



# Latent profile analyses of posttraumatic stress disorder, depression and generalized anxiety disorder symptoms in trauma-exposed soldiers



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## ABSTRACT

Posttraumatic stress disorder (PTSD) is comorbid with major depressive disorder (MDD; Kessler et al., 1995) and generalized anxiety disorder (GAD; Brown et al., 2001). We aimed to (1) assess discrete patterns of post-trauma PTSD-depression-GAD symptoms using latent profile analyses (LPAs), and (2) assess covariates (gender, income, education, age) in defining the best fitting class solution. The PTSD Checklist (assessing PTSD symptoms), GAD-7 scale (assessing GAD symptoms), and Patient Health Questionnaire-9 (assessing depression) were administered to 1266 trauma-exposed Ohio National Guard soldiers. Results indicated three discrete subgroups based on symptom patterns with mild (class 1), moderate (class 2) and severe (class 3) levels of symptomatology. Classes differed in symptom severity rather than symptom type. Income and education significantly predicted class 1 versus class 3 membership, and class 2 versus class 3. In conclusion, there is heterogeneity regarding severity of PTSD-depression-GAD symptomatology among trauma-exposed soldiers, with income and education predictive of class membership.

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## 1. Introduction

Posttraumatic stress disorder (PTSD) is comorbid with generalized anxiety disorder (GAD; Brown et al., 2001), and major depressive disorder (MDD; Müller et al., 2014; Pietrzak et al., 2011). There is heterogeneity among people with PTSD, GAD and depression; two people with a similar diagnosis may have different symptom presentations (American Psychiatric Association, 2013).

Hence diagnostic criteria for PTSD, given its comorbidity (Spitzer et al., 2007), and use of DSM categorical diagnoses (Galatzer-Levy and Galatzer-Levy, 2007) has been debated. Although a person-centered approach to discern post-trauma comorbidity and heterogeneity has been suggested (Galatzer-Levy and Bryant, 2013), few have used this approach (e.g., Au et al., 2013). We assessed heterogeneity in PTSD-GAD-depression symptomatology in trauma-exposed soldiers using a person-centered approach and assessed the predictive value of socio-demographics in defining groups.

About 48–55% of individuals with PTSD have comorbid MDD (Elhai et al., 2008; Kessler et al., 1995). About 17% of men and 15% of women with lifetime PTSD have comorbid GAD (Kessler et al.,

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1995); in veterans the prevalence rate for comorbid PTSD-GAD is 5% (Milanek et al., 2013). Explanations for such co-occurrence patterns include PTSD's symptom overlap with depression and GAD (Brady et al., 2000; Garber and Weersing, 2010; Spitzer et al., 2007); depression as a risk factor for traumatic event exposure and PTSD symptoms following trauma exposure (Brady et al., 2000; Breslau, 2009); and shared environmental and/or genetic risk or buffering factors (Breslau, 2009; Neria et al., 2010).

The “network approach,” a symptom-level explanation highlights individualized causal network-based interrelationships of symptoms in co-occurring conditions. For example, the MDD fatigue symptoms could causally influence GAD concentration problems (Borsboom et al., 2011). In contrast, an empirically supported latent-level explanation is the quantitative hierarchical model (Watson, 2005, 2009), proposing a higher-order factor of emotional disorders encompassing subclasses of 1) bipolar disorders 2) distress disorders (e.g., MDD, PTSD, GAD), and 3) fear disorders (panic disorder, phobias). PTSD, GAD and depression are conceptualized as sharing distress (Watson et al., 2011).

Studies have examined underlying component(s) of PTSD, GAD and depression possibly responsible for their co-occurrence. Assuming homogeneity in the population; most studies have used variable-centered approaches such as factor analyses to assess relations between variables (Olinio et al., 2012). However, variable-centered approaches are problematic if there is heterogeneity in the population; aggregated results may not apply to individual-based relations - an ecological fallacy (von Eye and Bogat, 2006). Thus, person-centered approaches that account for population heterogeneity are recommended (Galatzer-Levy and Bryant, 2013). One such approach involves Latent Class Analysis (LCA) assessing categorical symptom indicators or Latent Profile Analysis (LPA) assessing continuous indicators for group classification. LPA classifies individuals into latent homogenous classes based on similar response patterns across continuous indicators assessing symptom severity (McCutcheon, 1987). Thus, individual profiles are compared with reference to shape (qualitative differences) and symptom levels (quantitative differences) (Nugent et al., 2012). LPA is preferred in the current study. First, it allows for assessment of

heterogeneity in PTSD-depression-GAD comorbidity by identifying classes of individuals differing in symptom type or severity (Nugent et al., 2012). Second, instead of just the presence/absence of symptoms and disorders, it takes into account symptom dimensionality to outline symptom clusters (Galatzer-Levy et al., 2013); this can highlight course of illness and etiology helpful in clinical treatment (Olinio et al., 2012).

Table 1 summarizes findings from studies using person-centered approaches in assessing heterogeneity in PTSD, depression, and/or anxiety symptoms. As seen, majority of PTSD research has supported a three-class solution differing in symptom severity (Ayer et al., 2011; Breslau et al., 2005; Elhai et al., 2011; Steenkamp et al., 2012). However, regarding depression, there is less consistent research regarding the best-fitting class solution (Chen et al., 2000; Crum et al., 2005; Ferdinand et al., 2005; Parker et al., 1999; Prisciandaro and Roberts, 2009). Additionally, there is no known study assessing GAD symptoms with LPA/LCA. Studies assessing heterogeneity in PTSD-depression symptom patterns have not only indicated that PTSD and depression probably comprise a similar latent class (Olinio et al., 2012) but there is comparable severity across the disorders in the form of a four-class solution (Au et al., 2013) or a three-class solution (Armour et al., in press).

Unique to the literature, we extend the aforementioned line of research to assess heterogeneity in PTSD, GAD, and depression symptomatology; this is particularly relevant given their membership in the same distress disorder category of the quadripartite model (Watson, 2005). Further, we also assess the predictive function of some relevant socio-demographic risk factors – age, gender, income and educational status – based on availability in the dataset and relevant literature. Research indicates a relation between younger age and membership in the more symptomatic PTSD class (Naifeh et al., 2010), and greater likelihood of GAD (Milanek et al., 2013). Women are more likely to have greater PTSD, depression, and GAD severity (Ayazi et al., 2014; Neria et al., 2010). Finally, research indicates a relation between lower socio-economic status and PTSD and GAD diagnoses (Ayazi et al., 2014). Further, there is a relation between less education and poor psychological health among trauma-exposed populations (reviewed in Roberts

**Table 1**  
Summary of findings of latent class solutions of PTSD, depression and anxiety symptoms in prior studies.

Study	Best fitting class solution	Severity/type differences	Nature of classes
<i>PTSD symptoms</i>			
Ayer et al. (2011)	3-class	Severity	Mild/no symptomatology, moderate, severe
Breslau et al. (2005)	3-class	Severity	Mild/no symptomatology, moderate, severe
Elhai et al. (2011)	3-class	Severity	Mild/no symptomatology, moderate, severe
Steenkamp et al. (2012)	3-class	Severity	Mild/no symptomatology, moderate, severe
Maguen et al. (2013)	4-class	Severity and type	High symptom, intermediate symptom, intermediate symptom with low emotional numbing, low symptom
Naifeh et al. (2010)	2-class	Severity	More symptomatic, less symptomatic
Berntsen et al. (2012)	6-class	Severity and type	Resilient, extremely resilient, new onset, late-benefit, strong-benefit, mid-benefit
Nugent et al. (2012)	6-class	Severity and type	Resilient, moderate with amnesia, moderate with diminished interest, moderate without diminished interest and amnesia, severe without amnesia, severe overall
Wolf et al. (2012)	3-class	Severity and type	Low PTSD severity, high PTSD severity, dissociative
<i>Depression symptoms</i>			
Prisciandaro and Roberts (2009)	3-class	Severity	Severe, moderate, cognitive-affective distress
Parker et al. (1999)	3-class	Type	Psychotic, melancholic and non-melancholic
Crum et al. (2005)	2-class	Severity	Simple unaffected/mild, affected
Ferdinand et al. (2005)	4-class	Severity and type	Mild, moderate, severe, class with prominent sleep difficulties
Chen et al. (2000)	5-class	Severity and type	Anhedonia, suicidal, psychomotor, severely depressed, non-depressed
<i>Anxiety symptoms</i>			
Ferdinand et al. (2005)	3-class	Severity	Mild, moderate, severe

and Browne, 2011) and between less education and membership in the PTSD pervasive disturbance class (Steenkamp et al., 2012).

### 1.1. Current study

Using LPA to assess heterogeneity in PTSD-depression-GAD symptom patterns, we first hypothesize a best-fitting three-class solution differing in symptom severity based on prior research (e.g., Armour et al., in press, Prisciandaro and Roberts, 2009; Steenkamp et al., 2012). We have no further hypothesis regarding the qualitative nature of classes in our sample. Second, we hypothesize that being younger, female, having lower income and lower educational status will predict membership in the more severe symptomatology class (reviewed in Ozer et al., 2003; Roberts and Browne, 2011).

## 2. Methods

### 2.1. Participants/procedure

The current study was part of a prospective mental health longitudinal study among members of the Ohio Army National Guard (OHARNG). The sampling frame consisted of all soldiers enlisted in the OHARNG as of June 2008 and those enlisted between July 2008 and February 2009. All the soldiers were sent letters alerting them of the study with an option to opt-out and then subsequently a phone call to obtain each soldier's consent to participate in a telephone interview. Among the 12,225 members invited to participate in the telephone interview, 345 individuals were excluded for a lack of mailing address. Further, among potential subjects, 1013 (8.3%) declined to participate, 1130 (10.1%) did not have a telephone number listed with the Guard, and 3568 (31.8%) did not have a valid/working telephone number. Additionally, the following participants were further excluded: 187 (2.8%) based on age eligibility restrictions, 1364 (20.9%) declined to participate, 31 (.4%) for having English language or hearing deficits, and 2316 (35.5%) for not being contacted before the cohort was closed to new recruitment. This resulted in a sample size of 2616 participants.

The National Guard Bureau, Office of Human Research Protections of the U.S. Army Medical Research and Materiel Command and several institution review boards including University of Toledo, Columbia University and Case Western Reserve University approved the study. Written Informed consent was obtained. The investigation was carried out in accordance with the Declaration of Helsinki.

### 2.2. Measures

#### 2.2.1. Computer-assisted telephone interview (CATI)

Trained professionals at the survey research firm Abt SRBI, Inc. conducted CATI. Demographic and mental health functioning data were obtained by standardized self-report measures.

#### 2.2.2. Deployment Risk and Resilience Inventory (DRRI)

The DRRI with its 10 subscales assesses deployment-related risk and resiliency factors, including potentially traumatic combat experiences (King et al., 2006). Evidence indicates good internal consistency (.80 or higher) for 8 subscales and good criterion-related validity for the 10 subscales (Vogt et al., 2008). For the current study, we used only the DRRI items referencing exposure to military-related traumatic events.

#### 2.2.3. The Patient Health Questionnaire-9 (PHQ-9)

This self-report instrument assesses 9 DSM-IV major depressive episode (MDE) criteria with a Likert scale of four response options

("0 = Not at all" to "3 = Nearly every day") referencing the past two weeks. The instrument has good internal consistency ranging from .86 to .89 (Kroenke et al., 2001) with .85 in the current study, and good test-retest reliability (Kroenke et al., 2001). The major depression diagnostic algorithm for DSM-IV criteria has lower sensitivity and specificity compared to the PHQ-9 cut-off score of 10 in predicting a DSM-IV MDE episode (Fine et al., 2013); the latter has sensitivity ranging from 74 to 88% and specificity ranging from 88 to 91% (Arroll et al., 2010; Kroenke et al., 2001). For the current study, the PHQ-9 was modified to reflect lifetime DSM-IV depression symptoms by asking the question "In your lifetime, did you ever have a period of at least two weeks during which you were bothered by" specific symptoms, and then asking about the frequency of the symptom endorsement for that same two week period. Assessing lifetime depression with the PHQ-9 has moderate accuracy in detecting people with MDE or MDD as assessed by the Structured Clinical Interview for DSM-IV Axis I disorders (Fine et al., 2013).

#### 2.2.4. PTSD Checklist (PCL)

The PCL (Weathers et al., 1993) is a self-report measure that assesses severity of the 17 DSM-IV PTSD symptoms using a five-point Likert-type scale (1 – "not at all" to 5 – "extremely") referencing the past month. There is evidence of convergent and discriminant validity, high internal consistency (.94) including that of .95 in the current study, and good one-week test-retest reliability (.88) (Ruggiero et al., 2003). The recommended cut-off point to diagnose PTSD ranges from 30 to 60 (reviewed in McDonald and Calhoun, 2010). A cut off score of 44 yields good sensitivity (.94), and specificity (.86) (Blanchard et al., 1996). For the current study, we assessed for lifetime PTSD symptoms after the worst military traumatic event by asking the question "Now I'm going to ask you about problems and complaints you may have had because of this event. Please tell me how much you were ever bothered by each of these problems in relation to this stressful experience" for each PTSD symptom.

#### 2.2.5. The Generalized Anxiety Disorder 7-item scale (GAD-7)

The GAD-7 is a 7-item self-report measure assessing GAD symptoms with a four-point Likert-type scale (0 = "Not at all" to 3 = "Nearly every day") referencing the past two weeks. It further assesses functional impairment related to the endorsed symptoms (Spitzer et al., 2006). The measure has good internal consistency ranging from .89 to .92 (Löwe et al., 2008; Spitzer et al., 2006), with .84 in the current study; good test-retest reliability (.83) and good convergent validity (e.g.,  $r$  of .72 and .74) with other anxiety measures (Spitzer et al., 2006). A cut off score of 10 or greater is recommended to diagnose potential cases of GAD (Löwe et al., 2008; Spitzer et al., 2006). The present study assessed for lifetime symptomatology by asking the question "In your lifetime, did you ever have a period of at least two weeks during which you were bothered by" specific symptoms, and then asking about the frequency of the symptom endorsement for that specific time period.

### 2.3. Treatment of missing data

The sample of 2616 participants was restricted to those not missing more than 30% on either the PCL (>5 items), PHQ-9 (>3 items) or GAD 7 (>2 items) measures; we thus excluded one participant missing more than 6 PHQ-9 items. When restricting this sample of 2615 to those with a deployment-related trauma, the resulting effective sample size was 1266 participants. In the effective sample, data were not missing completely at random (MCAR); Little's  $\chi^2$  (1125) = 1569.792,  $p < .001$ . Missing data were estimated using Maximum Likelihood procedures (ML).

## 2.4. Sample characteristics

The final sample averaged 33 years ( $SD = 8.81$ ) in age, with the majority being male ( $n = 1144$ , 90.4%). A majority identified themselves to be Caucasian ( $n = 1127$ , 89.0%); while few were African-American ( $n = 81$ , 6.4%) or Hispanic ( $n = 6$ , 1.3%). Most received a high school diploma or equivalent ( $n = 1260$ , 99.5%), and many had attended some college/technical training ( $n = 636$ , 50.2%) or graduated from college ( $n = 243$ , 19.2%). Further, 873 participants worked full-time (69.0%), 103 participants worked part-time (8.1%), 185 participants were unemployed (14.6%), and 80 participants were on a student status (6.3%). Household income was reported as \$20,000 or less by 84 participants (6.6%), between \$20,001 and \$40,000 by 276 participants (21.8%), between \$40,001 and \$60,000 by 311 participants (24.6%), between \$60,001 and \$80,000 by 236 participants (18.6%) and greater than \$80,000 by 333 participants (26.3%).

Participants averaged 12.7 years in the service ( $SD = 7.81$ ), with all participants being deployed at least once ( $M = 2.02$ ,  $SD = 1.76$ ). Most reported their most recent deployment related to Operation Iraqi Freedom or Operation Enduring Freedom ( $n = 742$ , 58.6%). Exposure to combat was the most endorsed traumatic event ( $n = 999$ , 78.9%), followed by sudden and unexpected death of a loved one or close friend ( $n = 874$ , 69.0%), witnessing someone being killed or injured ( $n = 968$ , 55.1%), and witnessing severe human suffering ( $n = 598$ , 47.2%).

## 2.5. Analytic procedure

First, we conducted an LPA using Mplus 7.1 for continuous indicators (McLachlan and Peel, 2000; Muthén, 2004) of the PHQ-9, PCL, and GAD-7 item-level scores to identify the best-fitting class solution. We used maximum likelihood (ML) estimation with robust standard errors to assess classification of participants based on item responses. One through four-class models were analyzed. Although most prior research with PTSD (e.g., Steenkamp et al., 2012) and depression items (e.g., Prisciandaro and Roberts, 2009) indicate a three-class model, we additionally ran a four-class model because no prior study has integrated PTSD, depression and GAD items simultaneously. We used several recommended fit statistics to determine the optimal number of classes. Lower Bayesian Information Criterion (BIC) values and sample-size adjusted BIC values (SSBIC) are recommended (DiStefano and Kamphaus, 2006; Nylund et al., 2007a,b; Yang, 2006). A model with a 10-point lower BIC value has a 150:1 likelihood to be the better fitting model (Raftery, 1995). Additionally, when comparing a K-class model with a K-1 class model, a significant Lo–Mendell–Rubin likelihood (LRT) test indicates that the model with K classes is optimal; this value is in fact preferred over comparison of the BIC values (Nylund et al., 2007a). Hence, the best class solution would have lower BIC and SSBIC values, and a significant LRT  $p$  value.

The second step included analyzing covariates of class membership wherein the best-fitting class solution (using latent class posterior probabilities) found in Step 1 was regressed on covariates. Based on prior research elaborated above regarding their relation

with PTSD, depression and GAD, age, gender, income (equal or less than \$60,000 versus greater than \$60,000) and educational status (no college versus some college or higher than college education) were included as covariates.

## 3. Results

See Table 2 for results on fit statistics. Using the empirically supported LRT value (Lo et al., 2001) and comparing a model with K classes model against a model with  $K - 1$  classes (Nylund et al., 2007a), the three-class solution was superior to the two-class solution, adjusted Lo–Mendell–Rubin  $2LL_{diff} 34 = 3925.999$ ,  $p < .001$ . No subsequent class comparisons yielded significant results. The three-class solution also seems optimal when considering recommendations of relying more on LRT values compared to BIC values (Nylund et al., 2007a). Regarding recommendations of Nylund et al. (2007a) and Yang (2006) to choose the model with the lower BIC and SSBIC values respectively, it can be seen that the current study has models with continuously lowering BIC and SSBIC values, with the four-class model having the lowest BIC and SSBIC values. In these instances, DiStefano and Kamphaus (2006) recommend calculating differences between the BIC and SSBIC values of successive models with guidelines that a marginal difference between classes indicates that an additional class adds little to the model. Our results indicate that the difference between the two and three-class model was far more substantial compared to the difference between any other successive model comparisons. Additionally, prior research with PTSD and depression indicates a three-class solution as well. Thus, the three-class model seems optimal in terms of fit, theory, prior empirical findings, and parsimony.

Fig. 1 presents the corresponding profile plot. Class 3 is characterized by individuals with the highest mean scores on all depression, GAD and PTSD items. Class 2 has participants who had the next highest scores on all items, followed by class 1 participants with the lowest scores on all the items. See Table 3 for descriptive and diagnostic information on each latent class and the overall sample.

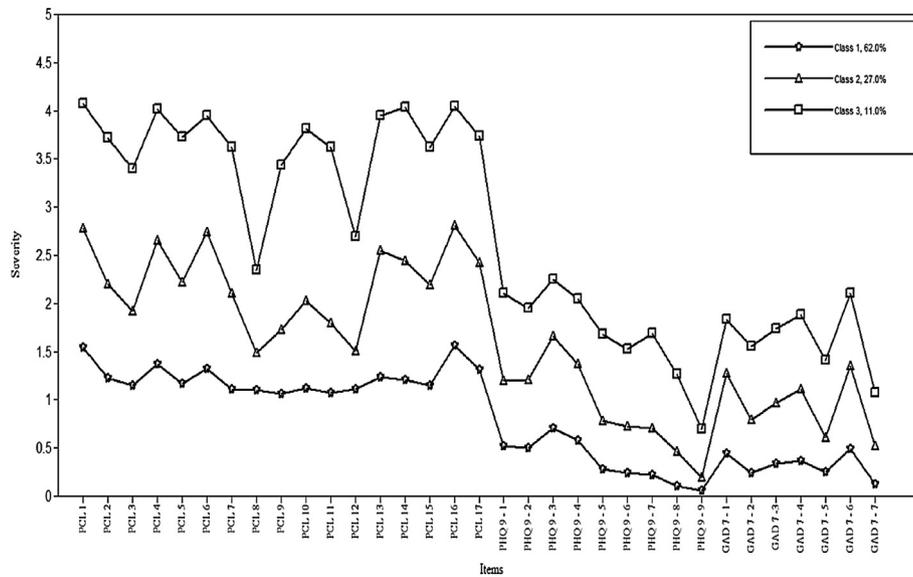
For the three-class solution, income,  $B = -.82$ ,  $z = .23$ ,  $p < .001$ ,  $OR = .44$ , and education,  $B = -.64$ ,  $z = .22$ ,  $p = .004$ ,  $OR = .53$  were significant in predicting class 1 versus class 3 membership. Higher income and education by every single unit increment decreased the chances of being in class 3 compared to class 1 by 56% and 47% respectively. Further, income,  $B = -1.38$ ,  $z = .26$ ,  $p < .001$ ,  $OR = .25$ ; and education,  $B = -.93$ ,  $z = .23$ ,  $p < .001$ ,  $OR = .40$  were also significant in predicting class two versus class 3 membership. Higher income and higher education by every single unit increment decreased the chances of being in class 3 compared to class 2 by 75% and 60% respectively.

## 4. Discussion

The current study assessed discrete patterns of PTSD–depression–GAD symptoms using LPA, and covariates in defining the best-fitting class solution in 1266 trauma-exposed soldiers. Results indicated a best-fitting three-class solution differing only in

**Table 2**  
LPA fit indices for a one-class, two-class, three-class, and four-class solution for the PHQ-9, PCL and GAD-7 item scores.

Model	AIC	BIC	SSABIC	Entropy	Adjusted Lo–Mendell–Rubin ( $p$ )
1 class	123,225.293	123,564.772	123,355.124		
2 class	110,291.399	110,805.761	110,488.113	.98	12,948.582 (.000)
3 class	106,417.236	107,106.481	106,680.833	.964	3925.999 (.0007)
4 class	104,173.758	105,037.886	104,504.238	.958	2302.000 (.2745)



**Fig. 1.** Figure of the three latent classes using the PCL, GAD-7 and PHQ-9 item scores. Note. The scale for item level severity is different for the different measures of the PCL-M (1–5), PHQ-9 (0–3), and GAD 7 (0–3).

**Table 3**

Means, standard deviations and diagnostic information for each latent class per the three-class solution.

	Full sample (N = 1266)	Class 1 (n = 786)	Class 2 (n = 341)	Class 3 (n = 139)
<b>PTSD</b>				
Mean score (SD)	29.86 (14.6)	20.80 (4.05)	37.93 (6.86)	61.83 (9.17)
Probable diagnosis (algorithm)	205 (16.2%)	0 (0%)	75 (22%)	130 (93.5%)
Probable diagnosis (44 cut-off score)	206 (16.3%)	0 (0%)	70 (20.5%)	136 (97.8%)
Mean age of onset (SD)		25.03 (10.24)	24.68 (10.81)	22.84 (10.13)
<b>Depression</b>				
Mean score (SD)	5.85 (6.18)	3.25 (4.50)	8.1 (5.26)	15.17 (5.34)
Probable diagnosis (algorithm)	357 (28.2%)	120 (15.3%)	135 (39.6%)	102 (73.4%)
Probable diagnosis (10 cut-off score)	312 (24.6%)	80 (10.2%)	117 (34.3%)	115 (82.7%)
Mean age of onset (SD)		28.02 (17.15)	26.26 (10.52)	28.44 (14.97)
<b>GAD</b>				
Mean score (SD)	4.45 (5.2)	2.26 (3.62)	6.56 (4.77)	11.64 (5.24)
Probable diagnosis	216 (17.1%)	42 (5.4%)	87 (25.5%)	87 (62.6%)
Mean age of onset (SD)		29.65 (18.86)	28.23 (13.39)	27.42 (12.09)
<b>All three diagnoses (PTSD algorithm, depression algorithm, GAD cut-off score)</b>				
	77 (6.1%)	0 (0%)	12 (3.5%)	65 (46.8%)
<b>All three diagnoses (PTSD, depression, and GAD cut-off scores)</b>				
	85 (6.7%)	0 (0%)	7 (2.1%)	78 (56.1%)

Note. We have reported the mean age of onset for PTSD (for those who endorsed response options other than “more than a year later; don't know or refused to answer” following their experience of their worst traumatic event); we used the *DSM-IV* algorithm for a depression diagnosis.

symptom severity (mild-class 1, moderate-class 2 and severe-class 3). Further, income and education significantly predicted class 1 versus class 3 and class 2 versus class 3 membership.

We found a best-fitting three-class solution consistent with prior research on PTSD (e.g., Steenkamp et al., 2012), depression (e.g., Prisciandaro and Roberts, 2009), and PTSD and depression together (Armour et al., in press). The current study extends findings of prior studies by uniquely assessing within-class and between-class heterogeneity with reference to PTSD-depression-GAD symptom severity. Our findings indicated differences across classes only in PTSD-depression-GAD symptom severity rather than type of symptoms comprising each homogenous class. In other words, classes are only distinguished by severity of PTSD, depression and/or GAD symptoms rather than presence or absence

of certain symptoms. This reflects a high degree of similarity in symptom severity response patterns across these distress disorders. Given that the instruments in the current study were modified to assess for lifetime symptoms and that there is no certain manner to assess if all the three disorder's symptom patterns overlapped, we are looking at heterogeneity in symptom patterns across time rather than necessarily overlapping at a certain timepoint.

Rarer in the literature has also been the current study's use of person-centered approaches compared to variable-centered approaches to assess symptom heterogeneity especially for the symptoms of usually comorbid emotional disorders. The use of LCA/LPA with symptoms of multiple conditions highlights important symptom differences (severity and/or type) among sub-classes of

people which can inform clinical assessment and/or treatment. For example, given the findings of the current study, we may expect to find that a person with severe PTSD symptoms may be more likely to have severe depression and/or GAD symptoms either overlapping with the PTSD symptoms or at different time points longitudinally. Thus, LCA/LPA approaches allows for a refined categorization of individuals (Nugent et al., 2012).

Studies by Au et al. (2013) and that by Armour et al. (in press) are most similar to the current study because they analyzed PTSD and depression symptoms using person-centered approaches; the difference is that they did not assess for additional GAD symptoms. Current study results are similar to both studies in terms of finding classes differing in symptom severity rather than symptom type; however differ from the Au et al. (2013) study which found a best-fitting 4 class solution. Specifically, Au et al. (2013) found two moderate severity classes compared to one moderate severity class in the current study. Differences in methodology and nature of the sample could explain differences in findings. Compared to Au et al. (2013) who analyzed four PTSD subscales and one depression mean scores in sexual assault victims, we analyzed all individual symptom mean scores in a military sample. Additionally, we looked at lifetime symptoms compared to Au et al. (2013) who assessed symptoms 1–4 months following traumatic event exposure. Thus, current study's assessment of each symptom over an extended period of time in a military sample with diverse traumatic experiences is important to note when comparing study findings.

Let us additionally refer as well to the quadripartite model's conceptualization of PTSD, depression and GAD belonging to the "distress disorders" category sharing a high amount of emotional distress (Watson, 2005). Had we found the three classes differing in symptom severity across measures, we could rethink if these disorders capture the same amount of emotional distress for an individual. It looks like the three classes of participants are homogenous in the sense that they may have the same amount of emotional distress possibly represented by PTSD-depression-GAD symptomatology; however the disorders themselves may still be distinct in terms of their non-specific factors. In this manner, results may add to the conceptualization of these emotional disorders per the quadripartite model.

There are some additional noteworthy points regarding the symptom patterns within classes. First, class 1 did not comprise people with a probable PTSD diagnosis; however it had people with a probable GAD and/or depression diagnoses. This trend is consistent with research indicating a greater prevalence of MDD and GAD compared to PTSD (Neria et al., 2010). Second, the proportion of people with a probable PTSD diagnosis and PTSD's comorbidity with other disorders increased with class symptom severity. This is consistent with research indicating that as PTSD's severity increased, comorbidity with conditions such as mood disorders increased (Galatzer-Levy et al., 2013). People with sub-clinical PTSD symptoms and partial PTSD (4.6% prevalence rate in a veteran sample) may have comorbid mood or anxiety disorders post-trauma needing clinical intervention (Grubaugh et al., 2005; Müller et al., 2014). Thus, paying attention to sub-clinical PTSD symptoms is important because its comorbid distress and comorbidity, although present in a large majority of veterans, is not extensively addressed in trauma treatment literature (Grubaugh et al., 2005).

Third, when using both diagnostic benchmarks (*DSM-IV* algorithm and cut-off score), we see more comparable results for PTSD diagnoses rather than for depression diagnoses. What this could mean is that probably using both diagnostic benchmarks with the PHQ-9 may be essential to obtain a more comprehensive picture of the diagnostic prevalence rates for depression. This is especially

important given that research has indicated a difference in diagnostic efficiency when assessing for lifetime depression with the PHQ-9 with the two diagnostic methods of using the *DSM-IV* algorithm and recommended cut-off score (Fine et al., 2013). Lastly, the age of onset of PTSD symptoms seems to precede the age of onset for depression and GAD symptoms which is consistent with prior research (Breslau et al., 2000).

Among socio-demographic risk factors, only income and education predicted class membership. Higher income and higher education were associated with being in a lower symptom severity class. Results follow existing literature (reviewed in Roberts and Browne, 2011). Socio-economic factors associated with low income such as unemployment, and poorer living conditions are possibly associated with poor psychological health among trauma-exposed populations (reviewed in Roberts and Browne, 2011). Hypotheses regarding age and gender as risk factors of class membership were not confirmed. It must be noted that there is inconsistency in the literature regarding their role as risk factors. While one line of research indicates that age is not a significant predictor of PTSD class membership (Steenkamp et al., 2012) and is unrelated to PTSD, depression and GAD severity (Neria et al., 2010), contrasting research indicates a significant relation between younger age and membership in the more symptomatic PTSD class (Naifeh et al., 2010), and between increasing age with worse psychological health post-trauma exposure (reviewed in Roberts and Browne, 2011). Additionally, our results are consistent with literature indicating that gender is not a significant predictor of PTSD class membership (Naifeh et al., 2010; Steenkamp et al., 2012), gender's role as a risk factor for PTSD is small (meta-analyzed in Brewin et al., 2000), and there are no gender differences in GAD severity (Ayazi et al., 2014; Milanak et al., 2013).

#### 4.1. Implications

The current study has important clinical and theoretical implications. First, when looking at symptoms of usually comorbid disorders such as PTSD, depression and GAD, there seems to be heterogeneity in symptom severity rather than symptom type across classes over a period of time. Thus, it would be preferable to assess for PTSD, depression and GAD symptom severity patterns post-trauma. Second, there may be a resilient class on one end of the spectrum and clinical impairment on the other with regards to post-trauma exposure (Elhai et al., 2011); this is important for mood disorder treatment in terms of understanding differences in reactions to trauma exposure. Third, similarity of response patterns in type across classes supports the affective disorder conceptualization in the quadripartite model (Watson, 2005).

Fourth, finding distinct classes of people differing in symptom severity consistently across the assessed symptoms adds to the usefulness of person-centered approaches. Lastly, people with better education and higher income may have less severe symptomatology; these variables could be highlighted when thinking of quality of life concerns for clients. Thus, it may be important to address the factors of income and education in clinical assessment, treatment, as well as preventive efforts. Providing people with better education and opportunities for increased income may serve as a protective factor for PTSD, depression and GAD severity.

#### 4.2. Limitations and future research

Use of self-report measures can reflect likely social desirability effects and inaccuracies in clinical diagnoses; future research would benefit from additional use of clinician-administered structured diagnostic measures. Further, missing data were not missing

completely at random which can result in biased estimates. Additionally, analyses of other fear and distress-based disorders in a latent class analysis framework would possibly indicate important comorbidity trends. Calabrese et al. (2011) used the entire sample finding that one of PTSD's most common comorbid disorder were alcohol abuse (7.5%) and alcohol dependence (17%); thus assessing PTSD's symptomatology with such conditions may be of future interest. For the PCL, not restricting the symptom assessment to the same 1 month time frame opens up the possibility that different PTSD symptoms may be present at different time points which may complicate the interpretation of the current study results. Although the current study has possible implications for understanding and treating post-trauma symptoms, limitations of use of cross-sectional data and lack of definitive overlapping timeline for symptomatology need to be considered. The current study lays the foundation to assess such a similar question for overlapping symptoms occurring within the same time period; this will shed light on whether the three disorders are possibly a part of a common post-trauma distress (Norman et al., 2011), and may possibly inform transdiagnostic treatments.

### Contributors

Ateka Contractor conducted the literature review, analysis, manuscripts preparation, and incorporated feedback into the drafts of the manuscript.

Jon Elhai assisted with the analyses and provided feedback on drafts.

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### Conflict of interest

None.

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