Patterns of comorbidity associated with *ICD-11* PTSD among older adults in the United States

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ABSTRACT

Little research has been conducted on posttraumatic stress disorder (PTSD) comorbidity among older adults regarding the description of PTSD in the 11th version of the *International Classification of Diseases* (*ICD-11*). This study sought to provide evidence of a dimensional model of psychopathology using the 'Hierarchical Taxonomy of Psychopathology' (HiTOP) model as a theoretical framework to explain patterns of *ICD-11* PTSD comorbidity. Distinct patterns of *ICD-11* PTSD comorbidity among a nationally representative sample ($n = 530$) of adults aged 60 years and older from the United States were examined using latent class analysis (LCA). Covariates associated with comorbidity classes were assessed through multinomial logistic regression. *ICD-11* PTSD was highly co-morbid with other psychopathologies. LCA results favoured a two-class solution. Class 1 (71.7%) was char-acterised by moderate probabilities for major depressive disorder and alcohol use disorder; Class 2 (28.3%) was characterised by a moderate-high probability of general psychopathology and was associated with lower social support, spousal/partner physical abuse, and history of attempted suicide. PTSD was highly comorbid with other disorders among older adults. Distinct patterns of PTSD comorbidity exist among this cohort and these findings can aid clinicians and researchers in understanding and predicting maladaptive responses to trauma and asso-ciated psychopathology.

1. Introduction

Posttraumatic stress disorder (PTSD) frequently co-occurs with other psychiatric disorders including major depressive disorder (MDD; Rytwinski et al., 2013), generalised anxiety disorder (GAD; Gallagher and Brown, 2015), eating disorders (Brewerton, 2007), sub-stance use disorders (SUD; Driessen et al., 2008; Pietrzak et al., 2011), psychotic disorders (Seow et al., 2016), borderline personality disorder (BPD; Frías and Palma, 2015), and also with suicidal ideation (Panagioti et al., 2012). High rates of comorbidity are unsurprising given that trauma exposure is a common risk factor for PTSD as well as all other forms of psychopathology (Bendall et al, 2008; Brewerton, 2007; Copeland et al., 2018; Gilbert et al., 2009; Kessler et al., 2010; Najavits et al., 2017; Varese et al., 2012). One goal of the new model of PTSD presented in the recently published 11th version of the *International Classification of Diseases* (*ICD-11*; World Health Organization [WHO], 2018) was to reduce diagnostic comorbidity by including only a small number of core symptoms

(Maercker et al., 2013). Retaining core symptoms – and excluding transdiagnostic ones – should reduce diagnostic comorbidity if psy-chiatric disorders are orthogonal (although orthogonality in this con-text is not without enduring controversy; see Marshall, 2020). However, recent findings indicate that psychopathological/ psychiatric co-morbidity rates remain extremely high for *ICD-11* PTSD (Hyland et al., 2018; Karatzias et al., 2019; Shevlin et al., 2018). The *ICD-11* also contains a sibling disorder to PTSD, Complex PTSD (CPTSD; WHO, 2018). In order to meet the diagnostic requirements for CPTSD, an individual must meet the requirements for PTSD and additional symptoms reflecting 'disturbances in self-organization'. Akin to PTSD, CPTSD has been found to be highly comorbid with other forms of psychopathology (Karatzias et al., 2019).

A wealth of data shows that diagnostic comorbidity is extremely common (Caspi and Moffitt, 2018; Kotov et al., 2017). Diagnostic co-morbidity can be explained and understood within a dimensional model of psychopathology. The 'Hierarchical Taxonomy of Psychopathology' (HiTOP; Kotov et al., 2017) is a prominent dimensional model of

psychopathology which proposes that variation and covariation in psychopathology is explainable in terms of a small number of super-ordinate correlated latent dimensions (e.g. 'internalising', 'externalising', and 'thought disorder'). These dimensions are divided into 'subfactors' that explain covariation between specific clusters of mental health problems that cut across traditional psychiatric diagnoses. In the HiTOP model, PTSD (symptoms) sits within the 'distress' subfactor of the 'internalising' dimension. Thus, the HiTOP model predicts that PTSD should be most strongly correlated with disorders within the same subfactor such as MDD, GAD, and BPD. Moreover, because the internalising dimension is correlated with all other dimensions, PTSD would also be expected to correlate with disorders in other dimensions, albeit to a lesser extent. Thus, HiTOP states that comorbidity is unavoidable because psychiatric disorders are manifestations of the same, or related, latent variable(s). Furthermore, focusing on the core symptoms of PTSD should reduce measurement error, thereby increasing covariation with other psychiatric disorders. As such, the parameters of the HiTOP model predict that reducing PTSD to its core symptoms will not only not lead to a reduced rate of diagnostic comorbidity, but it may in fact lead to an increased rate of comorbidity.

Miller and colleagues (2012) examined the latent structure of PTSD comorbidity in a sample of military veterans with high rates of PTSD and found that three latent factors ('fear', 'distress', and 'externalising') adequately represented the structure of PTSD comorbidity. Consistent with the HiTOP model, these factors shared similarities such as the 'distress' factor encompassing the same disorders (MDD, GAD, dysthymia, and BPD) that has been observed as a common factor found among community samples (see Beesdo-baum et al., 2009; Kotov et al., 2017). Identifying discernible patterns of comorbidity, along with the risk factors for these different patterns of comorbidity, is important as this information may aid clinicians in preventing individuals from progressing to highly dysfunctional multimorbid trajectories associated with adverse outcomes such as increased social and occupational impairment, suicidal ideation, and physical morbidity (Calabrese et al., 2011; Hefner and Rosenheck, 2019; Momartin et al., 2004).

Variable-oriented approaches to modelling comorbidity, such as those used by Miller et al. (2012), presuppose, and function optimally with, sample homogeneity. When examining a potentially heterogenous population where distinct subgroups may exist, such as individual responses to trauma, person-oriented approaches such as latent class analysis (LCA) - which can account for sample heterogeneity - may be more appropriate (von Eye and Bogat, 2006). Prior studies examining patterns of PTSD comorbidity using LCA across a range of internalising and externalising disorders have revealed three discrete classes (Galatzer-Levy et al., 2013; Müller et al., 2014). One class reflected individuals with a low probability of comorbidity across all disorders (except for a moderate probability of major depression); another was characterised by a high probability of comorbid mood and anxiety disorders; and the third was characterised by a high probability for SUDs, mood, and anxiety disorders. Suicidal ideation was found to be a characteristic of all high comorbidity classes. This finding is in line with research suggesting that psychiatric comorbidity is a risk factor for suicidal behaviour in relation to both PTSD comorbidity and general psychopathology (Calabrese et al., 2011; Gili et al., 2019; Kavalidou et al., 2019; Kavalidou et al., 2017; Norman et al., 2018; Turecki and Brent, 2016).

The literature pertaining to PTSD comorbidity specifically among older adults is relatively underdeveloped; the available data suggests that PTSD in older adults is highly comorbid with a range of internalising and externalising disorders (Averill and Beck, 2000; Chopra et al., 2014; Glück et al., 2016; Pietrzak et al., 2012; Pless Kaiser et al., 2019; Spitzer et al., 2008). However, epidemiological evidence indicates that psychiatric morbidity (including PTSD) and comorbidity is significantly lower among older adults in comparison to their younger counterparts (Gum et al., 2009; Kessler et al., 2005; Thomas et al., 2016). For example, Kessler and colleagues (2005) found

that 11.6% of adults aged 60 years and older reported having two or more psychiatric disorders, which was substantially lower than those aged 18-29 (33.9%), 30-44 (34.0%), and 45-59 (27.0%). Furthermore, it has been found that older age is associated with decreased odds of psychiatric comorbidity among individuals who met the criteria for a past-year diagnosis of PTSD (Reynolds et al., 2016). Therefore, as rates of diagnostic psychiatric comorbidity may be substantially lower among older adults, it is important to determine if patterns of covariation among psychiatric disorders observed from previous studies among the general population are generalisable to this population.

In this study, we investigated patterns of comorbidity for *ICD-11* PTSD among a nationally representative sample of older adults (60 years and above) from the United States. Based on the predictions of the HiTOP model, we formulated four hypotheses. First, we hypothesised that rates of diagnostic psychiatric comorbidity involving *ICD-11* PTSD and a range of other psychiatric disorders would be high. Second, that the highest comorbidity rates would be found for 'distress' related disorders including MDD, GAD, and BPD. Third, based on prior findings regarding the latent structure of PTSD comorbidity, we hypothesised that multiple latent classes would be identified, including classes characterised by (i) low comorbidity, (ii) comorbidity with internalising disorders, and (iii) comorbidity with externalising and/or psychotic disorders. Finally, we hypothesised that the latent classes characterised by the highest levels of diagnostic comorbidity would be associated with a history of suicidal behaviour. Moreover, we included additional covariates that have been found to play an important role in predicting positive/negative mental health outcomes, such as social support (Wang et al., 2018).

2. Methods

2.1. Participants and Recruitment Strategy

Participants in this study were drawn from the National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III) study which is a nationally representative sample of non-institutionalised adults from the U.S. aged 18 years and older ($N = 36,309$). Information on the NESARC-III data are available elsewhere (Grant et al., 2014). Protocols of the NESARC-III project received ethical approval from the institutional review boards of the National Institutes of Health and Westat, and all participants provided their informed consent. Approval for secondary analysis was granted by the ethical review board of the first author's affiliated institution.

The current sample ($n = 530$) was selected from the full NESARC-III dataset based on several inclusion criteria: (a) were aged 60 years or older, (b) reported experiencing or witnessing at least one traumatic event in their lifetime, and (c) met the symptomatic requirements for an *ICD-11* PTSD diagnosis. Data were adjusted for oversampling (of ethnic/racial minorities) and non-responses and were weighted to reflect the U.S. civilian population as per the 2012 American Community Survey (Bureau of the Census, 2013). All parameter estimates were adjusted for the complex survey design of the NESARC-III based on the stratification, clustering, and weighting of the study population, whereas sample size is based on the unweighted data. The sample included a higher proportion of females (59.9%, $n = 330$) than males (40.1%, $n = 200$), and the average age was 67.65 years ($SD = 6.67$) (see Supplementary Table 1 for other sample characteristics).

2.2. Measures

All data were gathered using the *Alcohol Use Disorder and Associated Disabilities Interview Schedule–5* (AUDADIS-5; Grant et al., 2011). The AUDADIS-5 is a structured, diagnostic interview which assesses participants for symptoms associated with an array of psychiatric disorders.

2.2.1. Traumatic exposure

Participants were presented with two lists of different traumatic events that they may have experienced. One list consisted of 19 traumatic events that they may have personally experienced (e.g. childhood sexual abuse). The second list consisted of 13 traumatic events that they may have witnessed/learned about (e.g., witnessing/learning about another person's childhood sexual abuse). Participants were then asked to select, from these lists, the traumatic event(s) that they have personally experienced or witnessed/learned about. Participants could also select "other" as an additional option if the type of traumatic event that they experienced was not specified on either list. However, in order to reduce response burden, respondents could only report experiencing a maximum of four different types of traumatic events from these two lists and were instructed to specify their most stressful traumatic event. If the respondent had experienced more than four traumatic events, only the four most severe events were recorded. All PTSD items were responded to in relation to their most distressing event.

For the purposes of the current study, several of the direct traumatic events were used as covariates of latent class membership. These included being sexually abused before age of 18 years, being sexually assaulted as an adult, being physically abused before age of 18 years, being beaten up by a spouse/romantic partner, being beaten up by someone else, experiencing other forms of interpersonal trauma (kidnapped, stalked, or mugged), experiencing a non-interpersonal trauma (serious or life-threatening injury/illness, saw a dead body or body parts, being admitted to a juvenile detention/jail, or experiencing a natural disaster), and experiencing a war-related trauma (being injured in a terrorist attack, experiencing active military combat, being a peacekeeper/relief worker, being a civilian in war zone/place of terror, being a refugee, being a prisoner of war).

2.2.2. ICD-11 PTSD symptoms

Items were extracted from the AUDADIS-5 that corresponded to the six *ICD-11* PTSD symptoms. See Supplementary Table 2 for a comparison between the items extracted from the AUDADIS-5 and their corresponding items from the International Trauma Questionnaire (ITQ; Cloitre et al., 2018), the only available and psychometrically supported measure of *ICD-11* PTSD and CPTSD. Symptoms were answered using a dichotomous response format ('yes' = 1, 'no' = 0). The internal consistency among the sample of older adults was satisfactory (Cronbach's alpha = .77). In addition, the *ICD-11* model of PTSD, using the same items as the current study, has previously been found to provide excellent statistical fit among adults aged 60 years and above (Fox et al., 2020).

An *ICD-11* PTSD diagnosis requires the presence of at least one of two 'Re-experiencing' symptoms, one of two 'Avoidance' symptoms, and one of two 'Sense of Threat' symptoms. Diagnosis also requires that these symptoms cause functional impairment, however, this criterion was not screened for with all participants. As such, participants screened positive for a probable PTSD diagnosis based on the traumatic exposure and symptom requirements only. 530 respondents met the symptom criteria for lifetime *ICD-11* PTSD, corresponding to 6.1% of the full sample of older adults aged 60 years and above (n = 8,367), and 8.8% of older adults who endorsed at least one traumatic event (n = 5,625).

2.2.3. Comorbid psychiatric disorders

A range of lifetime psychiatric diagnoses, based on the criteria set forth in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*; American Psychiatric Association [APA], 2013), were extracted from the AUDADIS-5. This included mood and anxiety disorders (MDD, dysthymia, GAD, social phobia, specific phobia, agoraphobia, and panic disorder), eating disorders (anorexia nervosa, bulimia nervosa, and binge-eating disorder), alcohol use disorder (AUD), other drug use disorders (cannabis, opioid, cocaine, sedative, club drug, inhalant/solvent, hallucinogen, stimulant, and heroin use disorders),

and personality disorders (antisocial personality disorder [ASPD], BPD, and schizotypal personality disorder [SPD]). Eating disorders (ED) and drug use disorders (DUD) were subsequently grouped to create dichotomous variables that indicates the presence (or absence) of any ED, or any DUD. A total comorbidity count variable was also created that corresponded to the (unweighted) total number of the above psychiatric disorders. These psychiatric comorbid disorders were measured according to the *DSM-5* guidelines.

Previous research has examined the procedural validity of the AUDADIS-5 (compared to the semi-structured, clinician-administered PRISM-5 [Psychiatric Research Interview for Substance and Mental Disorders, DSM-5 version]), and indicated that the concordance of *DSM-5* diagnoses between the AUDADIS-5 and PRISM-5 were fair-to-moderate (Hasin et al., 2015). Furthermore, test-retest reliability of past-year, prior-to-past-year, and lifetime diagnoses were generally fair-to-good (Grant et al., 2015), with Kappa statistics ranging from .35 – .87 for the diagnostic variables, and intraclass correlation coefficients ranging from .45 – .85 for their respective continuous scales.

2.2.4. Attempted suicide

To assess history of suicidal attempts, participants were asked "in your entire life did you ever attempt suicide?". Responses were scored using a dichotomous response format ('yes' = 1, 'no' = 0). This item has been used in previous versions of the NESARC and was found to have a moderate test-retest reliability across NESARC Wave 1 and Wave 2 (Palmetto and Link, 2010).

2.2.5. Perceived social support (PSS)

PSS was measured using the general population version of the 12-item Interpersonal Support Evaluation List (ISEL-12; Cohen et al., 1985). Half of the items are positive statements (e.g. "if I wanted to have lunch with someone, I could easily find someone to join me"), and the other half are negatively phrased (e.g. "if I were sick, I know I would find someone to help me with my daily chore"). The items are measured on a four-point Likert-scale ('definitely false' = 1, 'definitely true' = 4). Higher scores indicate greater perceived social support. Responses were summed to create a composite PSS score ranging from 12–48. A unidimensional model has previously been found to be both valid and reliable (Merz et al., 2014). The internal consistency among the current sample was satisfactory (Cronbach's alpha = .85).

2.2.6. Sociodemographic variables

Several sociodemographic variables were assessed including age, sex, marital status, residency (urban/rural), education, and past-year household income. Education was measured using 14 categories ranging from "no formal schooling" to "completed master's degree or equivalent or higher graduate degree". Household income was measured using 21 categories that ranged from "less than $5,000" to "$200,000 or more".

2.3. Analytical Plan

The analytical plan was three-fold. First, prevalence rates of various psychiatric disorders were estimated among the older adult sample that met the symptom criteria for *ICD-11* PTSD. Second, latent classes of PTSD comorbidity were examined through LCA (conducted using Mplus 7.4; Muthén and Muthén, 2012), using robust maximum likelihood (MLR) estimation. To determine the optimal number of latent classes, models with one to six classes were examined. 500 random sets of starting values were used followed by 100 final stage optimizations in order to avoid solutions based on local maxima. The fit of each latent class model was determined using several fit indices: the Akaike information criterion (AIC; Akaike, 1987), the Bayesian information criterion (BIC; Schwarz, 1978), the sample size-adjusted BIC (ssaBIC; Sclove, 1987), entropy values, and the Lo–Mendell–Rubin adjusted likelihood ratio test (LMR-A; Lo et al., 2001). Lower AIC, BIC, and

ssaBIC values, and higher entropy values, indicate better model fit. A non-significant LMR-A value indicates that the model with one less class should be accepted. Previous Monte Carlo simulation studies indicated that the BIC is the best indicator for class enumeration (Nylund et al., 2007). Regarding the individual psychiatric disorders, and akin to studies of a similar nature (Burstein et al., 2012; Galatzer-Levy et al., 2013), a probability ≥ .15 indicated a class characteristic; a probability ≥ .15 and ≤ .59 was indicative of a moderate probability of comorbid diagnosis; and a probability ≥ .60 suggested that the disorder was highly probable within the respective class.

Third, a multinomial logistic regression was performed by regressing the latent classes (identified during the class enumeration process) onto several covariates (age, sex, marital status, residency, education, household income, social support, attempted suicide, and multiple forms of traumatic exposure). This was conducted using the R3STEP function in Mplus (Muthén and Muthén, 2012; Vermunt, 2010). This three-step procedure involves first identifying the most appropriate latent classes; then obtaining the most likely class memberships based on the posterior probabilities of the LCA, while accounting for the classification uncertainty rate (i.e. measurement error); and finally the most likely class memberships are analysed with the covariates, thus accounting for at least some of the misclassification error (Asparouhov and Muthén, 2014; Vermunt, 2010). This method is also preferable as it does not result in a shift in latent classes when the covariates are included.

3. Results

3.1. ICD-11 PTSD Comorbidity

The sample characteristics and descriptive statistics of the variables used in the current study are reported in Supplementary Table 1. Among the older adults who met symptom criteria for *ICD-11* PTSD, the most common co-occurring disorder was MDD (40.5%), followed by AUD (30.1%), BPD (28.0%), and GAD (21.9%) (Table 1 for full details). Moreover, 21.5% reported experiencing no comorbid disorder, 25.9% reported one additional comorbid disorder, 19.1% reported two additional comorbid disorders, 12.2% reported three additional comorbid disorders, and 21.2% reported experiencing four or more additional comorbid disorders.

Table 1
Prevalence rates of *ICD-11* PTSD lifetime comorbid psychiatric disorders.

Comorbid disorder	%[a] (n)[b]
Major depressive disorder (MDD)	40.5 (222)
Dysthymia	16.4 (90)
Generalised anxiety disorder (GAD)	21.9 (126)
Social phobia	9.4 (52)
Specific phobia	12.0 (75)
Agoraphobia	5.0 (30)
Panic disorder	11.3 (58)
Alcohol use disorder (AUD)	30.1 (160)
Any drug use disorder (DUD)	10.4 (55)
Any eating disorder (ED)	2.8 (15)
Antisocial personality disorder (ASPD)	4.0 (20)
Borderline personality disorder (BPD)	28.0 (166)
Schizotypal personality disorder (SPD)	18.4 (100)
Number of comorbid disorders	
0	21.5 (108)
1	25.9 (138)
2	19.1 (89)
3	12.2 (74)
4 +	21.2 (121)

Note: *n* = 530

[a] = Percentages are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population

[b] = Sample size is based on the unweighted data.

3.2. Latent Class Analysis

Table 2 presents the LCA results for the different class solutions. Two diagnostics indicate that a two-class solution fit the data best: the BIC value and the LMR-A test finding. However, a single further diagnostic favoured the three-class solution (the ssa-BIC). The two-class solution (see Figure 1) was determined to be the most appropriate model on the grounds of statistical fit and parsimony. However, for the purposes of transparency, the three-class solution is included as supplementary material (see Supplementary Figure 1).

Class 1 (71.7%) was characterised by moderate probabilities of comorbid MDD (.30) and AUD (.23). This class was labelled 'PTSD with moderate probabilities of depressive/alcohol use disorders'. Class 2 (28.3%) was characterised by a high probability for comorbid MDD (.66) and BPD (.74), and moderate probabilities for dysthymia (.38), GAD (.48), social phobia (.23), specific phobia (.25), agoraphobia (.15), panic disorder (.28), DUD (.22), AUD (.47), and SPD (.48). This class was labelled 'PTSD with general psychopathology'.

3.3. ICD-11 PTSD Patterns of Comorbidity Covariates

The results of the multinomial logistic regression are reported in Table 3, and Class 1 ('PTSD with moderate probabilities of depressive/alcohol use disorders') was treated as the reference class for all comparisons. Lower levels of social support (OR = 0.94 [95% CI 0.89, 1.00], *p* = .035), a history of attempted suicide (OR = 2.96 [95% CI 1.17, 7.44], *p* = .021), and physical abuse from a spouse/romantic partner (OR = 2.79 [95% CI 1.20, 6.46], *p* = .017) were associated with an increased likelihood of membership of Class 2 ('PTSD with general psychopathology').

4. Discussion

There is limited research regarding *ICD-11* PTSD comorbidity, especially with older adults. In line with emerging evidence from general population and clinical samples (Hyland et al., 2018; Karatzias et al., 2019; Shevlin et al., 2018), we found that *ICD-11* PTSD was highly comorbid with a range of lifetime psychiatric disorders. Moreover, despite an overall decline in psychiatric morbidity among older adults (Gum et al., 2009; Kessler et al., 2005; Thomas et al., 2016) and comorbidity with PTSD (Reynolds et al., 2016), we found that nearly four fifths of the sample met the diagnostic criteria for at least one other psychiatric disorder. This suggests that although there is a general downward trend in the prevalence of psychiatric disorders among older adults, psychiatric comorbidity remains high for those with PTSD.

Consistent with our second hypothesis, the highest rates of comorbidity were identified for other 'distress' disorders including MDD, BPD, and GAD. The notable exception to this pattern was the association with AUD which, according to the HiTOP model, sits within the 'externalising' dimension of psychopathology. A putative explanation for the increased probability of comorbid AUD is the self-medication hypothesis, which proposes that PTSD symptom manifestation precedes the development of drug/alcohol addiction and that individuals misuse drugs/alcohol in an attempt to assuage the distressing nature of their psychiatric symptoms (Khantzian, 1997; Leeies et al., 2010). However, given the cross-sectional nature of the data, and that a lifetime traumatic exposure assessment was used, it is not possible to garner the precise temporal ordering to test the self-medication hypothesis. In other words, it is unclear whether trauma exposure and/or PTSD symptoms preceded the onset of substance abuse.

Among the different psychiatric disorders that were comorbid with PTSD, similar prevalence rates were found compared to the general population (Pagura et al., 2010). However, among the current sample of older adults, PTSD comorbidity was substantially lower among several of the internalising 'fear' disorders (consisting of social phobia,

Table 2
Model fit statistics for LCA demonstrating patterns of *ICD-11* PTSD comorbidity among older adults.

Number of classes	Log likelihood	AIC	BIC	ssaBIC	LMR-A (*p*)	Entropy
1	-2749.045	5524.090	5579.637	5538.371	-	-
2	-2586.928	5227.855	5343.223	5257.517	320.584 (.025)	.73
3	-2543.710	5169.420	5344.608	5214.462	85.462 (.576)	.80
4	-2519.699	5149.397	5384.405	5209.820	47.482 (.553)	.86
5	-2498.372	5134.744	5429.573	5210.547	42.172 (.402)	.87
6	-2482.050	5130.101	5484.749	5221.284	32.276 (.719)	.88

Note: *n* = 530; Estimator = MLR; AIC = Akaike information criterion; BIC = Bayesian Information Criterion; ssaBIC = sample size-adjusted Bayesian Information Criterion; LMR-A = Lo–Mendell–Rubin adjusted likelihood ratio test.
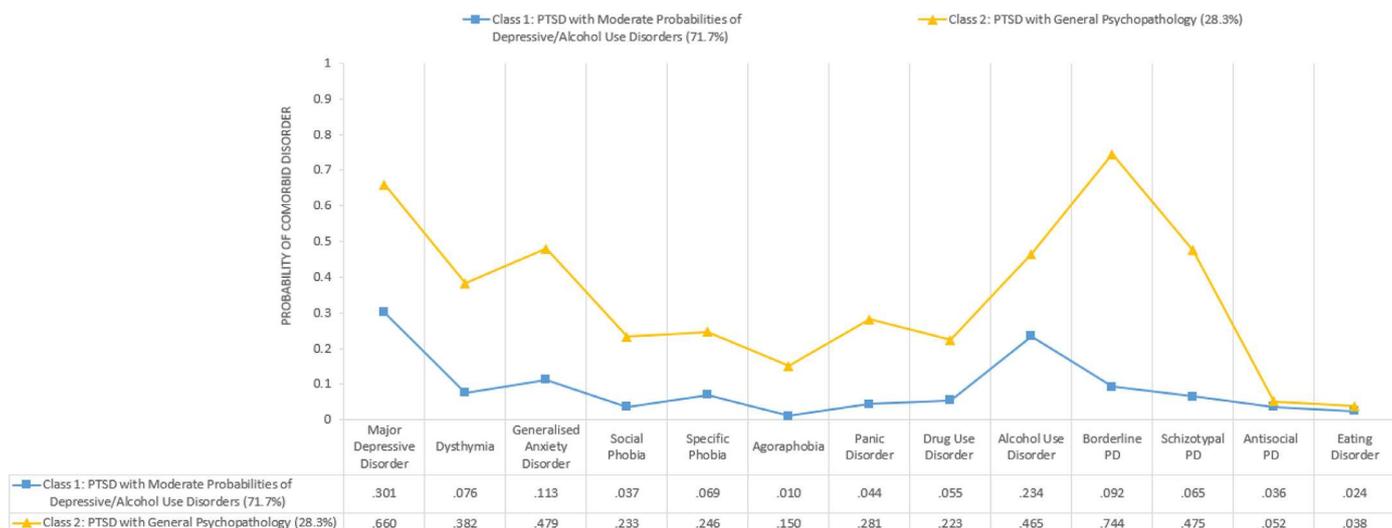

Figure 1. Latent classes of *ICD-11* PTSD comorbidity.
Note: The x-axis represents the varying lifetime psychiatric disorders; the y-axis represents the probability of endorsing the respective comorbid psychiatric disorder; PD = personality disorder.

Table 3
Multinomial logistic regression for covariates of latent class membership.

Covariate	Class 2 vs. Class 1 OR (95% CI)
Age	0.96 (0.91 / 1.01)
Sex[a]	0.72 (0.32 / 1.63)
Marital status[b]	0.50 (0.23 / 1.06)
Residency[c]	1.26 (0.69 / 2.29)
Education	1.05 (0.91 / 1.21)
Household income	0.98 (0.91 / 1.06)
Social support	**0.94* (0.89 / 1.00)**
Attempted suicide	**2.96* (1.17 / 7.44)**
Sexually abused before age 18	1.29 (0.62 / 2.68)
Sexually assaulted as an adult	1.15 (0.33 / 3.97)
Physically abused before age 18	0.64 (0.24 / 1.68)
Beaten up by spouse/romantic partner	**2.79* (1.20 / 6.46)**
Beaten up by someone else	0.69 (0.24 / 1.98)
Other interpersonal trauma	0.47 (0.19 / 1.14)
Non-interpersonal trauma	1.39 (0.77 / 2.50)
War-related trauma	0.50 (0.19 / 1.34)

Note: Class 1 = PTSD with moderate probabilities of depressive/alcohol use disorders; Class 2 = PTSD with general psychopathology; OR = odds ratio; 95% CI = 95% confidence intervals
[a] = Sex coded as 0 = male, 1 = female
[b] = Marital status coded as 0 = not married/cohabiting, 1 = married/cohabiting
[c] = Residency coded as 0 = urban, 1 = rural.
Statistical significance: *p < .05.

specific phobia, agoraphobia, and panic disorder), compared to the general population. Most notably, panic disorder and specific phobia. It is also important to note that a subset of the current sample is likely to

have also met the requirements of CPTSD, the sibling disorder to PTSD in the *ICD-11*. However, given the available items in the AUDADIS-5 we were not able to extract sufficient items to represent this sibling disorder. A diagnosis of CPTSD may partially explain the observed comorbidity rates, most notably among MDD, GAD, and BPD (Frost et al., 2020; Karatzias et al., 2019). However, previous research has found similar comorbidity rates between PTSD and CPTSD regarding AUD and suicidality (Karatzias et al., 2019).

It is also possible that the PTSD symptoms are covered by diagnostic overshadowing, whereby symptoms are falsely attributed to PTSD but are in reality manifestations of another disorder (Hryvniak and Rosse, 1989). However, a strength of the *ICD-11* model of PTSD focusing on the 'core PTSD' symptoms should, in theory, reduce the likelihood of diagnostic overshadowing. For example, the *ICD-11* model does not include symptoms pertaining to difficulty concentrating, or the inability to recall certain aspects of a traumatic event. Therefore, diagnostic overshadowing with other psychiatric disorder, or age-related conditions (e.g. dementia) are unlikely to be an issue within the context of the current study.

Given the heterogenous nature of trauma response, we applied a person-centred approach to examining patterns of PTSD comorbidity. Somewhat inconsistent with previous findings from the general population (Galatzer-Levy et al., 2013; Müller et al., 2014) and our third hypothesis, we found that a two-class solution was the most appropriate representation of latent patterns of PTSD comorbidity. This suggests that psychiatric comorbidity among older adults with PTSD may manifest in somewhat different ways than in the general population. These previous studies reported a moderate probability of MDD within the lower comorbidity class, however, we found that this class ('PTSD with moderate probabilities of depressive/alcohol use disorders') was

characterised by an increased probability of AUD and MDD. This suggests that PTSD may carry an inherent risk for comorbid depressive/alcohol use disorders among older adults, even in the more resilient class.

The second class ('PTSD with general psychopathology') was characterised by increased likelihood of nearly all other disorders with the exception of ASPD and EDs. Individuals in this class had moderate or high probabilities of meeting requirements for diagnoses that cut across the internalising, externalising, and thought-disorder spectra of the HiTOP model. Thus, diagnostic comorbidity in this sample did not follow a simple dimensional-specific pattern; this finding is consistent with the HiTOP's description of correlated superordinate dimensions of psychopathology which ultimately reflect a general vulnerability to all forms of psychopathology (Kotov et al., 2017). This description could be evaluated in future analyses taking advantage of superordinate analytic approaches within LCA.

Although there is no consensus regarding the precise reason for the observed psychiatric morbidity and comorbidity differences among older adults compared to their younger and middle-aged counterparts, possible explanations include: (1) generational differences in one's willingness to disclose psychiatric symptoms due to fear of stigma (Cook and Simiola, 2018; Pless Kaiser et al., 2019); (2) that older adults are more likely to report psychological symptoms as somatic complaints (Cook and Simiola, 2018; Palmer et al., 1997; Pless Kaiser et al., 2019); (3) the inability to accurately report psychological symptoms due to cognitive impairments (Thomas et al., 2016); and (4) due to the distressing nature and concomitant health-risks of PTSD, and most notably PTSD and comorbid psychiatric diagnoses, it may possible that age-related differences reflect a form of survivor bias whereby individuals with PTSD are less likely to survive into older adulthood (Cook and Simiola, 2018; Thomas et al., 2016). These explanations may, in-part, account for the differences in comorbidity patterns among the current sample compared to the general population studies.

The higher rates of SPD in the second class may be explained through a number of different reasons. First, this high comorbidity may be due to the deleterious effects of trauma exposure as a shared risk factor of psychosis and PTSD (Bendall et al., 2008; Varese et al., 2012). Second, there may be an overlap in the clinical manifestation of PTSD symptoms and psychotic indicators (Seow et al., 2016). For example, re-experiencing the traumatic event (e.g. flashbacks) may be misconstrued as hallucinations, and hypervigilance may be misconstrued as paranoia (O'Conghaile, and DeLisi, 2015). Third, high comorbidity rates between PTSD and psychosis may be mediated through numerous other psychiatric comorbidities such as substance abuse and depressive symptoms (Sareen et al., 2005).

Consistent with our fourth hypothesis, those with a history of suicidal attempts were nearly three times more likely to belong to the class characterised by high rates of comorbidity. This is consistent with previous findings (Galatzer-Levy et al., 2013; Müller et al., 2014), and provides additional evidence that an increased burden of psychopathology is a risk factor of suicidality. Membership of the highly comorbid class was also associated with lower levels of social support. This predictor being associated with high comorbidity levels aligns with results found among general (non-PTSD) populations. For instance, there is a wealth of existing data demonstrating the important role that social support and social connection plays in maintaining good mental health (Wang et al., 2018). Moreover, we found that spousal/partner physical abuse was the only type of traumatic experience to predict membership of the higher comorbidity class. This finding is similar to Galatzer-Levy and colleagues (2013) who found that partner physical abuse was the only trauma-specific variable that predicted class membership for the two higher-comorbidity classes, compared to the low comorbidity class.

The findings of this study have important clinical and research implications. First, it was found that ICD-11 PTSD was a highly comorbid disorder among older adults. Clinicians working with geriatric populations should be aware of this high comorbidity among patients exhibiting symptoms of PTSD, as psychiatric diagnostic assessments in later life can carry difficulties such as older adults being less likely to endorse social or occupational impairment that may lead to psychiatric disorders being under-, or mis-diagnosed (see Bodner et al., 2018). Second, results provide evidence that there are distinct patterns of PTSD comorbidity among older adults. Clinicians working with older adults should be cognizant that increased rates of disorder comorbidity are associated with less social support, spousal/partner physical abuse, and history of suicide attempts. Older adults with multiple mental health problems require urgent and substantial clinical interventions. Third, the current findings provide additional evidence in support of the HiTOP model, and demonstrate that this framework may be useful for clinicians in understanding which disorders are most likely to exist comorbidly.

The findings of this study should be interpreted in light of several limitations. First, the current study used a nationally representative household sample of U.S. older adults, therefore, the generalisability to older adults in other nations, or in in-patient clinical settings, cannot be assumed. Second, the measure of ICD-11 PTSD did not consider the functional impairment criterion, and as such comorbidity rates may be overestimated. However, it has been argued that a limitation of current psychiatric diagnostic assessments, specifically related to the functional impairment criteria, may be inaccurate among older adults (Bodner et al., 2018). For example, older adults may be less likely to attribute social impairment to PTSD symptomatology if they are physically impaired, or occupational impairment if they are retired. Third, it will also be important to replicate this study using measures specifically designed to capture the ICD-11 PTSD diagnostic criteria (such as the ITQ; Cloitre et al., 2018), including items that explicitly refer to the "here-and-now" quality of the re-experiencing symptoms. Moreover, future research should aim to include an assessment of ICD-11 CPTSD. Fourth, as LCA is an exploratory and data-driven approach, future studies should aim to examine latent classes of PTSD within varying contexts to ensure that these findings are robust. Fifth, it should be noted that the measure of suicidal attempt history does not take into account factors such as the intensity or outcome of the attempted suicide (e.g. serious life-threatening injuries/hospitalisation). Moreover, due to the sensitive nature of this question, it is possible that the prevalence rate was under-estimated. Sixth, the measure of comorbidity used was a count variable denoting the presence/absence of a disorder and was not weighted to reflect differences in the functional impairment of the disorder. The limitation of such a counting approach is that all comorbid psychiatric disorders are incorrectly assumed to be equal in terms of distress/functional impairment. Seventh, as the measures of psychiatric comorbidity used were lifetime assessments, it was not possible to precisely infer temporal ordering among the disorders. For example, whether PTSD symptoms had abated before the onset of the other forms of psychopathology. As such, future research should aim to address this limitation by employing longitudinal methods of psychiatric assessment.

In summary, previous research has found that diagnostic psychiatric comorbidity reduces among older adults. Despite this reduction among older adults, it was found that ICD-11 PTSD appears to remain a highly comorbid disorder in later life. Diagnostic psychiatric comorbidity was most notably observed among other internalising 'distress' disorders (MDD, BPD, and GAD) and AUD. Similar to studies among the general population, the latent class with higher diagnostic psychiatric comorbidity was associated with a greater likelihood of having a history of suicidal attempts. Moreover, these findings provide a useful addition to the literature pertaining to both the structure of general psychopathology and the structure of ICD-11 PTSD comorbidity. These findings demonstrate the importance of identifying early signs of maladaptive posttraumatic responses and can inform clinicians and researchers of potential comorbid subtypes that may manifest as a response to trauma.

Authorship contribution statement

Robert Fox: Conceptualisation, methodology, acquisition of data, statistical analyses/interpretation of data, contributed to the writing, revising, and editing of the manuscript. **Philip Hyland:** Project administration, conceptualisation, methodology, supervision, statistical analyses/interpretation of data, contributed to the writing, revising, and editing of the manuscript. **Joanna McHugh Power:** Project administration, methodology, supervision, interpretation of analysis, contributed to the writing, revising, and editing of the manuscript. **Andrew N. Coogan:** Project administration, methodology, supervision, contributed to the writing, revising, and editing of the manuscript. All authors contributed to and have approved the final manuscript.

Role of the funding source

Data accessibility statement

The data that support the findings of this study are available from the National Institute on Alcohol Abuse and Alcoholism (NIAAA). Restrictions apply to the availability of these data, which were used under license for this study. Data are available at https://www.niaaa.nih.gov/research/nesarc-iii with the permission of the NIAAA.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2020.113171.

References

Akaike, H., 1987. Factor analysis and the AIC. Psychometrika 52, 317–332.

American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders, 5th ed. American Psychiatric Publishing, Arlington, VA.

Asparouhov, T., Muthén, B., 2014. Auxiliary variables in mixture modeling: Three-step approaches using M plus. Structural Equation Modeling: A Multidisciplinary Journal 21 (3), 329–341. https://doi.org/10.1080/10705511.2014.915181.

Averill, P.M., Beck, J.G., 2000. Posttraumatic stress disorder in older adults: a conceptual review. Journal of Anxiety disorders 14 (2), 133–156. https://doi.org/10.1016/S0887-6185(99)00045-6.

Beesdo-baum, K., Höfler, M., Gloster, A.T., Klotsche, J., Lieb, R., Beauducel, A., ... Wittchen, H.U., 2009. The structure of common mental disorders: a replication study in a community sample of adolescents and young adults. International Journal of Methods in Psychiatric Research 18 (4), 204–220. https://doi.org/10.1002/mpr.293.

Bendall, S., Jackson, H.J., Hulbert, C.A., McGorry, P.D., 2008. Childhood trauma and psychotic disorders: a systematic, critical review of the evidence. Schizophrenia bulletin 34 (3), 568–579. https://doi.org/10.1093/schbul/sbm121.

Bodner, E., Palgi, Y., Wyman, M.F., 2018. Ageism in mental health assessment and treatment of older adults. In: Ayalon, L., Tesch-Römer, C. (Eds.), Contemporary perspectives on ageism. Springer, Cham, Switzerland, pp. 241–262.

Brewerton, T.D., 2007. Eating disorders, trauma, and comorbidity: Focus on PTSD. Eating disorders 15 (4), 285–304. https://doi.org/10.1080/10640260701454311.

Bureau of the Census, 2013. American Community Survey, 2012. Bureau of the Census, Suitland, MD.

Burstein, M., Georgiades, K., Lamers, F., Swanson, S.A., Cui, L., He, J.P., ..., Merikangas, K.R., 2012. Empirically derived subtypes of lifetime anxiety disorders: Developmental and clinical correlates in US Adolescents. Journal of consulting and clinical psychology 80 (1), 102–115. https://doi.org/10.1037/a0026069.

Calabrese, J.R., Prescott, M., Tamburrino, M., Liberzon, I., Slembarski, R., Goldmann, E., ..., Ganocy, S., 2011. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. The Journal of clinical psychiatry 72 (8), 1072–1078. https://doi.org/10.4088/JCP.11m06956.

Caspi, A., Moffitt, T.E., 2018. All for one and one for all: Mental disorders in one dimension. American Journal of Psychiatry 175 (9), 831–844 doi:0.1176/appi.ajp.2018.17121383.

Chopra, M.P., Zhang, H., Pless Kaiser, A., Moye, J.A., Llorente, M.D., Oslin, D.W., Spiro III, A., 2014. PTSD is a chronic, fluctuating disorder affecting the mental quality of life in older adults. The American Journal of Geriatric Psychiatry 22 (1), 86–97. https://doi.org/10.1016/j.jagp.2013.01.064.

Cloitre, M., Shevlin, M., Brewin, C.R., Bisson, J.I., Roberts, N.P., Maercker, A., ..., Hyland, P., 2018. The International Trauma Questionnaire: development of a self-report measure of ICD-11 PTSD and complex PTSD. Acta Psychiatrica Scandinavica 138 (6), 536–546. https://doi.org/10.1111/acps.12956.

Cohen, S., Mermelstein, R., Kamarck, T., Hoberman, H.M., 1985. Measuring the functional components of social support. In: Sarason, I.G., Sarason, B.R. (Eds.), Social support: Theory, research and applications. Springer, Dordrecht, the Netherlands, pp. 73–94. https://doi.org/10.1007/978-94-009-5115-0_5.

Cook, J.M., Simiola, V., 2018. Trauma and Aging. Current psychiatry reports 20 (10), 93. https://doi.org/10.1007/s11920-018-0943-6.

Copeland, W.E., Shanahan, L., Hinesley, J., Chan, R.F., Aberg, K.A., Fairbank, J.A., ..., Costello, E.J., 2018. Association of childhood trauma exposure with adult psychiatric disorders and functional outcomes. JAMA network open 1 (7), e184493. https://doi.org/10.1001/jamanetworkopen.2018.4493.

Driessen, M., Schulte, S., Luedecke, C., Schaefer, I., Sutmann, F., Ohlmeier, M., ..., Broese, T., 2008. Trauma and PTSD in patients with alcohol, drug, or dual dependence: A multi-center study. Alcoholism: Clinical and Experimental Research 32 (3), 481–488. https://doi.org/10.1111/j.1530-0277.2007.00591.x.

Frías, Á., Palma, C., 2015. Comorbidity between post-traumatic stress disorder and borderline personality disorder: a review. Psychopathology 48 (1), 1–10. https://doi.org/10.1159/000363145.

Fox, R., Hyland, P., McHugh Power, J., Coogan, A.N., 2020. Posttraumatic stress disorder among older adults: A differential item functioning analysis of PTSD in ICD-11 and DSM-5. Psychological Trauma: Theory, Research, Practice, and Policy. https://doi.org/10.1037/tra0000596.

Frost, R., Hyland, P., Shevlin, M., Murphy, J., 2020. Distinguishing Complex PTSD from Borderline Personality Disorder among individuals with a history of sexual trauma: A latent class analysis. European Journal of Trauma & Dissociation 4 (1), 100080. https://doi.org/10.1016/J.EJTD.2018.08.004.

Galatzer-Levy, I.R., Nickerson, A., Litz, B.T., Marmar, C.R., 2013. Patterns of lifetime PTSD comorbidity: A latent class analysis. Depression and Anxiety 30 (5), 489–496. https://doi.org/10.1002/da.22048.

Gallagher, M.W., Brown, T.A., 2015. Bayesian analysis of current and lifetime comorbidity rates of mood and anxiety disorders in individuals with posttraumatic stress disorder. Journal of psychopathology and behavioral assessment 37 (1), 60–66. https://doi.org/10.1007/s10862-014-9436-z.

Gilbert, R., Widom, C.S., Browne, K., Fergusson, D., Webb, E., Janson, S., 2009. Burden and consequences of child maltreatment in high-income countries. The lancet 373 (9657), 68–81. https://doi.org/10.1016/S0140-6736(08)61706-7.

Gili, M., Castellví, P., Vives, M., de la Torre-Luque, A., Almenara, J., Blasco, M.J., ..., Lagares, C., 2019. Mental disorders as risk factors for suicidal behavior in young people: A meta-analysis and systematic review of longitudinal studies. Journal of affective disorders 245, 152–162. https://doi.org/10.1016/j.jad.2018.10.115.

Glück, T.M., Knefel, M., Tran, U.S., Lueger-Schuster, B., 2016. PTSD in ICD-10 and proposed ICD-11 in elderly with childhood trauma: prevalence, factor structure, and symptom profiles. European journal of psychotraumatology 7 https://doi.org/10.3402/ejpt.v7.29700.

Grant, B.F., Chu, A., Sigman, R., Amsbary, M., Kali, J., Sugawara, Y., ..., Goldstein, R., 2014. Source and Accuracy Statement: National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III). National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Grant, B.F., Goldstein, R.B., Chou, S.P., Saha, T.D., Ruan, W.J., Huang, B., ..., Hasin, D.S., 2011. The Alcohol Use Disorder and Associated Disabilities Interview Schedule Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition Version (AUDADIS-5). National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Grant, B.F., Goldstein, R.B., Smith, S.M., Jung, J., Zhang, H., Chou, S.P., ..., Aivadyan, C., 2015. The Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5): reliability of substance use and psychiatric disorder modules in a general population sample. Drug and alcohol dependence 148, 27–33. https://doi.org/10.1016/j.drugalcdep.2014.11.026.

Gum, A.M., King-Kallimanis, B., Kohn, R., 2009. Prevalence of mood, anxiety, and substance-abuse disorders for older Americans in the national comorbidity survey-replication. The American Journal of Geriatric Psychiatry 17 (9), 769–781. https://doi.org/10.1097/JGP.0b013e3181ad4f5a.

Hasin, D.S., Shmulewitz, D., Stohl, M., Greenstein, E., Aivadyan, C., Morita, K., ..., Nunes, E.V., 2015. Procedural validity of the AUDADIS-5 depression, anxiety and post-traumatic stress disorder modules: substance abusers and others in the general population. Drug and alcohol dependence 152, 246–256. https://doi.org/10.1016/j.drugalcdep.2015.03.027.

Hefner, K., Rosenheck, R., 2019. Multimorbidity among Veterans Diagnosed with PTSD in the Veterans Health Administration Nationally. Psychiatric Quarterly 90 (2), 275–291. https://doi.org/10.1007/s11126-019-09632-5.

Hryvniak, M.R., Rosse, R.B., 1989. Concurrent psychiatric illness in inpatients with post-traumatic stress disorder. Military Medicine 154 (8), 399–401. https://doi.org/10.1093/milmed/154.8.399.

Hyland, P., Shevlin, M., Fyvie, C., Karatzias, T., 2018. Posttraumatic stress disorder (PTSD) and complex PTSD (CPTSD) in DSM-5 and ICD-11: Clinical and behavioural correlates. Journal of Traumatic Stress 31, 174–180. https://doi.org/10.1002/jts.22272.

Karatzias, T., Hyland, P., Bradley, A., Cloitre, M., Roberts, N.P., Bisson, J.I., Shevlin, M., 2019. Risk-factors and comorbidity of ICD-11 PTSD and Complex PTSD: Findings from a trauma-exposed community sample of adults in the United Kingdom. Depression and Anxiety 36, 887–894. https://doi.org/10.1002/da.22934.

Kavalidou, K., Smith, D.J., Der, G., O'Connor, R.C., 2019. The role of physical and mental multimorbidity in suicidal thoughts and behaviours in a Scottish population cohort study. BMC psychiatry 19 (1), 38. https://doi.org/10.1186/s12888-019-2032-8.

Kavalidou, K., Smith, D.J., O'Connor, R.C., 2017. The role of physical and mental health multimorbidity in suicidal ideation. Journal of affective disorders 209, 80–85. https://doi.org/10.1016/j.jad.2016.11.026.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., Merikangas, K.R., Walters, E.E., 2005. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Archives of general psychiatry 62 (6), 593–602. https://doi.org/10.1001/archpsyc.62.6.593.

Kessler, R.C., McLaughlin, K.A., Green, J.G., Gruber, M.J., Sampson, N.A., Zaslavsky, A.M., ..., Benjet, C., 2010. Childhood adversities and adult psychopathology in the WHO World Mental Health Surveys. The British Journal of Psychiatry 197 (5), 378–385. https://doi.org/10.1192/bjp.bp.110.080499.

Khantzian, E.J., 1997. The self-medication hypothesis of substance use disorders: A reconsideration and recent applications. Harvard review of psychiatry 4 (5), 231–244. https://doi.org/10.3109/10673229709030550.

Kotov, R., Krueger, R.F., Watson, D., Achenbach, T.M., Althoff, R.R., Bagby, R.M., ..., Eaton, N.R., 2017. The Hierarchical Taxonomy of Psychopathology (HiTOP): a dimensional alternative to traditional nosologies. Journal of abnormal psychology 126 (4), 454–477. https://doi.org/10.1037/abn0000258.

Leeies, M., Pagura, J., Sareen, J., Bolton, J.M., 2010. The use of alcohol and drugs to self-medicate symptoms of posttraumatic stress disorder. Depression and anxiety 27 (8), 731–736. https://doi.org/10.1002/da.20677.

Lo, Y., Mendell, N.R., Rubin, D.B., 2001. Testing the number of components in a normal mixture. Biometrika 88 (3), 767–778. https://doi.org/10.1093/biomet/88.3.767.

Maercker, A., Brewin, C.R., Bryant, R.A., Cloitre, M., van Ommeren, M., Jones, L.M., ..., Somasundaram, D.J., 2013. Diagnosis and classification of disorders specifically associated with stress: proposals for ICD-11. World Psychiatry 12 (3), 198–206. https://doi.org/10.1002/wps.20057.

Marshall, M., 2020. The hidden links between mental disorders. Nature 581 (7806), 19–21. https://doi.org/10.1038/d41586-020-00922-8.

Merz, E.L., Roesch, S.C., Malcarne, V.L., Penedo, F.J., Llabre, M.M., Weitzman, O.B., ..., Johnson, T.P., 2014. Validation of interpersonal support evaluation list-12 (ISEL-12) scores among English and Spanish-speaking Hispanics/Latinos from the HCHS/SOL Sociocultural Ancillary Study. Psychological assessment 26 (2), 384–394. https://doi.org/10.1037/a0035248.

Miller, M.W., Wolf, E.J., Reardon, A., Greene, A., Ofrat, S., McInerney, S., 2012. Personality and the latent structure of PTSD comorbidity. Journal of anxiety disorders 26 (5), 599–607. https://doi.org/10.1016/j.janxdis.2012.02.016.

Momartin, S., Silove, D., Manicavasagar, V., Steel, Z., 2004. Comorbidity of PTSD and depression: associations with trauma exposure, symptom severity and functional impairment in Bosnian refugees resettled in Australia. Journal of affective disorders 80 (2-3), 231–238. https://doi.org/10.1016/S0165-0327(03)00131-9.

Müller, M., Vandeleur, C., Rodgers, S., Rössler, W., Castelao, E., Preisig, M., Ajdacic-Gross, V., 2014. Factors associated with comorbidity patterns in full and partial PTSD: findings from the PsyCoLaus study. Comprehensive psychiatry 55 (4), 837–848. https://doi.org/10.1016/j.comppsych.2014.01.009.

Muthén, L.K., Muthén, B.O., 2012. Mplus User's Guide, 7th ed. Muthén & Muthén, Los Angeles, CA.

Najavits, L., Hyman, S., Ruglass, L., Hien, D.A., Read, J.P., Gold, S.N., 2017. Substance use disorder and trauma. APA handbook of trauma psychology. American Psychological Association, Washington, DC, pp. 195–213.

Norman, S.B., Haller, M., Hamblen, J.L., Southwick, S.M., Pietrzak, R.H., 2018. The burden of co-occurring alcohol use disorder and PTSD in U.S. Military veterans: Comorbidities, functioning, and suicidality. Psychology of Addictive Behaviors 32 (2), 224–229. https://doi.org/10.1037/adb0000348.

Nylund, K.L., Asparouhov, T., Muthén, B.O., 2007. Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. Structural equation modeling: A multidisciplinary Journal 14 (4), 535–569. https://doi.org/10.1080/10705510701575396.

O'Conghaile, A., DeLisi, L.E., 2015. Distinguishing schizophrenia from posttraumatic stress disorder with psychosis. Current opinion in psychiatry 28 (3), 249–255.

https://doi.org/10.1097/YCO.0000000000000158.

Pagura, J., Stein, M.B., Bolton, J.M., Cox, B.J., Grant, B., Sareen, J., 2010. Comorbidity of borderline personality disorder and posttraumatic stress disorder in the US population. Journal of psychiatric research 44 (16), 1190–1198. https://doi.org/10.1016/j.jpsychires.2010.04.016.

Palmer, B.W., Jeste, D.V., Sheikh, J.I., 1997. Anxiety disorders in the elderly: DSM-IV and other barriers to diagnosis and treatment. Journal of Affective Disorders 46 (3), 183–190. https://doi.org/10.1016/S0165-0327(97)00146-8.

Palmetto, N.P., Link, B.G., 2010. The reliability of adult lifetime suicide attempt reports in the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). Comprehensive Psychiatry 6 (51), e8. https://doi.org/10.1016/j.comppsych.2010.06.036.

Panagioti, M., Gooding, P.A., Tarrier, N., 2012. A meta-analysis of the association between posttraumatic stress disorder and suicidality: the role of comorbid depression. Comprehensive psychiatry 53 (7), 915–930. https://doi.org/10.1016/j.comppsych.2012.02.009.

Pietrzak, R.H., Goldstein, R.B., Southwick, S.M., Grant, B.F., 2011. Prevalence and Axis I comorbidity of full and partial posttraumatic stress disorder in the United States: results from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. Journal of anxiety disorders 25 (3), 456–465. https://doi.org/10.1016/j.janxdis.2010.11.010.

Pietrzak, R.H., Goldstein, R.B., Southwick, S.M., Grant, B.F., 2012. Psychiatric comorbidity of full and partial posttraumatic stress disorder among older adults in the United States: results from wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. The American Journal of Geriatric Psychiatry 20 (5), 380–390. https://doi.org/10.1097/JGP.0b013e31820d92e7.

Pless Kaiser, A., Cook, J.M., Glick, D.M., Moye, J., 2019. Posttraumatic stress disorder in older adults: A conceptual review. Clinical gerontologist 42 (4), 359–376. https://doi.org/10.1080/07317115.2018.1539801.

Reynolds, K., Pietrzak, R.H., Mackenzie, C.S., Chou, K.L., Sareen, J., 2016. Post-traumatic stress disorder across the adult lifespan: findings from a nationally representative survey. The American Journal of Geriatric Psychiatry 24 (1), 81–93. https://doi.org/10.1016/j.jagp.2015.11.001.

Rytwinski, N.K., Scur, M.D., Feeny, N.C., Youngstrom, E.A., 2013. The co-occurrence of major depressive disorder among individuals with posttraumatic stress disorder: A meta-analysis. Journal of Traumatic Stress 26 (3), 299–309. https://doi.org/10.1002/jts.21814.

Sareen, J., Cox, B.J., Goodwin, R.D., Asmundson, G.J.G., 2005. Co-occurrence of posttraumatic stress disorder with positive psychotic symptoms in a nationally representative sample. Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies 18 (4), 313–322. https://doi.org/10.1002/jts.20040.

Schwarz, G., 1978. Estimating the dimension of a model. The annals of statistics 6 (2), 461–464.

Sclove, S.L., 1987. Application of model-selection criteria to some problems in multivariate analysis. Psychometrika 52, 333–343. https://doi.org/10.1007/BF02294360.

Seow, L.S.E., Ong, C., Mahesh, M.V., Sagayadevan, V., Shafie, S., Chong, S.A., Subramaniam, M., 2016. A systematic review on comorbid post-traumatic stress disorder in schizophrenia. Schizophrenia Research 176 (2-3), 441–451. https://doi.org/10.1016/j.schres.2016.05.004.

Shevlin, M., Hyland, P., Vallières, F., Bisson, J., Makhashvili, N., Javakhishvili, J., ..., Roberts, B., 2018. A comparison of DSM-5 and ICD-11 PTSD prevalence, comorbidity and disability: an analysis of the Ukrainian Internally Displaced Person's Mental Health Survey. Acta Psychiatrica Scandinavica 137 (2), 138–147. https://doi.org/10.1111/acps.12840.

Spitzer, C., Barnow, S., Völzke, H., John, U., Freyberger, H.J., Grabe, H.J., 2008. Trauma and posttraumatic stress disorder in the elderly: findings from a German community study. The Journal of clinical psychiatry 69, 693–700. https://doi.org/10.4088/jcp.v69n0501.

Thomas, M.L., Kaufmann, C.N., Palmer, B.W., Depp, C.A., Martin, A.S., Glorioso, D.K., ..., Jeste, D.V., 2016. Paradoxical trend for improvement in mental health with aging: a community-based study of 1,546 adults aged 21–100 years. The Journal of clinical psychiatry 77 (8), e1019. https://doi.org/10.4088/JCP.16m10671.

Turecki, G., Brent, D.A., 2016. Suicide and suicidal behaviour. The Lancet 387 (10024), 1227–1239. https://doi.org/10.1016/S0140-6736(15)00234-2.

Varese, F., Smeets, F., Drukker, M., Lieverse, R., Lataster, T., Viechtbauer, W., ..., Bentall, R.P., 2012. Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective-and cross-sectional cohort studies. Schizophrenia bulletin 38 (4), 661–671. https://doi.org/10.1093/schbul/sbs050.

Vermunt, J.K., 2010. Latent class modeling with covariates: Two improved three-step approaches. Political analysis 18 (4), 450–469. https://doi.org/10.1093/pan/mpq025.

von Eye, A., Bogat, G.A., 2006. Person-oriented and variable-oriented research: Concepts, results, and development. Merrill-Palmer Quarterly 52 (3), 390–420. https://doi.org/10.1353/mpq.2006.0032.

Wang, J., Mann, F., Lloyd-Evans, B., Ma, R., Johnson, S., 2018. Associations between loneliness and perceived social support and outcomes of mental health problems: a systematic review. BMC psychiatry 18 (1), 156. https://doi.org/10.1186/s12888-018-1736-5.

World Health Organization, 2018. International statistical classification of diseases and related health problems (11th Revision). Retrieved from https://icd.who.int/browse11/l-m/en.