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PTSD, comorbid pathology and personality among Dutch veterans: a cluster analysis.

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Abstract: Previous research with other trauma populations demonstrated that internalising and externalising expressions of posttraumatic stress disorder (PTSD) are associated with different comorbid disorders and personality dimensions. The present study tested this association in a sample of 99 Dutch male veterans with PTSD. Cluster analysis was used to categorise subtypes of expressions of PTSD, using measures of comorbid depression, anxiety, substance abuse and hostility and the BIG-5 personality trait dimensions conscientiousness, neuroticism and extraversion. The results contradict previous research and suggest the existence of a low pathology cluster, a high pathology cluster and a high pathology cluster combined with substance abuse. This study is one of the first cluster-analytic investigations of Dutch veterans with PTSD, and discusses implications for future research and practical implications.

Samenvatting: Eerder onderzoek naar andere trauma populaties heeft aangetoond dat een posttraumatische stressstoornis (PTSS) geassocieerd wordt met verschillende comorbide stoornissen en persoonlijkheidsstijlen. Er werd een indeling gevonden in een internaliserende en een externaliserende stijl van expressie. Het huidige onderzoek heeft dit verband onderzocht in een groep van 99 mannelijke Nederlandse veteranen met PTSS. Door middel van clusteranalyse werden de verschillende stijlen gecategoriseerd op basis van comorbide depressie, angst, middelen misbruik en agressie en de BIG-5 persoonlijkheidsdimensies consciëntieusheid, neuroticisme en extraversie. De resultaten spreken eerder onderzoek tegen en wijzen op het bestaan van een cluster met lage pathologie, een cluster met hoge pathologie en een cluster met hoge pathologie gecombineerd met middelen misbruik. Dit onderzoek is een van de eerste studies naar de clustering van Nederlandse veteranen met PTSS en bespreekt implicaties voor toekomstig onderzoek en praktische implicaties.

Introduction

Posttraumatic stress disorder (PTSD) is an anxiety disorder that results from exposure to a traumatic, life-threatening event, such as combat, crime or an accident, that involved elicited feelings of fear, helplessness, or horror in the individual (American Psychiatric Association, 2000). Although many people experience traumatic events during their lifetime, most of them will fully recover. However, around 7% respond to such an event in a problematic way and develop symptoms of PTSD (Keane, Marshall & Taft, 2006).

In addition to emotional and cognitive symptoms that constitute the DSM-IV-TR definition of PTSD (i.e. avoidance, re-experiencing and hyperarousal; American Psychiatric Association, 2000), individuals with PTSD are more likely to experience family problems, physical health problems and other psychiatric disorders. Certain groups have a greater risk of developing PTSD. Veterans show higher prevalence rates of PTSD. In Dutch soldiers returning from Iraq an PTSD estimate of 17-21% was found (Engelhard et al., 2007). A high percentage of veterans with PTSD, around 75%, also suffer from other psychiatric disorders (Kulka et al., 1990; Ginzburg, Ein-Dor & Solomon, 2009). Frequently observed comorbid disorders are major depression (Koenen et al., 2003), generalised anxiety disorder (Chantarujikapong et al., 2001) and alcohol and drug abuse (Koenen et al., 2005). Among veterans with PTSD, lifetime prevalence of comorbid disorders was approximately 77% for other anxiety disorders and depression or both (Ginzburg et al, 2009) and 75% for substance use disorders (Kulka et al., 1990).

Based on the differences in comorbidity in individuals with PTSD, it appears that the form and expression of posttraumatic responses within a particular trauma population is considerably heterogeneous. Gaining more understanding of this variability is important because it creates a more detailed view of the PTSD population and possible comorbidity patterns. Veterans suffering from PTSD show high comorbidity rates, which may help explain the lack of success of regular PTSD treatment compared to other PTSD populations (Ford & Kidd, 1998; Bradley, Greene, Russ, Dutra, & Westen, 2005). Guidelines for treating PTSD warn for comorbid disorders, because they could have negative effects on treatment outcome (NICE, 2005; TENTS, 2008), which can imply the need for more individually, tailored treatments (Ford & Kidd, 1998).

Several studies have shown that patterns of psychiatric comorbidity cohere along two dimensions that differ with regard to the form in which psychological distress is expressed. These dimensions are labelled internalising, the propensity to express distress inwards, and

externalising, the propensity to express distress outwards (Krueger, 1999; Krueger et al., 2001; Miller, 2003; Miller, Fogler, Wolf, Kaloupek & Keane, 2008). A person high on externalisation is likely to express distress outward through behaviours, regardless of the situation in which they experience distress. In contrast, someone high on internalisation is likely to experience their distress internally, for example, through mood and thoughts (Rielage, Hoyt & Reshaw, 2010). The internalising dimension includes comborbid anxiety and mood disorders and the externalising dimension includes hostility, comorbid antisocial personality disorders and substance abuse disorders (Krueger et al., 2001; Miller, 2003; Miller & Resick, 2007; Forbes, Elhai, Miller & Creamer, 2010).

Research shows that also the form and expression of PTSD is influenced by individual differences in tendencies toward the externalisation versus the internalisation of distress (Miller, Kaloupek, Dillon & Keane, 2004). A model that has received recent attention in relation to PTSD comorbidities includes three subtypes: internalisers, externalisers and a low pathology group (Miller, Greif & Smith, 2003). Individuals who do not possess strong tendencies toward either of these extremes of managing distress have been referred to in previous research as the 'low pathology' group (Rielage et al., 2010). These subtypes could signal clinically relevant information about course and comorbidity patterns and can serve as a base for differentiated treatment (Dorrepaal et al., 2012).

In addition to those comorbid disorders that constitute the internalising and externalising dimension, Rielage and colleagues (2010) have shown that specific factors derived from the Big Five personality traits are useful in identifying different comorbidities among female veterans. Personality traits have been defined as 'dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings, and actions' (Castillo, Teten, Torres-Sena & Miller, 2006). The Big Five consists of five trait dimensions: openness, extraversion, conscientiousness, agreeableness and neuroticism. These main personality traits encompass human diversity and cover most of what we mean when referring to personality (McCrae & Costa, 1990, 1999). As Rielage et al. (2010) have shown, internalisers are characterised by low levels of extraversion and high levels of neuroticism, while externalisers are characterised by low levels of conscientiousness and moderate levels of neuroticism. Premorbid personality traits could be of strong influence on the relationship between trauma exposure and the emergence of PTSD and comorbid disorders (Miller, 2003). The behavioural dimensions of externalisation and internalisation therefore seem to reflect core personality processes that influence the form, course and expression of PTSD.

Miller and colleagues (2003) argue that understanding the variability and expression of PTSD is important to understanding the etiology and course of PTSD and in developing appropriate treatment techniques for this disorder. To the extent that the internalisation and externalisation dimension is able to predict PTSD comorbidities, it could assist in identifying which trauma survivors may need treatment for PTSD comorbidities (Rielage et al., 2010).

In the present study the first aim is to determine if the pattern of associations between personality dimensions and PTSD comorbidities exist amongst a Dutch veteran population and if the partition can be made into an internalising and an externalising cluster. A partition of individual veterans with PTSD into subgroups with propensities to the externalisation versus internalisation of distress is expected using cluster analyses. Specifically, following prior research, it is expected that there can be found (a) an internalising cluster defined by low levels of extraversion and high levels of neuroticism, combined with high levels of comorbid anxiety and depression, and (b) an externalising cluster defined by low levels of conscientiousness, moderate levels of neuroticism and high levels of hostility combined with comorbid substance abuse related disorders, and finally (c) a low pathology cluster, defined by high levels of conscientiousness and extraversion, low levels of neuroticism and hostility combined with low levels of comorbid anxiety, depression and substance abuse related disorders. (e.g. Forbes et al, 2010; Miller, 2003; Rielage et al, 2010).

Method

Participants

The data were collected from Dutch veterans diagnosed with PTSD (N = 99) that attended treatment at Foundation Centrum '45, a Dutch specialised centre for diagnostics and treatment of psychotrauma. The mean age of the participants was 40.8 year (SD = 8.7). Of the total sample, 76.5 % was in a relationship and 23.5 % was single at the time of assessment. 100% of the sample was male.

Measures

The Dutch *Zelf Inventarisatie Lijst* (ZIL) was used to measure PTSD symptoms (Hovens, Bramsen & Van der Ploeg, 2000). The ZIL is a 22-item self-report instrument of the extent to which a person has experienced PTSD symptoms in the past four weeks. Items are scored on a 4-point Likert-scale. The ZIL uses a cut-off score of 52 for a PTSD diagnosis (Hovens, et

al., 2000). Internal consistency of the scale is good with Cronbach's alpha between .90 and .94. A Pearson test-retest correlation showed that reliability of the total score is good ($r = .92$; Nunnally & Bernstein, 1994; Hovens et al., 2000). The ZIL has strong reliability and validity, with a sensitivity of .86 and a specificity of .71 (Bramsen et al., 1994).

The *Symptom Check List-90* (SCL-90; Arrindel, & Ettema, 1986) was used to measure symptoms of anxiety, depression and hostility. This 90-item multidimensional self-report measure encompasses eight different symptom clusters: agoraphobia, anxiety, depression, somatic symptoms, insufficiency of thought and behaviour, distrust, hostility, and problems with sleeping. Items are scored from 'very low' to 'very high' on a 7-point Likert scale. All scales have demonstrated strong internal consistency, with Cronbach's alpha ranging from .73 to .97. Convergent validity of the depression scale was good with a correlation of .80 with the Beck's Depression Inventory.

The personality traits conscientiousness, extraversion and neuroticism were assessed with the *NEO-Five Factor Inventory* (NEO-FFI; Costa & McCrae, 1992). The NEO-FFI is a self-report questionnaire with 60 items that are scored on a 5-point Likert scale. It is a widely used instrument to measure the five domains of personality (openness, conscientiousness, extraversion, agreeableness and neuroticism). Each of the in this study used domains possesses adequate internal consistency ($\alpha = .73$ to .88) and temporal stability ($r = .86$ to .90; Hoekstra, Ormel & Fruyt, 1996). Scores for each domain are obtained by summing the 12 item responses belonging to each of the subscales (Rosellini & Brown, 2011).

Comorbid substance abuse was based on the clinical diagnosis on axes I by a registered clinician. Of the sample, 19.2 % was diagnosed of having a substance abuse disorder.

Procedure

Participants' data were selected from a database already available at Foundation Centrum '45. Veterans completed a range of measures as part of a routine clinical assessment and evaluation procedure prior to commencing their treatment program. The data were collected between August 2005 and October 2012. In this period, 334 veterans enrolled in Foundation Centrum '45. Due to partial digitalization, data are only available from 215 clients. No fixed procedure was used to obtain the data for it was not originally collected for research purposes. Informed consent was obtained from all clients before they completed the questionnaires. Only veterans diagnosed with a posttraumatic stress disorder were selected from the available dataset. Their diagnosis was based on the clinical diagnosis of a registered clinician. Also, only veterans that completed all of the before mentioned questionnaires were selected for this

study. After visual data inspection one outlier on the extraversion scale of the NEO-FF-I was found. This participant was excluded from the sample.

Of the available remaining dataset of 215 clients, 99 were removed from this study because their data of the in this study used questionnaires were incomplete due to alterations in the range of measures that were part of the routine clinical assessment. In twelve cases, PTSD was not diagnosed and in five cases diagnoses of a substance abuse disorder was unknown. These seventeen clients were also removed from the study. This resulted in a final sample of 99 veterans with PTSD.

Statistical analyses

Cluster analysis

A cluster analysis was conducted to assess whether scores on the variables anxiety, depression, neuroticism, extraversion and conscientiousness could form distinct dimensions. A cluster analysis groups items within a heterogeneous sample and divides them into different homogeneous subgroups on the basis of similarities between variables (Miller et al., 2003). Prior to conducting these analyses, two assumptions need to be checked for. First, the scores of the different variables need to be normally distributed. Second, regarding the assumption of no perfect multicollinearity, no correlation between the variables $r > (-).90$ can exist (Field, 2013).

A cluster analysis was conducted in two stages. First, to obtain the ideal number of clusters, Ward's method was used (Ward, 1963). Ward's method is a hierarchical cluster analysis technique using squared Euclidian distance that sorts cases into groups in a series of steps equal to the number of cases in the sample. This method was selected because it optimizes the minimum variance within clusters and provides a quantitative method for selecting the optimal number of clusters. The stage at which two dissimilar clusters are merged indicates that the number of clusters prior to this stage is the optimal solution (Aldenderfer & Blashfield, 1984). Second, a *K*-means analysis was conducted to assign individual cases to clusters. K-means analysis requires an a priori specification of the number of clusters. This method was selected because it has an advantage relative to Ward's method in that it makes more than one pass through the data and can compensate for poor initial partitioning (Aldenderfer & Blashfield, 1984).

Analyses of variance

To investigate differences between the clusters, a *one-way between-groups multivariate analysis of variance* (MANOVA) was conducted. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers and homogeneity of variance-covariance matrices. Post-hoc comparisons were made using Hochberg's GT2 test to show differences in scores on all variables between the clusters. Hochberg's GT2 is a reliable option when participant numbers of the clusters differ (Field, 2013). Furthermore, a *one-way between-groups analysis of variance* (ANOVA) was used to explore differences between the clusters based on ZIL scores.

Results

Correlational analyses

To conduct a cluster analysis correlations between all variables are required $r < .90$ (Field, 2013). This assumption was met with the highest correlation of .73 between the subscales anxiety and depression of the SCL-90. For the exact correlation coefficients, see Table 1.

Table 1. Correlation analysis with the variables anxiety (ANX), depression (DEP), hostility (HOS), neuroticism (NEUR), extraversion (EXT) and conscientiousness (CON).

	ANX	DEP	HOS	NEUR	EXT	CON
ANX	1					
DEP	.729	1				
HOS	.523	.522	1			
NEUR	.609	.665	.310	1		
EXT	-.451;	-.552	-.450	-.504	1	
CON	-.324	-.457	-.213	-.615	.468	1

Cluster analyses

To determine the optimal number of clusters, a hierarchical cluster analyses was conducted. Ward's method produces an agglomeration schedule that shows the agglomeration coefficient for every cluster solution. A higher coefficient indicates better discrimination between the clusters. To determine the optimal cluster number it is important to inspect to which extent

adding an extra cluster increases the discrimination coefficient. As seen in Table 2, a three cluster solution is the optimal solution because adding a fourth cluster hardly contributes as differences in coefficients become considerably smaller.

Table 2. Reformed agglomeration schedule

Cluster number	Last step	Current step	Difference
2	562.33	398.30	164.03
3	398.30	302.79	95.52
4	302.79	255.92	46.87

Next, a K-means cluster analysis was conducted with a set number of three clusters. A three-cluster *K*-means analysis resulted in the assignment of 39 cases to cluster 1, 43 cases to cluster 2, and 17 cases to cluster 3. The mean and standard deviation for all clusters on anxiety, depression, hostility, neuroticism, extraversion, conscientiousness and PTSD severity are shown in Table 3.

Table 3. The mean (M) and standard deviation (SD) on anxiety, depression, hostility, neuroticism, extraversion, conscientiousness and PTSD severity and percentage (%) substance abuse for all clusters.

	Cluster					
	Cluster 1 (n = 39)		Cluster 2 (n = 43)		Cluster 3 (n = 17)	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*
Anxiety	33.15	6.21	20.60	5.41	30.65	7.48
Depression	29.38	4.67	18.49	4.21	24.88	5.40
Hostility	19.72	5.37	11.33	3.31	13.94	4.97
Neuroticism	46.33	7.50	36.12	7.16	44.00	8.09
Extraversion	28.51	6.65	36.98	7.31	32.00	7.63
Conscientiousness	36.62	7.39	43.28	5.82	38.06	7.81
PTSD severity	68.51	8.35	49.78	11.23	62.41	9.43
	%		%		%	
Substance abuse	0		4.65		100	

Multivariate analysis of variance (MANOVA)

To investigate differences between the three clusters a one-way between-groups multivariate analysis of variance (MANOVA) was performed. Seven dependent variables were used: substance abuse, anxiety, depression, hostility, neuroticism, extraversion and conscientiousness. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers and homogeneity of variance-covariance matrices, with no violations noted. There was a statistically significant difference between all clusters on the combined dependent variables, $F_{(14, 180)} = 53.65$, $p = .00$; Wilks' $\lambda = .04$; $\eta^2 = .81$.

Post-hoc comparisons

Post-hoc comparisons using Hochberg's GT2 test showed that for substance abuse cluster 3 differed significantly from cluster 1 and 2 ($p < .05$). Substance abuse was not significantly different between cluster 1 and 2 ($p = .36$). In cluster 1 no cases of substance abuse were diagnosed, in cluster 2 4.65% of the sample were diagnosed with substance abuse disorder and in cluster 3 all clients suffered from substance abuse disorder. Post-hoc comparisons showed that anxiety scores of cluster 2 were significantly lower than that of cluster 1 and 3 ($p < .05$). Anxiety was not significantly different between cluster 1 and 3 ($p = .41$). The three clusters differed significantly on depression scores at the .01 level of significance ($p = .00$). Depression scores were highest in cluster 1 and lowest in cluster 2. Post-hoc comparisons showed that for hostility cluster 1 had significantly higher scores than cluster 2 and 3 ($p < .05$). Hostility was not significantly different between cluster 2 and 3 ($p = .13$). Neuroticism scores for cluster 2 were significantly lower than scores of cluster 1 and 3 ($p < .05$). Clusters 1 and 3 did not differ significantly ($p = .63$). Cluster 2 scored significantly higher than cluster 1 and 3 on extraversion ($p < .05$). Clusters 1 and 3 did not differ significantly ($p = .26$). For conscientiousness, cluster 2 scores were significantly higher than scores of cluster 1 and 3 ($p < .05$). Clusters 1 and 3 did not differ significantly ($p = .85$). For exact mean differences between the clusters and significance level, see table 4.

Table 4. The mean difference (MD) and p-value (*p*) between all clusters of post-hoc comparisons on substance abuse, anxiety, depression, hostility, neuroticism, extraversion and conscientiousness.

	Clusters					
	Cluster 1 & 2		Cluster 1 & 3		Cluster 2 & 3	
Measure	*MD*	*p*	*MD*	*p*	*MD*	*p*
Substance abuse	-.12	.36	-2.54	.00**	-2.42	.00**
Anxiety	1.49	.00**	.30	.41	-1.19	.00**
Depression	1.62	.00**	.67	.00**	-.95	.00**
Hostility	1.43	.00**	.98	.00**	-.44	.13
Neuroticism	1.15	.00**	.26	.63	-.89	.00**
Extraversion	-.89	.00**	-.37	.26	.52	.04*
Conscientiousness	-.89	.00**	-.19	.85	.70	.03*

* = $p < .05$
** = $p < .01$

Analysis of variance (ANOVA)

A one-way between-groups analysis of variance (ANOVA) was conducted to explore differences between the three clusters based on ZIL scores. Subjects were divided into three groups according to their cluster membership. There was a statistically significant difference at the $p < .05$ level in ZIL scores for the three clusters (F(2, 92)= 35.96, p= .00, η^2= .44). The effectsize is considered a large effect (Cohen, 1988). Post-hoc comparisons using Tukey's HSD test indicated that the mean score for cluster 1 (M= 68.51, SD= 8.35) was significantly different from cluster 2 (M= 49.78, SD= 11.23), cluster 2 differed significantly from cluster 3 (M= 62.41, SD= 9.43). Cluster 1 did not differ significantly from cluster 3.

Based on these findings cluster 1 can be described as a high pathology group, defined by high anxiety, depression, hostility, neuroticism and ZIL scores and relatively low scores on extraversion and conscientiousness. Cluster 2 can be considered as a low pathology group, based on relatively low anxiety, depression, hostility, neuroticism and ZIL scores and relatively high scores on extraversion and conscientiousness. Finally, cluster 3 can be considered a group of high pathology similar to cluster 1, combined with substance abuse disorder.

Discussion

The primary objective of this study was to replicate and extend prior evidence of comorbidity- and personality-based internalising and externalising expressions of posttraumatic response (Miller, 2003) amongst Dutch veterans. Former studies suggest that internalisers and externalisers share a common disposition to experience frequent and intense negative emotions and distress but differ in essential ways with regard to the form and direction in which that distress is expressed (Miller et al., 2004). A partitioning of the sample of Dutch veterans with combat-related PTSD into three clusters was expected: (a) an internalising cluster, defined by low levels of extraversion, high levels of neuroticism and high levels of comorbid anxiety and depression, and (b) an externalising cluster, defined by low levels of conscientiousness, moderate levels of neuroticism, and high levels of hostility combined with comorbid substance abuse disorders, and finally (c) a low pathology cluster, defined by high levels of conscientiousness and extraversion, low levels of neuroticism and hostility combined with low levels of comorbid anxiety, depression and substance abuse related disorders.

Although a partitioning of the sample in three clusters was found, the definition of the three clusters was considerably different from what was expected. This study partitioned the sample of Dutch veterans with combat-related PTSD into (cluster 1) a high pathology cluster defined by high levels of comorbid anxiety and depression, high levels of hostility, high PTSD severity, high neuroticism scores, low extraversion and conscientiousness scores, (cluster 2) a low pathology cluster defined by relatively low levels of comorbid anxiety and depression, low levels of hostility, low PTSD severity, low neuroticism scores and high extraversion and conscientiousness scores compared to cluster 1 and 3, and finally (cluster 3) a high pathology cluster similar to cluster 1, combined with substance abuse. In contrast to what was expected, the clear distinction in an externalising and internalising cluster as found by, among others, Miller et al. (2004) was not replicated in this study. Thus, rather than a division in different representation of symptoms, a division in high and low severity of PTSD related symptoms and comorbid disorders describes this sample.

Another model to divide PTSD related symptoms is a partitioning into simple PTSD and complex PTSD (Herman, 1992; Pelcovitz et al., 1997; Taylor et al., 2006). Complex PTSD, a definition proposed by Herman (1992), is an attempt to describe the various problems associated with exposure to interpersonal traumatic stress. Its characteristics include relatively high comorbid depression, anxiety and dissociative symptoms combined with altered personal relationships (Taylor et al., 2006). Simple PTSD is described as defined by

DSM-IV-TR criteria, without the associated features and comorbid disorders (Pelcovitz et al., 1997). Complex PTSD has been identified in survivors of various forms of trauma, including combat exposure (Roth, Newman, Pelcovitz, van der Kolk & Mandel, 1997). To draw conclusions about the division of the in this study used sample into a simple PTSD and a complex PTSD cluster, additional research needs to be conducted to account for the associated features of complex PTSD.

The present findings raise important issues for the treatment and screening process of PTSD clients. Cognitive behavioural therapy is recommended for all clients with PTSD (Van Balkom et al., 2013). In addition, clients with relatively low comorbid pathology benefit from EMDR. This treatment is less successful with high pathology clients (Van Balkom et al., 2013). For high pathology clients, more intensive care is needed. What is most important for these patients is to learn to have a subjective sense of mastery and competence that will allow them to live in the present without being constantly pulled back into experiencing the present as a recurrence of the past (Yehuda, 2001). While more traditional treatments might pursue a gradual unfolding of clinical material over time, high pathology clients compel us to consider choices that will more directly address their symptoms. High pathology clients need the most direct route to symptom relief and behavioral change whenever possible (Litt, 2013). Symptom reduction can be reached when providing a supporting therapeutic environment in a clinical setting. Systemic therapy can enhance safety and stability (Van Rens, De Weert-van Oene, Van Oosten, Rutten & Zong, 2012).

Special attention is needed regarding the high frequency of comorbid substance abuse disorders among veterans (Kulka et al., 1990; Pietrzak, Goldstein, Southwick & Grant, 2011). Substance abuse disorder is a way of coping for many clients. Traumatised individuals use substances to self-medicate feelings that they can't tolerate (Khantzian & Schneider, 1986), indicating that intolerance of painful emotions and behavioural instability are common among substance abusers (Litt, 2013). For this group, it is helpful to provide additional emotion regulation skills, for example distress tolerance, mindfulness and cognitive restructuring (Wuppermann et al., 2012).

This study is the first to conduct research regarding the clustering of PTSD, comorbid pathology and personality in a sample of Dutch veterans. The results, a division in high and low severity of PTSD related symptoms and comorbid disorders in a sample of Dutch veterans, should be considered another step in the development towards a model that accounts for the different representation of PTSD related symptoms and comorbid disorders. It

employs valid and reliable instruments that are frequently used for measuring the constructs and offers valuable practical implications for treatment and screening purposes.

Some limitations should also be taken into account. All data used in the present study are based upon self-reports, except for PTSD and comorbid substance abuse as diagnosed by a registered clinician. Participants may have intensified their complaints in order to ensure a proper treatment (Lindman-Port, Engdahl, Frazier & Eberly, 2002), which would lower the reliability of the used measures. Future research could employ multiple measures of the constructs, combining self-report data with more objective measures. Second, no fixed procedure was used to obtain the data for it was not originally collected for research purposes. Differences of test conditions may have lowered the reliability of the self-report measures. Another limitation of this study is that the diagnosis of both PTSD and substance abuse disorder was only based on the clinician's view. Substance abuse disorder is often underdiagnosed by the clinician as a comorbid disorder of PTSD (Ouimette & Brown, 2003). Thus, according to the Trimbos Institute, a centre of expertise on mental health and addiction, it is important to incorporate a validated questionnaire in the diagnostic process for a more reliable diagnoses of substance use related disorders (Van der Meer & Hendriks, 2013). With a higher reliability of diagnoses, the validity of the cluster analysis increases.

Future work should focus on replicating this study, with the recommendation to add an additional measure of substance abuse to increase reliability (Ouimette & Brown, 2003). A reliable diagnosis could provide information about the likelihood of particularly severe comorbidity patterns, as substance abuse appears to cohere with high levels of other symptoms such as anxiety, depression and hostility (Van der Meer & Hendriks, 2013). With additional research, the relation between personality and course of PTSD and comorbid disorders may be useful in mental health prevention efforts, helping to predict who may be vulnerable to depression, anxiety and substance use following trauma. This may particularly be useful in preparing military personnel for exposure to combat trauma and for debriefing after trauma exposure (Rielage et al., 2010). Given that the present study is one of the first cluster-analytic investigations of Dutch veterans with PTSD, the next step would be to conduct studies of other trauma populations to assess the generalizability of the findings.

In conclusion, this research suggests the presence of differences in PTSD linked to low pathology and high pathology in a sample of Dutch veterans. Earlier findings of an internalising and externalising cluster are not replicated in this study. These findings have important implications for treatment. Awareness of clinicians of the existence of a high pathology group and a low pathology group should be taken into account, with special

attention for substance abuse disorder. The screening process should address the comorbid disorders to conduct a treatment program that will fit the client's needs.

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