The Latent Structure of ICD-11 Posttraumatic Stress Disorder (PTSD) and Complex PTSD in a General Population Sample from USA: A Factor Mixture Modelling Approach.

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Abstract

The validity of ICD-11 Posttraumatic Stress Disorder (PTSD) and Complex PTSD (CPTSD), as measured by the International Trauma Questionnaire (ITQ; Cloitre et al., 2018) has been supported in many factor analytic and mixture modelling studies. There is, however, a paucity of research investigating the latent structure of the ITQ using factor mixture modelling (FMM). FMM was applied to data collected from a nationally representative sample of U.S. adults (N=1834). FMM results demonstrated strong support for a two-factor second-order model with four qualitatively distinct latent classes: a 'PTSD class', a 'CPTSD class', a 'DSO' (Disturbances in Self-Organisation) class and a 'low symptoms class'. Sexual abuse increased likelihood of membership to the 'CPTSD' (OR = 3.22) and physical abuse decreased likelihood of membership to the 'PTSD' (OR=0.51). Trauma exposure in adulthood predicted 'PTSD' and 'CPTSD' class membership. The 'CPTSD class' was characterised by higher levels of psychopathological co-morbidities and poorer psychological wellbeing compared to all other classes. Results provide additional support for the validity of PTSD and CPTSD as measured by the ITQ.

Keywords: ICD-11; Posttraumatic Stress Disorder; Complex Posttraumatic Stress Disorder; factor mixture model

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1. Introduction

In the 11th version of the International Classification of Diseases (ICD-11; World Health Organisation, 2018) Posttraumatic Stress Disorder (PTSD) and Complex PTSD (CPTSD) are included under the parent category of 'disorders specifically associated with stress'. Exposure to a trauma, defined as an extremely threatening or horrific event or series of events is a prerequisite for consideration of either disorder. The diagnostic criteria for PTSD consist of three symptoms clusters which relate specifically to the traumatic event and were selected based on investigations indicating that these clusters best discriminated PTSD from other disorders (Brewin et al., 2009). These symptoms include 1) re-experiencing of the trauma in the here and now (Re), (2) avoidance of traumatic reminders (Av), and (3) heightened sense of current threat (Th). The diagnosis of CPTSD is an adaptation of the ICD-10 "Enduring Personality Change after Catastrophic Experiences" (EPCACE) which, following from the theoretical proposal of Herman (1992), was included to recognize changes in affect, identity and relational capacities that can occur following prolonged or chronic exposure to trauma (WHO, 1999). CPTSD consists of six symptom clusters: the three PTSD clusters as well as three symptom clusters representing disturbances in self-organization (DSO), namely (1) affect dysregulation (2) negative self-concept and (3) disturbances in relationships. Significant functional impairment associated with the PTSD and DSO symptoms are required for diagnosis (WHO, 2019). The selection of the DSO symptom clusters and items was based on those symptoms identified as most frequently occurring in the DSM-IV filed trials of a version of complex PTSD "disorders of extreme Stress, not otherwise specified" (DESNOS) (see Roth et al. 1997; van der Kolk et al., 2005) as well those identified as most frequent and most impairing by expert clinicians in a consensus survey on complex PTSD (Cloitre et al.,

2011). International field trials have found substantial support among clinicians for the distinction between PTSD and CPTSD (Keeley et al., 2016) and that the addition of the CPTSD diagnosis has improved differential diagnosis across the stress related disorders relative to ICD-10 (Gaebel, 2019; Reed et al., 2018).

The characterisation of PTSD and CPTSD as distinct, albeit related, disorders has been supported by factor analytic research whereby symptom structures consistent with the ICD-11 distinction between PTSD and DSO have been identified and in mixture modelling research whereby distinct trauma groups representing PTSD and CPTSD have been identified (Brewin et al., 2017; Redican et al., 2021). This research has been facilitated by the development of the International Trauma Questionnaire (ITQ; Cloitre et al., 2018). Although the ITQ accommodates diagnostic and dimensional scoring, and many studies have applied categorical (mixture modelling) and dimensional (factor analysis) latent variable modelling to investigate the latent structure of PTSD and CPTSD, few studies have sought to simultaneously assess whether the latent structure of the ITQ is best represented by a categorical or dimensional model, or a combination of both. Factor analysis is a dimensional approach where continuous latent variable(s) are modelled to explain the variance and covariance of multiple observed indicators (Lubke & Muthén, 2005). Conversely, mixture modelling is a categorical approach where a categorical latent variable is modelled to separate individuals into discrete groups based on similar response patterns to observed indicators (Nylund et al., 2007). Factor mixture modelling (FMM) is a hybrid model that integrates features of factor analysis and mixture modelling, and has been developed as an alternative method by which to examine the latent structure of psychological constructs (Miettunen et al., 2016). FMM assigns individuals into discrete subgroups via a mixture approach and models heterogeneity within these groups through incorporating continuous latent factors, allowing the underlying structure of a construct to be assessed at the categorical and dimensional level simultaneously (Clarke et al., 2013). FMM facilitates direct

comparisons of model fit across categorical, dimensional, and hybrid models thereby allowing for informed decisions to be made regarding which approach best captures the latent structure of the construct under investigation (Whalen, 2017).

Clarke et al. (2013) have previously demonstrated the superiority of FMM over both factor analytic and mixture modelling in relation to conduct disorder (CD) symptomology. These researchers first identified the best fitting dimensional structure of their CD symptom data using factor analysis, identifying a single unidimensional construct of CD. They then identified the best fitting mixture model of CD symptoms using latent class analysis (LCA), identifying a three-class solution (i.e. three distinct groups characterised by the same pattern of variation across the CD symptoms. Next, the researchers tested a series of FMM's, utilising the number of classes from the optimal LCA solution (i.e. three-class model) as the upper-limit for extracting classes in the FMM, and incorporating the best-fitting FA model (i.e., a one-factor model) as the dimensional component of the FMM. Utilising standard fit indices to compare model fit across the best dimensional (i.e. FA), categorical (i.e. LCA) and hybrid (i.e. FMM) model, Clarke et al. (2013) found that the FMM best captured the latent structure of CD, highlighting the utility of FMM in understanding the latent structure of psychological constructs.

Only two studies have investigated the latent structure of ICD-11 PTSD and CPTSD using FMM. Wolf et al. (2015) were the first to apply this method using two samples including a nationally representative community sample of adults living in the United States and a small veteran sample. A FMM with two latent dimensional variables and four latent classes provided the best fit to the data in both samples. It was determined that classes were quantitatively rather than qualitatively distinct, a finding inconsistent with the proposed distinction between PTSD and CPTSD in ICD-11. A second study by Frost et al. (2019) applied FMM to investigate the latent structure of PTSD and CPTSD among a refugee sample. A correlated six-factor model with five qualitatively different latent classes was

identified as the best fitting model. In contrast to Wolf et al. (2015), distinct classes reflecting the distinction between PTSD and CPTSD were found, supporting the ICD-11 model. An important limitation of these studies was that they attempted to measure the ICD-11 symptoms of PTSD and CPTSD using proxy items. Further work is therefore required that uses data collected via a reliable and valid measure of ICD-11 PTSD and CPTSD (i.e., the ITQ).

In this study, a secondary analysis of data from a nationally representative sample of adults living in the U.S. was used to test whether responses to the ITQ are best represented by a categorical, dimensional, or 'hybrid' FMM model. We proposed that if the ICD-11's distinction between PTSD and CPTSD is meaningful and valid, a hybrid model which captures the distinction between PTSD and DSO symptoms at a dimensional level, and which identifies groups of adults with symptom profiles consistent with PTSD and CPTSD at a categorical level should provide the best fit to the data, similar to Frost et al. (2019). Alternatively, if the ICD-11 model is invalid, results would be similar to those reported by Wolf et al. (2015) whereby either (a) there would be no evidence of a distinction between PTSD and DSO symptoms at the dimensional level or (b) there would be no evidence of a qualitative distinction between PTSD and CPTSD at the categorical level.

Furthermore, we aimed to investigate the role of various demographic and trauma-related risk factors in predicting latent class membership. Although the effects of ACEs on adult psychopathology are well-documented (e.g. Kalmakis & Chandler, 2014; Kessler et al., 2010; McLaughlin et al., 2017) and previous research has highlighted the influential role of adverse childhood experiences (ACEs) in the development of PTSD and CPTSD (Cloitre et al., 2019; Frewen et al., 2019; Ho et al., 2020a,b; Ho et al., 2019; Jowett et al., 2020; Karatzias et al., 2019; Karatzias et al., 2017), the contribution of specific ACEs in predicting both disorders has been largely unexplored. Thus, we sought to examine the role of specific ACEs in predicting membership to each symptom profile. Childhood sexual and physical

abuse are considered as traumatic stressors and forms of adversity (McLaughlin et al., 2017). Thus, in line with Cloitre et al. (2019) who analysed the same dataset, we categorized both events as traumatic stressors. We anticipated similar results to Cloitre et al. (2019) where childhood physical and sexual abuse significantly predicted CPTSD. We hypothesized that the CPTSD class would be characterised by the highest levels of adulthood traumatic exposure (Cloitre et al., 2019; Hyland et al., 2017; Palic et al., 2017) and higher levels of psychological comorbidities and overall poorer wellbeing (Cloitre et al., 2019; Gilbar., 2020; Hyland et al., 2018; Karatzias et al., 2017; Karatzias et al., 2019).

2. Methods

2.1. Participants

The sample was a nationally representative household sample of non-institutionalised adults living in the U.S. Data were collected in 2017, using an existing online research panel for a project investigating the validity of ICD-11 PTSD and CPTSD symptom proposals (Cloitre et al., 2019). Participants were randomly recruited using a probability-based sampling strategy. Eligible participants were aged between 18-70 years at the time of the survey and had experienced at least one traumatic event in their lifetime. Of the 3,953 individuals screened for participation in the survey, 1,839 met the inclusion criteria and were invited to complete the survey (eligibility rate=46.3%). The survey design oversampled women and minority populations, each at a 2:1 ratio. To adjust for this oversampling, the data were weighted according to age/ethnic distribution of the US population (Cloitre et al., 2019; Shevlin et al., 2018). Ethical approval was obtained from the research ethics committee at Ulster University.

2.2. Findings from Cloitre et al. (2019)

The present study involves the re-analysis of an existing dataset (see Cloitre et al., 2019 for a detailed overview) and much is already known about the sample characteristics. In

brief, the sample had a mean age of 44.56 years (SD= 14.89) and 52% were female (n=956). More than half of the sample were married (55.3%; n=1016), 62.2% (n=1143) attained a college education, and the majority (71.1%; n= 1,306) were employed. Table 1 presents weighted sociodemographic characteristics of the sample. Cloitre et al. (2019) reported 7.2% (n=128) of the sample as meeting the requirements for a diagnosis of either PTSD or CPTSD (PTSD prevalence=3.4%, CPTSD prevalence= 3.8%). Females were more likely to meet the criteria for PTSD (OR=2.53) and CPTSD (OR=1.82) compared to males. In terms of childhood traumatic stressors, 17.5% (n=321) of the sample reported experiencing sexual abuse and 15.7% (n=289) reported experiencing physical abuse. The average number of ACEs reported was 1.36 (SD=1.72, Range= 0-8, Median = 1.00), with the most frequently reported ACEs being parental separation or divorce (33.5%; n=613), substance abuse in the home (24.5%; n= 450) and verbal abuse (21.3%; n=388). The average number of traumas reported in adulthood was 2.55 (SD=2.17, Range= 0-14, Median = 2.00), with the most commonly endorsed traumas being natural disaster (39.9%, n=725), transportation accident (55.8%, n=1021) and the sudden or unexpected death of a loved one (51.5%, n=943).

2.3.Measures

ICD-11 PTSD and CPTSD: The International Trauma Questionnaire (ITQ; Cloitre et al., 2018) is a self-report measure designed to capture all elements of an ICD-11 PTSD and CPTSD diagnosis. The ITQ first assesses a person's most distressing traumatic event, and how long ago the event occurred. There are six items measuring the three PTSD symptom clusters (Re, Av and Th) and six items measuring the three DSO symptom clusters (AD, NSC, DR). Three questions enquire about the extent to which the PTSD and DSO symptoms, respectively, have affected relationships, work and other important domains of functioning. Participants rate how often they have been bothered by each of the symptoms in the past month using a five-point Likert scale ranging from 'Not at all' (0) to 'Extremely' (4). To satisfy the criteria for a diagnosis of PTSD, one of two items from each PTSD symptom

cluster and at least one functional impairment item must be endorsed (endorsement is based on a Likert score of ≥ 2 (i.e., 'Moderately'). To qualify for a diagnosis of CPTSD, criteria for PTSD must be satisfied in addition to the endorsement of one of two items from each DSO symptom cluster and at least one functional impairment item (endorsement is Likert score ≥ 2). An individual can receive a diagnosis of PTSD or CPTSD, but not both. Cronbach's alpha for the PTSD (α=.89) and DSO (α=.89) sub-scales in the current study were excellent.

Childhood Traumatic Events, Adversities and Adulthood trauma: The Adverse Childhood Experiences Questionnaire (ACE; Felitti et al, 1998) was used to measure exposure to traumatic stressors and adversities in childhood. The ACE comprises ten questions measuring exposure to adverse experiences in the first eighteen years of life, and uses a yes (1) or no (0) response format. Two ACE items (childhood sexual and physical abuse) were categorized as traumatic stressors and the remaining items were categorized as childhood adversities. A revised version of the Life Events Checklist (LEC-R; Gray et al., 2004) was used to measure trauma exposure in adulthood. Participants were asked to indicate whether they had been exposed to 14 different traumatic events after the age of eighteen years, using yes (1) or no (0) responses. Responses were summed to create a total adulthood trauma score. Cronbach's alpha for the ACE items (α= =.77) and adult LEC-R items (α= =.69) were satisfactory.

Major Depressive Disorder and Generalized Anxiety Disorder: The Patient Health Questionnaire (PHQ-8; Kroenke et al., 2009) is an eight-item self-report measure of depression symptoms and the Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006) is a seven-item scale used to assess anxiety symptoms. For the PHQ-8, respondents indicate the number of the days over the past two weeks that they have been bothered by a particular depressive symptom using a four-point Likert scale ranging from 0 (not at all) to 3 (nearly every-day). Total scores range between 0 and 24, with higher scores indicative of greater symptom severity. A PHQ-8 score ≥10 indicates clinically significant depression

(Kroenke & Spitzer, 2002). For the GAD-7, participants indicate on a 4-point Likert scale the degree to which they have been bothered by symptoms over the last two weeks, with responses ranging from 0 (not at all) to 3(nearly every day). A GAD-7 score ≥10 can be used as a cut-off point for identifying cases of GAD (Spitzter et al., 2006). The internal reliability of the PHQ-8 (α= .93) and GAD-7 (α= .94) in this study were excellent.

Psychological Wellbeing: The World Health Organisation Well-being Index (WHO-5, WHO, 1998) is a five-item scale measuring subjective wellbeing, and comprises five positively phrased items including *"cheerful and in good spirits"* and *"felt calm and relaxed".* Participants indicate the extent to which each of the five statements has applied to them over the past two weeks. The WHO-5 uses a six-point Likert scale, ranging from 0 (at no time) to 5 (all of the time). Raw scores range from 0-25, with higher scores indicating a higher level of psychological wellbeing. Cronbach's alpha of the WHO-5 in the current study was excellent (α= .93).

Demographic variables: Demographic variables assessed included age (years), gender (0= male, 1=female), educational status (0= no college, 1= college), relationship status (0= not in committed relationship, 1= in a committed relationship), employment status (0= unemployed, 1=employed), ethnicity (0= non-white, 1=white) and household income (measured in categories ranging from 0 = less than $5,000 to 21= $250,000 or more).

Insert Table 1 about here.

2.4.Statistical Analysis

FMM was conducted in three consecutive steps as per Clarke et al. (2013). First, three alternative CFA models were tested: **Model 1** was a one-factor model where all PTSD (Re, Av, Th) and DSO (AD, NSC, DR) symptoms loaded onto a first-order CPTSD factor; **Model 2** was a correlated six-factor model (Re, Av, Th, AD, NSC, DR); and **Model 3** was a two-factor second-order model where Av, Re and Th loaded onto the second-order 'PTSD' factor, and, AD, NSC and DR load onto the second-order 'DSO'

factor (see supplementary materials). To determine the best-fitting model, a number of fit indices were assessed: the chi-square statistic, the comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis index (TLI; Tucker & Lewis, 1973), the root mean square error of approximation (RMSEA; Browne & Cudeck, 1992; Steiger,1990) and the Standardized Root Mean Square Residual (SRMR; Jöreskog & Sörbom, 1981). Standard cut-off criteria were used to determine model fit (Hu & Bentler, 1999) with a non-significant x^2 value (p >.05) indicating good fit; CFI and TLI values ≥ .90 and ≥ .95 considered as good and excellent model fit, respectively; SRMR values ≤ 0.8 indicating good fit; RMSEA values <.05 indicating close fit and <.08 indicating adequate fit (Steiger, 1990). In addition, Bayesian Information Criterion (BIC; Sclove, 1987), sample size adjusted BIC (ssaBIC; Sclove, 1987) and Akaike Information Criterion (AIC; Akaike, 1987) were used to assess relative fit with lower values indicative of superior model fit. The model with the lowest BIC was considered to be the best model, with differences ≥ 10 being considered strong evidence for the selection of the lower BIC model (Raftery, 1995).

Second, a latent profile analysis (LPA) on the item level data was conducted, testing models with two to six latent classes. The relative fit of the solutions were assessed using information criterion statistics and the Lo-Mendell-Rubin adjusted likelihood ratio test (LMR-A; Lo, Mendell & Rubin., 2001). A non-significant LMR-A indicates that there is no statistically significant improvement in fit with the inclusion of an additional class, and thus the more parsimonious model should be chosen (Nylund et al., 2007). It is often the case for LPA that as the number of latent classes increases, the information theory-based statistics fail to reach a single smallest value (Masyn, 2013, p. 572). Thus, diminishing gains in model fit were explored using ‘elbow plots’ to identify the point where changes in fit values begin to plateau, which in itself is indicative of minimal and non-significant gains in information (Masyn, 2013; Nylund et al., 2007). Entropy values, a

measure of classification certainty, were also inspected with higher values indicative of greater classification accuracy (Lubke & Muthén, 2007).

The third step involved fitting a series of FMMs to the data. The number of classes from the best-fitting LPA model were used as the upper-limit for extracting classes in the FMM (Clarke et al., 2013). There are several variations of the FMM, each with different restrictions to identify the model (Clarke et al., 2013; Lubke & Muthén, 2007). For the current study, a variation of 'type-1' FMMs were employed which are typically characterised by class-varying factor means, class-invariant item intercepts, class-invariant factor loadings and a factor covariance matrix fixed at zero (Clarke et al., 2013). However, rather than allowing factor means to vary, the current study estimated item-level intercepts to assess the performance of the individual ITQ symptom indicators across the latent classes. Factor means were fixed at zero to achieve model identification. To avoid solutions based on local maxima, 500 random sets of starting values were used in the initial stage, and 100 optimizations were used in the final stage of convergence. These values were increased for more complex models to ensure replication of the best log-likelihood value. In addition to using the same model fit criteria as used for LPA, profile plots were inspected to assess the substantive interpretability of the classes comprising each model (Nylund et al., 2007). A chi-square test was conducted to determine degree to which the variables representing most likely class membership corresponded with probable diagnostic status (criteria not met, PTSD criteria met, CPTSD criteria met). Observed and expected counts for each latent class with respect to diagnostic status were examined and the magnitude of the differences between observed and expected values were substantiated by assessing adjusted standardized residuals with values >1.96 indicating a statistically significant difference.

The final stage of the analyses involved investigating predictors of the latent classes. The demographic variables, childhood sexual and physical abuse, eight ACEs, and

total adult LEC were entered into the model in two stages using the R3step auxiliary command in Mplus (Asparouhov & Muthén, 2014). The R3step method is similar to multinomial logistic regression model (Vermunt, 2010) and ensures that covariates do not influence latent class formation whilst also recognising classification uncertainty (Asparouhov & Muthén, 2014). The first model included all covariates separately to examine the bivariate associations between covariates and latent class membership. In the second model, all covariates were added to the model simultaneously to assess whether any covariate was uniquely associated with latent class membership, over and beyond the effects of the other demographic and trauma-related predictors included in the model. Following this, differences across the latent classes with regards to mean scores on the GAD-7, PHQ-8 and WHO-5 were examined using the Bolck-Croon-Hagenaars Method (BCH method; Bolck et al., 2004). This method (analogous to four separate one-way ANOVAs) has been shown to be a robust method for investigating the relationship between class membership, covariates and distal outcomes (Bakk & Vermunt, 2015). For each distal outcome a Wald chi-square test was used to test the null hypothesis that the means were equal across all classes (akin to post-hoc tests following ANOVA); if this null hypothesis was rejected, pairwise comparisons were conducted to determine where the significant differences occurred.

All analyses were conducted using Mplus version 8.2 (Muthén & Muthén, 2017), with initial descriptive statistics computed using SPSS version 27. All models were estimated using robust maximum likelihood estimation (MLR; (Muthén & Muthén, 1998-2018). For the covariate analyses, listwise deletion was used which is the default when using the auxiliary procedure in Mplus.

3. Results

Goodness of fit statistics for the CFA, LPA and FMM models are reported in Table 2.

Insert Table 2 about here.

3.1.CFA Results:

Model 1 was rejected due to poor model fit. Model 2 ($x^2\ (39) = 83.104, \mathrm{p} < .001, \mathrm{RMSEA} = .025, \mathrm{CFI} = .993, \mathrm{TLI} = .987$) and Model 3 ($x^2\ (66) = 101.624, \mathrm{p} < .001, \mathrm{RMSEA} = .025, \mathrm{CFI} = .991, \mathrm{TLI} = .987$) demonstrated excellent fit. The chi-squared statistic was significant for both models; however this should not lead to rejection of these models as the power of chi-square tests is positively related to sample size (Tanaka, 1987). The difference in BIC values between Model 2 (correlated six-factor) and Model 3 (two-factor second-order) exceeded ten points ($\Delta\mathrm{BIC} = 19.25$), and thus the second-order model was selected as the optimal model. All items loaded significantly ($p < .001$) and strongly (> .74) onto their respective first-order PTSD and DSO factors, with the exception of one affective dysregulation item *'takes a long time to calm down'*, which had a relatively weaker factor loading (.55). All first-order PTSD (Re, Av, Th) and DSO (AD, NSC, DR) factors loaded strongly onto their respective second-order factors (all > .81). The correlation between the PTSD and DSO latent factors was .70.

3.2.LPA Results:

The LMR-A was significant for the two-class solution only, however, the loglikelihood and BIC values continued to decrease with each additional class. As demonstrated by the 'elbow' plots (see supplementary materials), increases in log-likelihood values were minimal after the three-class solution whilst increases in BIC were minimal after the four-class solution. Given the BIC is superior to other fit indices in identifying the correct number of latent classes with the use of continuous indicators (Nylund et al., 2007) and because the size of each class was adequate with the smallest class comprising 9% of the sample (Nylund-Gibson & Choi, 2018), the four-class solution was selected as the best model.

Insert Figure 1 around here.

3.3.FMM Results:

BIC values were lower for the FMMs compared to the CFA and LPA models, which indicated the superior fit of the FMMs. LMR-A was significant for the two-class model only, however, the log-likelihood was highest and information criterion statistics (i.e. BIC, ssaBIC and AIC) were substantially lower for the four-class model. Entropy increased from the three-class to the four-class solution, indicating improved classification certainty from the three to four-class solution. Inspection of profile plots and class compositions for each solution demonstrated the classes comprising the four-class solution to be most interpretable and thus, the four-class second-order FMM was selected as the best-fitting model.

The profile plot (Figure 1) presents the ITQ item endorsement patterns as influenced by the continuous latent factors derived from the CFA model across the four latent classes. Class 1 (78.9%, n=1447) was characterised by low symptom severity across all symptom indicators of the PTSD and DSO factors, and was thus labelled 'low symptoms'. Class 2 (7.1%, n=131) was labelled 'DSO class', as individuals in this class reported lower severity on all PTSD factor indicators but greater symptom severity on all DSO indicators, particularly the NSC item *"I feel worthless".* Class 3 (6.0%, n=109) was characterised by high symptom severity on all PTSD and DSO item indicators, particularly the Th item *'jumpy or easily startled'* and both NSC items, and was therefore labelled 'CPTSD class'. Finally, class 4 (8.0%, n= 147) was characterised by lower overall symptom severity across all symptom indicators compared to class 3, but higher symptom severity on the PTSD items compared to class 1 and class 2, and lower symptom severity on the DSO indicators compared to class 2. This class was also characterised by high endorsement of the Th item *'jumpy or easily startled'* and as a result, this class was labelled the 'PTSD class'.

3.4.Agreement between ITQ classification and FMM classes.

A chi-square test between variables representing most likely class membership and probable diagnostic status was conducted, with results demonstrating a significant association, (6, N=1735) = 132.419, p <.001. There was a high degree of correspondence between the two variables. The adjusted standardized residuals with respect to probable diagnostic status revealed that those in the 'no diagnosis group' were most likely to be in the 'low symptoms' class (adjusted standardised residual = 6.6), individuals in the 'CPTSD diagnosis' group were most likely to be in the 'CPTSD class' (adjusted standardised residual = 10.0) and individuals in the 'PTSD diagnosis' group were most likely to be in the 'PTSD class'(adjusted standardised residual = 4.8).

Insert Table 3 around here.

3.5.R3step (covariate) analyses:

A series of bivariate analyses were conducted using the R3step procedure. The reference class for all analyses was 'low symptoms'. Sexual abuse was found to be a significant predictor of all classes compared to the reference class and both the 'PTSD class' and 'CPTSD class' but not the 'DSO class' were significantly predicted by physical abuse, with these effects being strongest for the 'CPTSD class'. In terms of ACEs, all classes were predicted by physical neglect, emotional neglect and verbal abuse, with these effects being strongest for the 'CPTSD class'. Compared to the reference class, all classes were significantly predicted by substance abuse and mental illness in the home whilst the 'PTSD' and 'CPTSD' classes were predicted by household violence and incarnation of a family member.

As demonstrated in Table 4, the second step involved calculating adjusted odds ratios for demographic and trauma-related predictors of class membership. Compared to the 'low symptoms', individuals in the 'DSO class' (OR=0.973), 'CPTSD class' (OR=0.971) and 'PTSD class' (OR=0.964) were likelier to be younger. Unique demographic predictors of the

'DSO class' included not being in a committed relationship (OR=0.421) and having no college education (OR=0.509). Membership of the 'PTSD class' (OR=1.161) and 'CPTSD class' (OR=1.190) was predicted by higher adulthood LEC scores. Individuals in the 'CPTSD class' were approximately three times more likely to report sexual abuse (OR=3.22) and surprisingly, those in the 'PTSD class' were less likely to report physical abuse (OR= 0.505) relative to the reference class. In terms of ACEs, individuals in the 'DSO' class were approximately three times more likely than the reference class to report emotional neglect (OR=3.70) whilst conversely, individuals in the 'CPTSD class' were less likely to report physical neglect (OR=0.417) and parental separation or divorce (OR=0.448) relative to those in 'low symptoms'.

Insert Table 4 around here.

3.6.BCH (distal outcomes) Results

Sum scores for the PHQ-8, GAD-7 and WHO-5 were added into the model as distal outcomes using the BCH method (see Table 5). For the overall sample, the average GAD-7 score was 3.61 (SD= 4.84) and the average PHQ-8 scores 4.08 (SD= 5.40) with 13.8% (n=253) and 11.2% (n=199) of the sample exceeding the cut-off scores indicative of depression and generalised anxiety respectively. The mean WHO-5 score was 14.99 (SD=6.35). With regards to GAD-7 scores, pairwise comparisons between classes using x^2 showed that GAD-7 scores were significantly higher for the 'CPTSD class' compared to the 'PTSD class' whilst there was no significant difference in mean scores between the 'DSO class' and the 'PTSD class'. With regards to PHQ-8 scores, the mean score was highest for the 'CPTSD class' followed by the 'DSO class' and 'PTSD class'. Results from the x^2 analysis demonstrated how the average level of depression symptomology was significantly lower for the reference class compared to all other classes. Additionally, the average level of depression symptomology for the 'CPTSD class' was significantly higher than the 'DSO class' which in turn was identified as being significantly higher than

the ‘PTSD class’. The mean WHO-5 score was highest for the ‘low symptoms’ class, followed by the ‘PTSD class’ and ‘DSO class’ whilst the mean level of psychological wellbeing was lowest for the ‘CPTSD class’. Results from the x^2 analysis demonstrated how the average WHO-5 score was significantly lower for the ‘CPTSD class’ compared to all other classes.

Insert Table 5 around here.

4. Discussion

This was the first study to investigate the latent structure of ICD-11 PTSD and CPTSD as measured by the ITQ in a general population sample of U.S. adults using FMM. Furthermore, we sought to explore demographic and trauma-related predictors of the identified symptom profiles as well as assessing differences across classes in terms of co-morbid psychological disorders and wellbeing.

Consistent with prior research (Frost et al., 2019; Wolf et al., 2015), a hybrid model was found to best capture the latent structure of PTSD and CPTSD. Specifically, a two-factor second-order model with four qualitatively different latent classes was identified as the best-fitting model. The superior fit of the hierarchical CFA model corresponds with findings from much of the research conducted to date (Redican et al., 2021), and aligns with the ICD-11 conceptualisation of CPTSD as comprising of two distinct dimensions of PTSD and DSO (Brewin et al., 2017). Notably, similar to a small number of prior studies (Haselgruber et al., 2020; Vang et al., 2021), the affective dysregulation item representing hyperactivation loaded weakly onto the affective dysregulation factor in the present study. Although the hyperactivation and hypoactivation items capture alternative facets of affective dysregulation, the representation of both items as manifestations of a shared underlying construct (i.e. affective dysregulation) has been supported within the literature (Karatzias et al., 2018). The emergence of four qualitatively different symptom profiles is consistent with

findings from other general population studies where 'PTSD', 'CPTSD', 'DSO' and 'low symptoms' classes were also identified (Ben-Ezra et al., 2018; Kazlauskas et al., 2020; Tian et al., 2020; Rink & Lipinksa, 2020). Altogether, our findings contradict those of Wolf et al. (2015) as our results demonstrate that even when differences between PTSD and DSO symptoms are acknowledged at the dimensional level, there is evidence of qualitatively distinct trauma populations at the categorical level, and that these groups reflect the distinction between PTSD and CPTSD. These findings provide support for the ICD-11 predictions that there are distinct trauma groups in the population. The diagnostic status of some individuals did not accurately reflect their latent class membership (i.e., 17% (n=273) of participants in the no diagnosis, PTSD diagnosis or CPTSD diagnosis groups), the results revealed that there was a significantly greater proportion of individuals in the 'low symptoms', 'PTSD' and 'CPTSD' classes with the correct corresponding diagnostic status than expected, which supports the diagnostic accuracy of the 'PTSD' and 'CPTSD' symptom profiles. These results add to the growing body of research establishing the ITQ as a valid measure of PTSD and CPTSD (Redican et al., 2021).

Similar to findings from existing research (e.g. Cloitre et al., 2019; Hyland et al., 2017), sexual abuse significantly predicted membership of the 'CPTSD class', concurring with the ICD-11 theorization that childhood sexual abuse increases likelihood of developing CPTSD (Maercker et al., 2013). Surprisingly, and in contrast to Cloitre et al. (2019), our results indicated that those in the 'PTSD class' were less likely to report physical abuse compared to the reference class. This divergent finding may have resulted from the different analytic procedure adopted in the current study such that both events were analysed in conjunction with other ACEs whereas Cloitre et al. (2019) analysed both events in the presence of other childhood traumatic events, not ACEs, using the revised version of the Life Events Checklist (LEC; Gray et al., 2004).

ACEs are recognised as significant risk-factors for all posttraumatic stress responses (Cloitre et al., 2019; Frewen et al, 2019; Ho et al., 2020; Karatzias et al., 2019). Indeed, bivariate results showed a strong association between all ACEs measured in the current study, with the exception of parental separation or divorce, and the PTSD and CPTSD symptom profiles when compared to the non-symptomatic group. Notably, when considered within the multivariate context, only a small number of associations remained statistically significant. Given the established role of shared variance in explaining the effects of childhood maltreatment on mental health outcomes (Cecil et al., 2017), it is unsurprising that many of the associations became non-statistically significant when considered in the context of other traumas and adversities. Contradictory to existing research where physical neglect increased the risk of CPTSD (e.g. Choi et al., 2021; Gilbar et al., 2018; Karatzias et al., 2017), multivariate results showed how individuals in the 'CPTSD' were less likely to report physical neglect despite there being a positive bivariate association. It is possible that the shared variance between physical neglect and CPTSD is fully accounted for by the other covariates included in the multivariate model. Alternatively, Knefel et al. (2019) highlighted how the PTSD criteria of re-experiencing and avoidance may not be particularly relevant to those who have experienced neglect and similarily, Sölva et al. (2020) in their investigation of the different profiles of childhood adversities amongst foster children, reported how the 'high neglect' group experienced lowest CPTSD symptom severity. When considered in the presence of other more interpersonal traumas and adversities, it is possible that that physical neglect may decrease risk of membership to the 'CPTSD class'.

Similar to findings from Cloitre et al. (2019), adulthood traumatic exposure significantly predicted membership of both the 'PTSD class' and 'CPTSD class'. However, Cloitre et al. (2019) utilised an aggregate trauma variables representing different levels of trauma exposure (i.e. 0, 1, 2, 3 or ≥4), and found that the risk of CPTSD relative to PTSD only increased at the highest level of adulthood trauma exposure (i.e. ≥4 traumas).

Conversely, the current study assessed trauma utilising a sum score reflecting the total number of traumas to which an individual was exposed, with the effect of cumulative adulthood trauma exposure being strongest for CPTSD. Collectively, these results demonstrate why the type of trauma is a risk factor for either condition, but not a perquisite for the diagnosis. As per previous studies (Ben-Ezra et al., 2018; Ho et al., 2020b; Karatzias, Hyland et al., 2019; Perkonigg et al., 2016), age significantly predicted PTSD and CPTSD symptomology, thereby indicating how maladaptive posttraumatic stress responses tend to be endorsed predominantly by younger age groups.

Our results demonstrated that the 'CPTSD class' reported the highest levels of depression and anxiety symptomology, and the lowest levels of overall psychological wellbeing, which is consistent with previous research (Hyland et al., 2018; Karatzias et al., 2019; Karatzias, Hyland et al., 2018; Elklit et al., 2014). Similar to existing research (Gilbar, 2020; Hyland et al., 2017, Ho et al., 2020), those in the 'DSO class' reported higher levels of depression symptomology compared to the 'PTSD class' whilst those in the 'PTSD class' reported a higher mean anxiety score compared to those in the 'DSO class', although this difference was not statistically significant. The high degree of comorbidity between disorders may be explained by the fact that the symptoms constituting DSO are cross-diagnostic. For example, emotional dysregulation is also a central component of many anxiety and mood disorders (Dvir et al., 2014) and the symptoms reflecting negative self-concept, which were heavily endorsed by both the 'DSO class' and 'CPTSD class', are also features of major depressive disorder (Zahn et al., 2015). Conversely, the co-occurrence of depression and anxiety disorders with posttraumatic stress responses can also be considered in the context of the 'Hierarchical Taxonomy of Psychopathology' (HiTop; Kotov et al., 2017) in which PTSD falls under the 'internalising dimension' and thus should be most strongly correlated with other disorders within the same dimension such as depressive and anxiety disorders (Fox et al., 2020). There are a myriad of other potential explanations for the high levels of

comorbidity observed such as a shared vulnerability across disorders in terms of risk factors (Spinhoven et al., 2014), genetic disposition as well as similarities in cognitive and memory processes (Angelakis & Nixon, 2015). Further research is required to unpack the patterns of comorbidity observed among PTSD/CPTSD and other forms of psychopathology.

With regard to the identification of the 'DSO class', various proposals have been made to elucidate what exactly this class may represent: (1) it may represent individuals with other psychological disorders (Cloitre et al., 2020; Knefel et al., 2015), (2) it may be a function of the larger sample sizes typical of studies analysing data from large samples of the general population, which tend to extract more classes or (3) it may reflect individuals with subthreshold CPTSD who possess a greater vulnerability to the symptoms constituting DSO but greater resilience to PTSD symptoms (Perkonigg et al., 2016). Given the high levels of depression symptomology, poorer psychological wellbeing and high endorsement of NSC items in the 'DSO class' in the current study, it is plausible that this class may reflect individuals with other psychiatric disorders which can also occur post-trauma (Cloitre et al., 2020; Knefel et al., 2015; Perkonigg et al., 2016). Individuals in the 'DSO class' were also approximately three times more likely to report emotional neglect, an adversity linked to internalising symptoms in adulthood (Cohen et al., 2017). Further investigation of the 'DSO class' is necessary to understand what exactly this class represents, especially in general population samples (Cloitre et al., 2020).

Several study limitations are worth noting. Although the sample was a large nationally representative general-population sample of U.S. adults, the prevalence of PTSD and CPTSD was relatively low thereby limiting generalisability of findings to highly traumatised samples. Although clinically meaningful and distinct symptom profiles were identified, the relatively low endorsement of PTSD and DSO symptoms in the current study resulted in an uneven distribution of participants across the latent classes with the majority of participants belonging to the 'low symptoms' class. There is clearly a need for further

research in traumatised clinical samples who are likely to present with higher rates of PTSD and CPTSD. Future research conducted on clinical samples is therefore recommended. There are also limitations associated with the ACE measure utilised in the current study such as the lack of consensus regarding which events can be considered as ACEs and the dichotomous yes/no nature of this scale prohibits examination of the frequency, intensity or chronicity of ACE exposure (Anda et al., 2020). Thus, it is possible that the unanticipated findings surrounding the effects of physical abuse and neglect may be explained by the implementation of this particular measure. Finally, the cross-sectional nature of the study does not allow for inferences regarding causality to be made.

Overall, this study provides further support for the validity of PTSD and CPTSD, as defined by ICD-11, in a general population sample of US adults through the application of FMM. Establishing risk factors that distinguish these disorders from each other has important implications for the diagnosis, treatment and prevention of both disorders (Cloitre et al., 2013). Thus, the identification of risk factors specific to and shared across the various symptom profiles in the present study affords a comprehensive understanding of the aetiological risk factors associated with the various posttraumatic responses. In saying that, several unexpected findings were observed in terms of the role of physical abuse and neglect in predicting posttraumatic responses, thus determining whether such findings replicate across other samples is an important avenue of exploration for future studies.

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Table 1: Sociodemographic (Weighted) Characteristics of the Sample (N=1839)

	% (n)
Sex	
Male	48.0 (883)
Female	52.0 (956)
Age in years	
18-24	10.0 (184)
25-34	20.7 (382)
35-44	19.0 (350)
45-54	18.5 (339)
55-64	21.6 (398)
65+	10.2 (187)
Age	M =44.55 , SD = 14.89
Region	
Northeast	18.1 (333)
Midwest	20.9 (385)
South	38.2 (702)
West	22.8 (420)
Highest educational attainment	
Less than high school	9.1 (168)
High school	28.7 (528)
Some college	30.3 (558)
Bachelor's degree or higher	31.8 (585)
Current relationship status	
In a committed relationship	63.4 (1165)
Not in a committed relationship	36.6 (674)
Current employment status	
Employed	71.1 (1307)
Unemployed	28.9 (532)
Ethnicity	
Non-white	36.2 (666)
White	63.8 (1173)
Income level ($)	
0-19,999	10.8 (198)
20,000 - 34,999	11.0 (202)
35,000 – 49,999	12.2 (225)
50,000 – 74,999	17.6 (322)
75,000 – 99,999	14.4 (264)
100,000 or more	34.1 (628)

Table 2: Fit Statistics for the CFA, LCA and FMM of ICD-11 PTSD and CPTSD.

Model	Log-likelihood	AIC	BIC	ssaBIC	Entropy	LMR-A (p)
CFA						
Model 1	-26497.891	53067.782	53266.295	53151.924	-	-
Model 2	-24307.505	48717.010	48998.237	48836.212	-	-
Model 3	**-24327.939**	**48741.877**	**48978.990**	**48842.381**	-	-
LPA						
2 classes	-27193.751	54461.501	54665.529	54547.981	.974	.0000
3 classes	-26117.401	52334.802	52610.515	52451.667	.946	.2366
4 classes	**-25274.137**	**50674.274**	**51021.672**	**50821.523**	**.940**	**.5128**
5 classes	-24832.832	49817.663	50236.747	49995.297	.938	.7760
6 classes	-24384.670	48947.340	49438.109	49155.359	.938	.7589
FMM						
2 factors 2 classes	-23599.779	47311.558	47620.356	47442.446	0.990	.0000
2 factors 3 classes	-23358.178	46854.355	47234.839	47015.628	0.979	.7047
2 factors 4 classes	**-22966.634**	**46097.268**	**46549.437**	**46288.926**	**0.986**	**.7398**

Note: AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, ssaBIC = sample size adjusted Bayesian Information Criterion, LMR-A Lo-Mendell-Rubin adjusted likelihood ratio test. Best-fitting models for each approach (CFA, LPA, FMM) shown in bold.

Table 3: Unadjusted Odds Ratios for Demographic and Trauma-Related Predictors of Latent Class Membership.

Predictor	Class 2: DSO OR (95% CI)		Class 3: CPTSD OR (95% CI)		Class 4: PTSD OR (95% CI)	
Childhood Sexual Abuse	2.223*	(1.369, 3.611)	7.028**	(4.401, 11.223)	2.067*	(1.318, 3.240)
Childhood Physical Abuse	1.978	(1.176, 3.327)	6.961**	(4.332, 11.185)	2.191*	(1.332, 3.603)
Physical neglect (ACE 3)	1.056**	(1.305, 6.337)	1.358**	(1.927, 7.841)	1.877**	(3.543, 12.041)
Verbal abuse (ACE 4)	3.784**	(2.399, 5.968)	7.614**	(4.770, 12.152)	4.069**	(2.584, 6.406)
Emotional neglect (ACE 5)	5.974**	(3.777, 9.449)	8.853**	(5.490, 14.276)	4.824**	(3.007, 7.738)
Violence in the home (ACE 6)	1.575	(0.829, 2.992)	4.914*	(2.914, 8.286)	4.014*	(2.354, 6.842)
Parental separation or divorce(ACE 7)	1.487	(0.954, 2.319)	1.253	(0.792, 1.983)	1.872	(1.212, 2.893)
Substance abuse in the home (ACE 8)	1.866*	(1.183, 2.941)	5.551**	(3.495, 8.816)	2.700*	(1.733, 4.208)
Mental illness in the home (ACE 9)	2.634*	(1.600, 4.337)	4.898**	(3.034, 7.906)	2.413*	(1.446, 4.027)
Household member incarnated(ACE10)	1.525	(0.756, 3.075)	2.893*	(1.651, 5.071)	3.488*	(1.837, 6.473)
Gender	1.591	(1.024, 2.472)	1.342	(0.899, 2.005)	2.760	(1.322, 5.717)
LEC Adult Total Score	1.055	(0.959, 1.162)	1.333**	(1.219, 1.458)	1.186**	(1.091, 1.289)
Age	0.973**	(0.959, 0.989)	0.989	(0.974, 1.004)	0.968**	(0.955, 0.982)
Ethnicity	0.922	(0.592, 1.437)	0.675*	(0.434, 1.050)	0.692*	(0.442, 1.052)
Relationship Status (in a committed relationship)	0.363**	(0.233, 0.565)	0.710	(0.447, 1.128)	0.709	(0.457, 1.098)
Employment status (employed)	0.810	(0.521, 1.259)	0.577**	(0.366, 0.911)	1.467	(0.881, 2.441)
Educational Status (college education)	0.616*	(0.396, 0.958)	0.675	(0.428, 1.065) *	0.722	(0.463, 1.126)
Household income	1.068*	(1.020, 1.118)	0.966	(0.907, 1.029)	1.012	(0.955, 1.071)

Note: Class 1 (Baseline) is the reference category, * - significant at $p < 0.05$, **- significant at $p<0.01$.

Table 4: Demographic and Trauma-Related Predictors and Latent Class Membership (adjusted odds ratios).

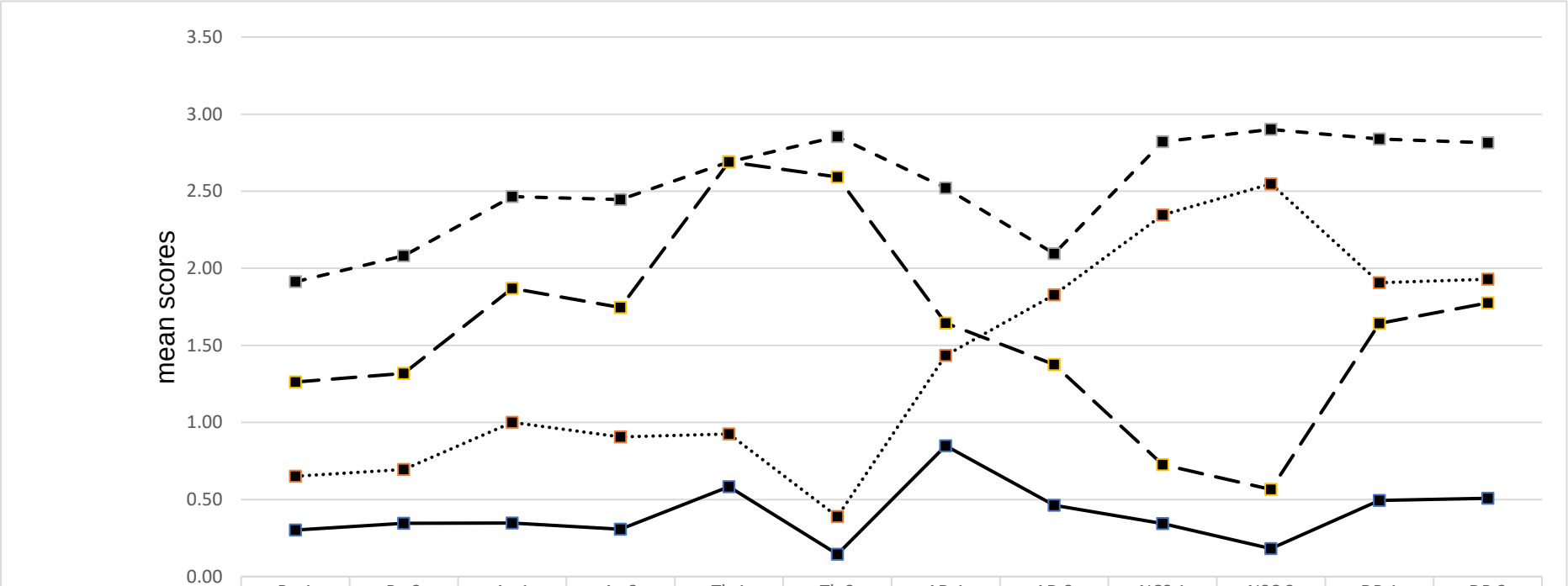
Predict	Class 2: DSO OR (95% CI)		Class 3: CPTSD OR (95% CI)		Class 4: PTSD OR (95% CI)	
Age	0.973**	(0.956, 0.990)	0.971**	(0.951, 0.991)	0.964**	(0.945, 0.982)
Gender	1.560	(0.908, 2.680)	1.324	(0.762, 2.300)	1.439	(0.868, 2.386)
Household Income	0.987	(0.932, 1.045)	0.965	(0.912, 1.022)	0.972	(0.925, 1.021)
Education Status	0.509**	(0.316, 0.822)	0.754	(0.399, 1.423)	0.831	(0.503, 1.372)
Relationship Status	0.421**	(0.254, 0.698)	1.120	(0.611, 2.053)	0.941	(0.554, 1.598)
Employment Status	1.141	(0.690, 1.885)	0.732	(0.402, 1.332)	1.937	(1.176, 3.189)
Ethnicity	1.255	(0.747, 2.107)	0.888	(0.515, 1.531)	0.938	(0.581, 1.515)
Childhood Sexual Abuse	1.504	(0.847, 2.688)	3.221*	(1.847, 5.617)	1.271	(0.728, 2.216)
Childhood Physical Abuse	0.891	(0.466, 1.703)	1.779	(0.849, 3.731)	0.505*	(0.224, 1.138)
Physical neglect (ACE 3)	0.950	(0.331, 2.728)	0.417**	(0.174, 0.999)	2.179	(0.962, 4.937)
Verbal abuse (ACE 4)	1.971	(1.041, 3.731)	1.867	(0.875, 3.982)	2.121	(1.058, 4.254)
Emotional neglect (ACE 5)	3.700*	(1.873, 7.310)	2.322	(1.151, 4.684)	2.156	(1.172, 3.967)
Violence in the home (ACE 6)	0.593	(0.286, 1.228)	1.211	(0.555, 2.642)	1.849	(0.848, 4.031)
Parental separation or divorce(ACE 7)	0.909	(0.543, 1.523)	0.448**	(0.251, 0.799)	0.883	(0.544, 1.433)
Substance abuse in the home (ACE 8)	1.210	(0.713, 2.053)	2.321	(1.248, 4.317)	1.240	(0.712, 2.158)
Mental illness in the home (ACE 9)	1.743	(0.975, 3.118)	2.295	(1.242, 4.243)	1.038	(0.573, 1.880)
Household member incarnated(ACE10)	0.767	(0.312, 1.886)	0.880	(0.397, 1.952)	1.547	(0.657, 3.640)
Total LEC Adult Score	1.302	(0.925, 1.150)	1.190**	(1.058, 1.339)	1.161*	(1.037, 1.301)

Note: Class 1 (Baseline) is the reference category, * - significant at $p < 0.05$, **- significant at $p<0.01$.

Table 5: Equality test of means of PHQ-8, GAD-7 and WHO-5 scores across the latent classes.

	Class 1: Low symptoms		Class 2: DSO		Class 3: CPSTD		Class 4: PTSD		Overall Chi-Square test	Pairwise comparison ($p < .05$)
	Mean	(se)	Mean	(se)	Mean	(se)	Mean	(se)		
Depression (PHQ-8)	2.355	(0.102)	10.158	(0.795)	14.106	(0.681)	7.840	(0.709)	444.287 ($p < 0.01$)	2, 3, 4 > 1 3 > 2, 4 4 > 2
Anxiety (GAD-7)	2.098	(0.096)	7.804	(0.609)	12.265	(0.649)	8.036	(0.634)	408.194 ($p < 0.01$)	2, 3, 4 > 1 3 > 2, 4
Psychological Wellbeing (WHO-5)	16.504	(0.176)	8.902	(0.636)	6.958	(0.522)	11.315	(0.651)	445.262 ($p < 0.01$)	2, 3, 4 < 1 2 > 3 4 > 2, 3

Figure 1. Profile Plot of Estimated Means for 4-class Factor Mixture Model Solution.



	Re 1	Re 2	Av 1	Av 2	Th 1	Th 2	AD 1	AD 2	NCS 1	NSC 2	DR 1	DR 2
Low Symptoms	0.30	0.35	0.35	0.31	0.58	0.15	0.85	0.46	0.34	0.18	0.49	0.51
DSO	0.65	0.70	1.00	0.91	0.92	0.39	1.44	1.83	2.35	2.55	1.91	1.93
CPTSD	1.91	2.08	2.46	2.45	2.69	2.85	2.52	2.10	2.82	2.90	2.84	2.81
PTSD	1.26	1.32	1.87	1.75	2.69	2.59	1.64	1.38	0.73	0.57	1.64	1.78