other index events was adjusted for in analyses examining correlates of PTGI-SF scores.

Association between PTSD Symptoms and PTG

Results of a curve estimation analysis revealed that the association between PTSD symptom severity and PTGI-SF scores was best characterized by a quadratic, inverted-U shaped association vs. a linear association ($t = 12.05$, $p < .001$; adjusted $R^2_{quadratic} = 0.13$ vs. $R^2_{linear} = 0.09$). Figure 2 illustrates the association between PTSD symptom severity and predicted PTGI-SF scores.

PTSD Symptom Severity Threshold Associated with PTG

The area under curve for the association between PCL-5 and PTGI-SF scores was 0.72 (95% CI = 0.70–0.73), z = 25.12, $p < .0001$. A PCL-5 score of ≥ 31 was determined to be optimally specific in identifying PTG, with a specificity of 0.95 and positive likelihood ratio of 3.72 (95% CI = 2.89–4.79). PCL-5 scores ranging from 31 to 51 were associated with the highest likelihood of PTG based on FPR and TPR values < 0.05 for the lower and upper bounds, respectively.

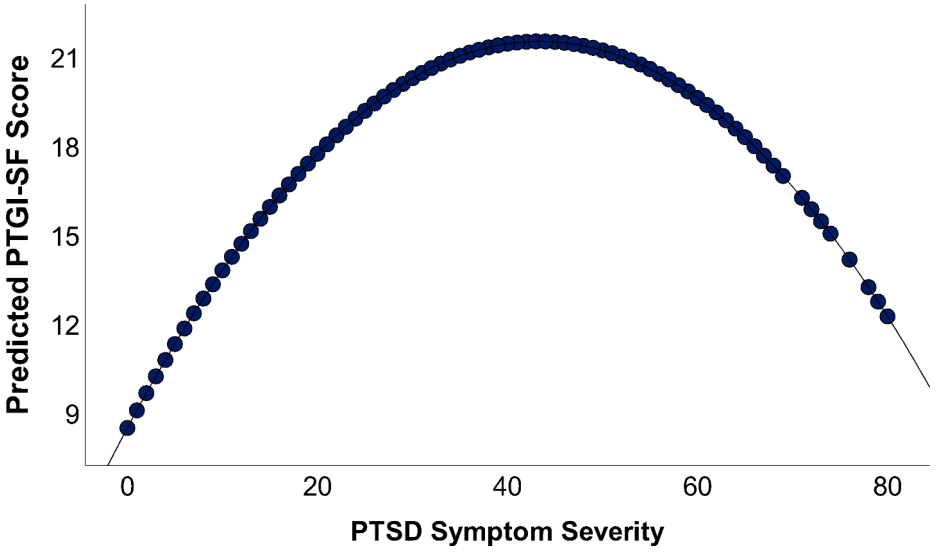

Fig. 2 Association between PTSD symptom severity and predicted PTGI-SF scores
Note. PTGI-SF, Posttraumatic Growth Inventory-Short Form; PTSD, posttraumatic stress disorder. Plotted circles represent predicted scores from a curve estimation analyses
Fitted line represents the quadratic line of best fit

Correlates of PTG

Table 1 shows characteristics of the full sample, and correlations between study characteristics and PTGI-SF scores. Results of a multivariable linear regression analysis indicated that racial/ethnic minority status, trauma burden, combat/captivity or illness/injury as index event, PTSD symptom severity, lifetime DUD, somatic symptoms, cognitive functioning, extraversion, emotional stability, purpose in life, gratitude, curiosity/exploration, altruistic behavior, frequency of religious service attendance, and intrinsic religiosity were associated with higher PTGI-SF scores.

Planned post-hoc analyses of the four-factor DSM-5 model of PTSD symptoms revealed that greater severity of intrusions ($\beta = 0.22$, $p < .001$), alterations in arousal and reactivity ($\beta = 0.17$, $p < .001$), and avoidance ($\beta = 0.17$, $p < .001$) symptoms were independently associated with PTGI-SF scores, whereas negative alterations in cognitions and mood symptoms ($p = .83$) were not. Using a novel eight-factor model of PTSD symptoms, internally-generated intrusions ($\beta = 0.17$, $p < .001$), anhedonia ($\beta = 0.08$, $p < .001$), avoidance ($\beta = 0.07$, $p = .004$), anxious arousal ($\beta = 0.06$; $p = .01$), and externally-generated intrusions ($\beta = 0.06$, $p = .04$) were independently associated with PTGI-SF scores, whereas negative affect ($p = .10$), externalizing behavior ($p = .35$), and dysphoric arousal ($p = .33$) symptoms were not.

A relative importance analysis revealed that the majority of variance explained in PTGI-SF scores ($R^2 = 0.27$) was accounted for by intrinsic religiosity (14.9% relative variance explained [RVE]), internally-generated intrusions (11.1% RVE), externally-generated intrusions (8.4%), index trauma type (8.0%), curiosity/exploration (7.6%), avoidance (7.2%), anxious arousal (7.0%), and more frequent religious service attendance (5.0%). The remainder of explained variance was accounted for by non-White race/ethnicity (4.9%), greater lifetime cumulative trauma burden (4.8%), more severe anhedonia symptoms (3.9%), higher purpose in life (3.7%), more severe somatic symptoms (2.7%), higher gratitude (2.6%), higher extraversion (2.3%), lifetime drug use disorder (2.0%), more frequent altruistic behavior (1.6%), better cognitive functioning (1.4%), and greater emotional stability (0.9%).

Discussion

To our knowledge, this study provides the most up-to-date characterization of the prevalence and correlates of PTG in a nationally representative sample of U.S. military veterans. Results revealed that 63.2% of trauma-exposed veterans endorsed at least one domain of PTG, the most prevalent of which were personal strength (44.5%), appreciation of life (42.5%), and new possibilities (32.2%). Consistent with prior work [13, 14], veterans who endorsed direct traumas such as combat/captivity or illness/injury as their index events reported greater PTG. Veterans with a positive screen for PTSD were substantially more likely than those without a positive screen to endorse any and all domains of PTG except Relating to Others.

Notably, results also suggest an increase in the prevalence of PTG among U.S. veterans relative to our 2011 study [14]. This increase was observed in both the full sample (50.1–63.2% for any PTG, $p < .001$), as well as among those who screened positive for

Table 1 Sociodemographic, military, trauma, health, personality, and psychosocial characteristics of the sample, and associations with PTGI-SF scores

	Sample characteristics (N = 3,847)	Bivariate correlation with total PTGI-SF score	Multivariable regression model
	Weighted mean (SD) or N (weighted %)	*r*	β
Posttraumatic growth			
Total PTGI-SF sum	13.9 (12.3)		
Sociodemographic characteristics			
Age	62.0 (15.7)	-0.10***	NS
Male sex	3356 (89.8%)	-0.09***	NS
White, non-Hispanic race/ethnicity	3133 (78.2%)	-0.14***	-0.06***
Married or living with partner	2721 (71.9%)	-0.00	
College graduate or higher education	1749 (33.6%)	0.04***	NS
Annual household income > $60,000	2245 (59.3%)	-0.03	
Retired	2092 (44.2%)	-0.05***	NS
Military characteristics			
Enlisted in military	2960 (79.5%)	0.04	
10 or more years in the military	1418 (37.1%)	0.01	
Positive effect of military on life	5.99 (1.39)	0.04	
Combat veteran	1321 (36.1%)	0.08***	NS
Trauma characteristics			
Adverse childhood experiences	1.6 (2.0)	0.12***	NS
Cumulative trauma burden	9.6 (8.4)	0.28***	0.09***
Combat/captivity or illness/injury index event	1500 (42.3%)	0.16***	0.14***
Years since index event	30.8 (19.7)	-0.05**	NS
PTSD symptom severity	14.4 (15.9)	0.41***	0.34***
Mental health characteristics			
Lifetime MDD	605 (17.5%)	0.15***	NS
Lifetime AUD	1537 (41.6%)	0.09***	NS
Lifetime DUD	443 (13.3%)	0.12***	0.06***
Lifetime suicide attempt	132 (3.9%)	-0.06***	NS
Lifetime mental health treatment	893 (23.1%)	0.14***	NS
Physical health characteristics			
Number of medical conditions	3.0 (2.2)	0.08***	NS
Somatic symptoms	3.0 (3.3)	0.18***	0.06***
Cognitive functioning	89.2 (15.1)	-0.21***	0.07***
Any ADL/IADL disability	568 (15.4%)	0.09***	NS
Personality characteristics			
Extraversion	3.8 (1.5)	0.05**	0.04*
Agreeableness	5.0 (1.2)	0.04	
Conscientiousness	5.8 (1.2)	0.01	
Emotional stability	5.2 (1.4)	-0.05**	0.06**
Openness to experiences	4.8 (1.2)	0.10***	NS
Psychosocial characteristics			
Purpose in life	21.1 (4.9)	0.06***	0.05*
Gratitude	6.2 (1.2)	0.10***	0.04*

Table 1 (continued)

	Sample characteristics (N = 3,847)	Bivariate correlation with total PTGI-SF score	Multivariable regression model
Community integration	4.0 (1.8)	0.06***	NS
Optimism	5.0 (1.5)	0.03	
Curiosity/exploration	5.0 (1.4)	0.14***	0.11***
Resilience	39.1 (6.8)	-0.03	
Grit	3.7 (0.6)	-0.05**	NS
Structural social support	8.1 (10.7)	0.03	
Social support received	18.5 (5.2)	-0.02	
Secure attachment	2692 (66.7%)	-0.08***	NS
Altruistic behavior	2.4 (1.1)	0.13***	0.05**
Social support provided	19.0 (4.3)	0.07***	NS
Frequency of religious service attendance	2.8 (1.8)	0.20***	0.07***
Time spent in private religious activities	3.1 (2.1)	0.23***	NS
Intrinsic religiosity	9.6 (4.1)	0.25***	0.18***

Note. PTGI-SF, Posttraumatic Growth Inventory-Short Form; PTSD, posttraumatic stress disorder; MDD, major depressive disorder; AUD, alcohol use disorder; DUD, drug use disorder; ADL, activities of daily living; IADL, instrumental activities of daily living. β, standardized coefficient. NS, not significant at $p < .05$ in the multivariable linear regression model. *$p < .05$, **$p < .01$, **$p < .001$

PTSD (72.0–86.4% for any PTG, $p < .001$). One interpretation of this finding is that the current study used a more comprehensive measure to assess PTEs (LEC-5) and the most up-to-date version of the PTSD Checklist to assess PTSD symptoms (PCL-5). Given that traumatic experiences serve as an impetus for the development of PTG [1], more comprehensive trauma exposure measures with greater coverage of PTEs assess a broader array of experiences from which PTG could develop. An increase in the prevalence of PTG may also be explained in part by greater utilization of adaptive coping strategies conducive to developing PTG, such as meaning making, emotional regulation, and interpersonal communication [44–46] among veterans. Further research is needed to determine factors that may underlie population-level increases in PTG among veterans, as well as to examine the nature and correlates of changes in PTG over time.

Using a curve estimation analysis, we found that a quadratic, inverted U-shape relationship provided the best characterization of the association between PTSD symptom severity and PTGI-SF scores. This finding aligns with prior work evidencing that PTG is more likely to develop at the moderate levels of PTSD symptoms relative to low or high levels [14, 16, 35, 36]. Further, a PCL-5 score range of 31 to 51 was associated with the highest likelihood of endorsing PTG. This finding provides further support for an inverted U-shaped relationship between PTSD symptoms and PTG, as a certain level of PTSD symptoms—moderate-to-high—is needed to trigger PTG [1]. Notably, a score of 31 was also identified as the lower limit of an optimally efficient PCL-5 score range of 31–33 for diagnosing PTSD using a structured clinical interview in veterans [41]. To our knowledge, the present study is the first to explicitly identify a range of PCL-5 scores associated with the endorsement of PTG. Results suggest that veterans with excessively low or high severity of PTSD symptoms may be less able to develop PTG due to insufficient symptoms from which to develop PTG or extremely debilitating symptoms that may thwart the process of developing PTG.

They further suggest that mitigation of severe PTSD symptoms using interventions such as cognitive behavioral therapy [47, 48] and acceptance and commitment therapy [49, 50] may potentially help veterans develop PTG.

Intrinsic religiosity was identified as the strongest correlate of PTG, which is consistent with our prior 2011 study of a separate nationally representative sample of veterans [14]. While some studies have found that religiosity and spirituality may be linked to mental disorders and related negative consequences [51, 52], positive associations between religiosity and PTG have also been observed. Religious individuals may be more likely to develop PTG, but at the same time, development of PTG may inspire individuals to grow spiritually [34]. Religiosity is rooted in and related to personal meaning in life [34, 53], as evidenced by positive links between religiosity and meaning/purpose in life [54, 55]. Intrinsic religiosity may also promote use of adaptive religious coping techniques (e.g., benevolent religious reappraisal, religious focus; [31, 56]). Both purpose in life and adaptive religious coping, with their known salutary effects [57, 58], may ultimately help trauma-exposed individuals develop PTG. Additionally, it is worth noting that intrinsic religiosity was a stronger correlate of PTG (14.9% RVE) compared to another religiosity measure—frequency of religious service attendance (5.0% RVE; i.e., organizational religious activities). This may be explained in part by the PTGI-SF including spiritual change as one of the five domains [42], although we acknowledge that spiritual changes following trauma exposure and intrinsic religiosity are not necessarily the same. Importantly, given the cross-sectional nature of the study, this interpretation should be made with caution and further study is warranted to examine the direction of these associations.

Intrusive symptoms of PTSD, particularly those that are internally-generated (e.g., intrusive distressing memories of the trauma), were strongly associated with PTG. Even though the 8-factor model of DSM-5 PTSD symptoms is relatively new [37, 38], previous studies have shown that reexperiencing/intrusive symptoms were associated with personal strength, new possibilities, and appreciation of life domains of PTG [59, 60]. This association is also supported by prior work showing that cognitive processing and restructuring are often needed for PTG to develop [61, 62]. Intrusive rumination may thus serve as a precursor to more deliberate or reflective rumination [63], which may in turn help foster PTG [64, 65]. Intrusive symptoms of PTSD likely provide an avenue to reflect and process a traumatic experience within the context of low avoidance of such symptoms, which may potentially help foster PTG. Given the novelty of the eight-factor PTSD model, no known study has examined the relationship between externally-generated intrusions (e.g., emotional and physiological reactions to trauma cues) and PTG; still, such uncontrolled reactions to environmental cues may also serve as a reminder and provide an opportunity to deliberately process and cognitively restructure traumatic experiences [63], even though the process itself may be distressing to individuals. Taken together, even though internally- and externally-generated intrusive symptoms of PTSD are manifested differently in trauma-exposed individuals, both symptom clusters may serve the same function helping to facilitate more deliberate and organized ruminative processing of traumatic life events. Further research is needed to evaluate whether facilitation of more deliberate and organized rumination of internally- and externally-generated intrusive symptoms may help promote PTG.

This study has several limitations. First, this is an observational, cross-sectional study, which precludes any causal or temporal inference among study variables. Correlates of PTG observed in this study are a mixture of positive and negative factors. Some of these factors

(e.g., intrusive symptoms of PTSD) may serve as catalysts for PTG, while others (e.g., extraversion) may help promote more constructive responses and trauma processing, and still others (e.g., gratitude, altruistic behavior) may be outcomes of PTG. Thus, interpretation of correlates of PTG should be made with caution; within-subject studies utilizing methods such as ecological momentary assessment are needed to disentangle interrelationships among these variables. Second, to identify robust correlates of PTG, our analyses adjusted for the nature of index event type; however, it is possible that correlates of PTG may differ by index event type, as well as other aspects of trauma history (e.g., duration of trauma, secondary stressors). Third, survey responses, which include PTSD symptoms, PTG, and other psychiatric disorders, were based on self-report assessments and, thus, may be subject to biases. Fourth, PTG was assessed using PTGI-SF which is based on the original PTGI [42]; however, an updated PTGI-X includes 4 additional items on existential changes that assess more diverse and non-religious aspects of spiritual and existential experiences that could arise following a traumatic event [66]. Fifth, given that the NHRVS is nationally representative of U.S. veteran population, participants are disproportionately older, male, and white, non-Hispanic, which may limit generalizability to more diverse veteran subgroups. Sixth, despite the wide range of variables assessed in the present study, it is possible that variables that were not assessed, such as ruminative processing [67] and psychological flexibility [68], may additionally be linked to PTG.

Despite these limitations, this study provides an up-to-date characterization of the epidemiology of PTG in the U.S. veteran population. Results revealed that more than 60% of trauma-exposed veterans and 80% of veterans who screened positive for PTSD endorsed PTG. An inverted U-shaped relationship between PTSD symptom severity and PTG was also observed, with the highest likelihood of PTG among veterans with PCL-5 scores ranging from 31 to 51. Intrinsic religiosity, and internally- and externally-generated intrusions were identified as the strongest correlates of PTG. Further research is needed to identify biological and psychosocial mechanisms underlying the development of PTG; examine the impact of PTG on physical, psychological, and social functioning; and develop and evaluate the effectiveness of clinical and public health interventions to promote PTG in veterans and other trauma-affected populations.

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Declarations

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