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BASIC RESEARCH ARTICLE

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Validation of a clinician-administered diagnostic measure of ICD-11 PTSD and complex PTSD: the International Trauma Interview in a clinical sample of military veterans

Ole Melkevik [a], Anni B. S. Nielsen [a,b], Katrine Friis[c], Caroline Lund [a], Bjarke W. Schmidt [a] and Sofie Folke [a,c]

[a]Research and Knowledge Centre, The Danish Veterans Centre, Ringsted, Denmark; [b]The Research Unit and Section of General Practice, Department of Public Health, University of Copenhagen, Copenhagen K, Denmark; [c]Department of Military Psychology, The Danish Veterans Centre, Copenhagen Ø, Denmark

ABSTRACT

Background: The International Trauma Interview (ITI) is the first clinician-administered diagnostic tool developed to assess posttraumatic stress disorder (PTSD) and Complex PTSD (CPTSD), both recently recognized in the ICD-11. The current study aims to test the construct and discriminant validity of the ITI in a population of treatment-seeking veterans.

Method: 124 Danish veterans seeking psychological treatment were interviewed by a group of trained clinicians for ICD-11 PTSD and CPTSD before beginning treatment at the Military Psychological Department in the Danish Defense. A series of confirmatory factor models were estimated in order to identify the extent to which latent variable operationalizations provide potential explanations for the associations between symptoms.

Results: Results indicate that symptoms of CPTSD, as measured by the ITI, are best represented by a single higher-order factor. We also found that a bifactor model provided adequate fit to the data. The commonly identified two-factor higher-order model was rejected due to the lack of discriminant validity between PTSD and DSO. The higher order model was found to explain associations between symptoms of CPTSD and symptoms of depression, stress, anxiety, and well-being.

Conclusion: The ITI does not fit a two-factor higher-order model in a sample of treatment-seeking Danish veterans. Rather, a single higher order factor shows excellent fit, and is found to explain associations between ITI symptoms and other internalizing symptoms.

Validación de una medida diagnóstica administrada por el clínico para el trastorno de estrés postraumático (TEPT) y el trastorno de estrés postraumático complejo (TEPTC), según la CIE-11: la Entrevista Internacional de Trauma en una muestra clínica de veteranos militares

Antecedentes: La Entrevista Internacional de Trauma (ITI por sus siglas en ingles) es la primera herramienta diagnóstica administrada por clínico desarrollada para evaluar el trastorno de estrés postraumático (TEPT) y el TEPT complejo (TEPTC), ambos reconocidos recientemente en la CIE-11. El estudio actual tiene como objetivo probar la validez de constructo y discriminante de la ITI en una población de veteranos que buscan tratamiento.

Método: 124 veteranos daneses que buscaban tratamiento psicológico fueron entrevistados por un grupo de médicos capacitados para el TEPT y el TEPTC de la CIE-11 antes de comenzar el tratamiento en el Departamento de Psicología Militar de la Defensa danesa. Fueron estimados varios modelos factoriales confirmatorios para identificar en qué medida las operacionalizaciones de variables latentes otorgan explicaciones potenciales para las asociaciones entre síntomas.

Resultados: Los resultados indican que los síntomas de TEPTC, medidos por la ITI, se representan mejor con un único factor de orden superior. También encontramos que un modelo bifactorial se ajustaba adecuadamente a los datos. El modelo de orden superior de dos factores, identificado comúnmente, fue rechazado debido a la falta de validez discriminante entre TEPT y AAO. Se descubrió que el modelo de orden superior explicaba las asociaciones entre los síntomas de TEPTC y síntomas de depresión, estrés, ansiedad y bienestar.

Conclusión: La ITI no se ajusta a un modelo de orden superior de dos factores en una muestra de veteranos daneses que buscaban tratamiento. En cambio, un único factor de orden superior muestra un ajuste excelente y se descubre que explica las asociaciones entre los síntomas de la ITI y otros síntomas internalizantes.

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HIGHLIGHTS

- Symptoms of ICD-11 PTSD and CPTSD, as measured by the ITI, are best represented by a single higher-order factor, in a sample of treatment-seeking veterans.
- The commonly identified two-factor higher-order model and six-factor correlated models were rejected due to the lack of discriminant validity between factors.
- A higher order factor explains associations between ICD-11 CPTSD symptoms and other internalizing symptoms.

CONTACT Ole Melkevik vetc-vic10@mil.dk Research and Knowledge Centre, the Danish Veterans Centre, Garnisonen 1, 4100 Ringsted, Denmark

1. Introduction

The International Classification of Diseases (ICD-11) introduced changes to the Post Traumatic Stress Disorder (PTSD) diagnosis while also introducing the diagnosis of complex PTSD (CPTSD) (Maercker et al., 2013). PTSD is defined by three sets of symptom clusters including (a) re-experiencing in the here and now, (b) avoidance of traumatic reminders, and (c) a sense of current threat. CPTSD encompasses PTSD symptoms as well as symptoms of affective dysregulation, negative self-concept, and disturbances in relationships, collectively labelled 'disturbances in self-organization' (DSO) (Maercker et al., 2013).

The development of the questionnaire-based International Trauma Questionnaire (ITQ; Cloitre et al., 2018) and the clinical interview International Trauma Interview (ITI; Roberts et al., 2018) has provided instruments which allow for the assessment of the same set of symptoms, reflecting ICD-11 PTSD and CPTSD.

While the two tools measure the same symptoms, there are some differences in the expected output from the ITQ and ITI, respectively. When comparing the two methods, Gelezelyte and colleagues (2022) found a tendency for all symptoms to be more strongly endorsed in the ITQ, resulting in a higher prevalence of ICD-11 PTSD and CPTSD when compared with the ITI. Thus, we assume that the ITI will provide more conservative and accurate assessments of symptom ratings and diagnostic status, as a clinician is more likely to correctly differentiate between different symptoms and to assess whether they are linked to a traumatic event or not.

Since they were first published, at least 18 studies have aimed to validate the ITQ with confirmatory factor analysis (Redican et al., 2021), while only three such studies have been published on the ITI (Bachem et al., 2024; Bondjers et al., 2019; Gelezelyte et al., 2022).

The evidence from the ITQ validation studies is presented favourably in a systematic review suggesting that there is support for the 'conceptual coherence of PTSD and CPTSD as empirically distinguishable disorders, as measured by the ITQ', and that 'the available evidence demonstrates that the ITQ is a valid measure of ICD-11 PTSD and CPTSD' (Redican et al., 2021).

For the ITI validation studies, the evidence is mixed. Two, out of three ITI studies conclude in favour of a model supporting PTSD and DSO as higher order factors (Bondjers et al., 2019; Gelezelyte et al., 2022). However, the most recent ITI study (Bachem et al., 2024) reports excellent fit for a six-factor correlated model in a military population, but rejects all tested models in a civilian sample.

None have, however, addressed additional methodological considerations which may elevate the confidence in the psychometric evaluations such as testing a comprehensive set of competing operationalizations, utilizing latent variables to define external factors of psychopathology, and testing for the lack of discriminant validity between latent variables.

Testing a comprehensive set of relevant models is important given the fact that model equivalence is common in the literature (Bachem et al., 2024; Ben-Ezra et al., 2018; Bondjers et al., 2019; Choi et al., 2021; Gelezelyte et al., 2022; Gilbar, 2020; Haselgruber et al., 2020; Hyland et al., 2017; Murphy et al., 2018). Consequently, there is a risk that the optimal models are overlooked in studies that only test two or three competing models. Utilizing full latent variable models when assessing associations between ITI constructs and other indicators of psychopathology is necessary in order to determine whether the item pool of the ITI is sufficiently distinct from related constructs like depression, anxiety, stress, and well-being. Clark and Watson (2019) recommend such tests in order to avoid redundancy or excessive overlap between constructs. Finally, tests for discriminant validity are important in order to reduce the risk of including redundant constructs in latent variable models. This is particularly important for the two-factor higher order model, as some studies have reported correlations between PTSD and DSO above $r = 0.9$ (Choi et al., 2021; Haselgruber et al., 2020). Rönkkö and Cho (2022) suggest that correlations that are statistically indistinguishable from 1 could indicate conceptual redundancy or misspesification in the measurement model.

In light of the reviewed literature, we find it is important to perform stringent assessments of the psychometric properties of the ITI. As novel features of this study, we will utilize full latent variable models and specific tests for discriminant validity while analysing data from treatment-seeking veterans where the prevalence of ICD-11 PTSD and CPTSD are likely to be higher than those included in other validation studies.

2. Method

2.1. Participants and procedures

Participants were previously deployed Danish soldiers and veterans (hereafter 'veterans') who referred themselves for treatment at the Military Psychology Department (MPD), Danish Veterans Centre, between August 2020 and July 2023. All Danish veterans deployed on international missions with the Danish Armed Forces are eligible to seek treatment at the MPD. The only inclusion criterion is that the symptoms or issues for which veterans seek help must be related to their military deployment.

Upon receipt of a referral, all new clients at the MPD completed an extensive online questionnaire battery and participated in an initial assessment interview conducted individually by licensed clinical psychologists. If PTSD or CPTSD was indicated during the initial assessment, it was followed by a clinical interview using the ITI.

The ITI was administered by a team of 25 licensed clinical psychologists, all of whom were trained by Neil Roberts, SF, or KF (authors) in how to administer and score the ITI. Throughout the study, SF and KF provided bimonthly supervision to ensure consistent administration and scoring of the ITI, while also mitigating rater drift. These supervision sessions involved coding audio-recorded interviews and discussing ratings.

The current sample was restricted to treatment-seeking veterans who were at least 18 years old and had substantial knowledge of the Danish language. The final sample comprised 124 participants.

2.2. Measures

ITI: The ITI is a semi-structured clinician-administered interview designed to assess symptoms of PTSD and CPTSD according to ICD-11 criteria, starting with a question to identify the presence of an index trauma and followed by two parts: Part one assesses symptoms of PTSD, while part two assesses Disturbances in self-organization (DSO) symptoms, as proposed in ICD-11 (Roberts et al., 2018).

Part one items are derived from the Clinician Administered PTSD Scale for DSM-5 (CAPS-5; Weathers et al., 2018) and include two items for each of the three PTSD symptom clusters: re-experiencing (RE; flashbacks or nightmares), avoidance (AV; avoidance of internal or external reminders of the traumatic event), and sense of current threat (TH; hypervigilance or exaggerated startle response). Each symptom is rated on a five-point scale for both severity and frequency over the past month (0 = absent, 4 = extreme). Additionally, part one includes questions about functional impairment in social and occupational contexts due to PTSD symptoms, also rated on a scale from 0 (no adverse impact) to 4 (extreme impact with little to no functioning). The Cronbach's alpha of the PTSD items were $\alpha = 0.825$, suggesting high internal consistency.

Part two assesses DSO symptoms which reflect pervasive and enduring difficulties that have emerged or worsened as a consequence of the traumatic event. These symptoms are categorized into three clusters: (a) affective dysregulation (AD; hyperactivation or hypoactivation), (b) negative self-concept (NSC; feelings of failure or worthlessness), and (c) disturbed relationships (DR; feeling distant from others or difficulty maintaining emotional closeness). Like part one, each symptom is rated on the same five-point scale (0 = absent, 4 = extreme), with additional questions assessing the impact of these DSO symptoms on functioning in daily life. The procedure explaining how the ITI is used for diagnosis is explained elsewhere (Bondjers et al., 2019; Gelezelyte et al., 2022). The total PTSD severity score ranges from 0 to 24, the DSO severity score also ranges from 0 to 24, and the overall CPTSD severity score ranges from 0 to 48. The Cronbach's alpha of the DSO items was $\alpha = 0.868$, suggesting high internal consistency.

The Danish version of the ITI was translated from English by authors SF and KF in collaboration with researchers and clinicians from the Danish Veterans Centre. This translation was based on an earlier version developed by researchers at the Competence Centre for Transcultural Psychiatry, Mental Health Centre Ballerup, Denmark (Vindbjerg et al., 2023). The translation was then back-translated by an independent professional translator to ensure both linguistic accuracy and consistency with the original instrument. The back-translation was reviewed and approved by Neil Roberts to ensure alignment with the intended diagnostic framework.

In line with previous validation studies of the ITI (Bachem et al., 2024; Bondjers et al., 2019; Gelezelyte et al., 2022) the version used in the current study was Test Version 3.1 (Roberts et al., 2018).

DASS: Symptoms of depression, anxiety, and stress were measured with the 42-item Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1995) which was included in the online questionnaire filled out prior to the ITI interview. Each symptom category is assessed by 14 items on a four-point Likert scale from 0 ('I did not experience it at all') to 3 ('I experienced it many times or all the time'). Higher scores indicate more severe symptom load. All subscales were included in the analyses as latent factors. For the descriptive tables (Tables 1 and 2), variables were included as sum-scores with a theoretical minimum of 0 and a theoretical maximum of 42. A high score indicated high levels of symptoms. The Cronbach's alpha of all DASS subscales were $\alpha = 0.914$ or higher, indicating high internal consistency.

The depression subscale was included in the analyses as a latent variable including correlated residual errors for items 5 and 42 (both refer to the lack of initiative), items 17 and 38 (both refer to lack of purpose), and items 10 and 24 (both refer to the lack of enthusiasm and enjoyment). The anxiety subscale was included in the analyses as a latent variable including correlated residual errors for items 9 and 20 (both refer to being afraid for no reason) and items 15 and 19 (both refer to physical discomfort). The stress subscale was included in the analyses as a latent variable including correlated residual errors for items 32 and 35 (both refer to a lack of tolerance for disturbances),

Table 1. Means (SD), ICC, and bivariate correlations between ITI variables (Descriptive statistics).

	Mean	SD	ICC	RE1	RE2	AV1	AV2	TH1	TH2	AD1	AD2	NSC1	NSC2	DR1	DR2
RE1	2.10	1.32	0.21	1.00											
RE2	1.68	1.12	0.17	0.37	1.00										
AV1	2.50	1.13	0.30	0.50	0.54	1.00									
AV2	2.35	1.18	0.17	0.47	0.51	0.59	1.00								
TH1	2.77	0.95	0.16	0.42	0.40	0.44	0.54	1.00							
TH2	1.80	1.24	0.16	0.36	0.30	0.37	0.40	0.50	1.00						
AD1	2.32	0.86	0.16	0.36	0.34	0.46	0.49	0.51	0.47	1.00					
AD2	2.02	1.28	0.33	0.36	0.47	0.49	0.48	0.47	0.44	0.46	1.00				
NSC1	2.12	1.25	0.22	0.46	0.30	0.44	0.49	0.47	0.32	0.43	0.45	1.00			
NSC2	1.91	1.16	0.23	0.40	0.27	0.42	0.48	0.39	0.33	0.44	0.47	0.76	1.00		
DR1	2.27	1.07	0.12	0.42	0.37	0.51	0.51	0.59	0.36	0.47	0.51	0.53	0.46	1.00	
DR2	2.23	1.11	0.19	0.36	0.38	0.57	0.54	0.57	0.40	0.52	0.53	0.57	0.51	0.84	1.00

Notes: SD: Standard deviation; ICC: Intraclass correlation-coefficients; RE1: Distressing dreams; RE2: Intrusive recollections/flashbacks; AV1: Internal avoidance; AV2: External avoidance; TH1: Hypervigilance/sense of current threat; TH2: Exaggerated startle response; AD1: Long-time upset (hyperactivation); AD2: Emotional numbing (hypoactivation); NSC1: Feelings of failure; NSC2: Feelings of worthlessness; DR1: Feeling distant or cut off from others; DR2: Difficulties feeling close to others.

for items 12 and 33 (both refer to questions regarding nervousness), and for items 1 and 11 (both refer to feelings of annoyance).

WHO-5 Well-Being Index: Well-being was assessed using The World Health Organization 5 Well-Being Index (WHO-5; Topp et al., 2015) which is a global self-report questionnaire considered the gold-standard measure for assessing the positive well-being dimension of quality of life within the last 14 days, using five questions (6-point Likert-like scale with 'at no time' (= 0) to 'all of the time' (= 5)). The scale has been developed and validated across a number of different populations (Heun et al., 2001; Khosravi et al., 2015; Nielsen et al., 2024). Well-being was included in the analyses as a latent variable. For Table 2, this variable was used as a sum score with a theoretical minimum of 0 to a theoretical maximum of 25, where a high score indicates high levels of well-being. The Cronbach's alpha of the WHO-5 index was $\alpha = 0.856$, indicating high internal consistency.

The number of unique past traumatic experiences was assessed by the Trauma Life Events Questionnaire (TLEQ) (Kubany et al., 2000), which lists 19 traumatic events that could have happened in a person's life (e.g. natural disaster, robbery involving a weapon, childhood trauma). Respondents are asked to indicate how many times each trauma had occurred, with an upper limit of six or more times. The variable was used by dichotomizing the items, with 1 indicating the event had occurred one or more times. This scale was only available for a subsample of 111 individuals.

2.3. Statistical analysis

CFA was performed in order to evaluate the ITI's factor structure. Similar to previous ITI validation studies (Bachem et al., 2024; Bondjers et al., 2019; Gelezelyte et al., 2022), model fit was evaluated using the chi-square test, Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC). For increased levels of transparency and comparability between studies, we also decided to report diagnostic information regarding impermissible values and issues relating to discriminant validity for each model.

Positive evaluations of models are indicated by a non-significant chi-square test; CFI and TLI values of $\geq .95$; and RMSEA values of $\leq .06$ (Hu & Bentler, 1999). Models with impermissible values were re-estimated with the residual error fixed to 0. Fixing residual errors to 0 results in a standardized factor

Table 2. Descriptive statistics of the International Trauma Interview (ITI) subscales.

	Full sample ($N = 123$)		No diagnosis ($n = 26$)		PTSD ($n = 17$)		CPTSD ($n = 80$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
ITI total	26.05	9.73	12.30	7.73	22.59	5.97	31.25	5.28
PTSD	13.19	5.10	6.00	3.91	13.47	3.26	15.46	3.31
DSO	12.86	5.29	6.31	4.43	9.12	3.64	15.79	2.91
Re-experiencing	3.78	2.03	1.35	1.79	3.82	1.33	4.55	1.57
Avoidance	4.85	2.06	1.88	1.73	5.24	1.44	5.71	1.24
Sense of threat	4.58	1.91	2.77	2.18	4.41	1.54	5.20	1.47
Affect dysregulation	4.35	1.85	2.31	1.64	3.88	1.90	5.10	1.32
Negative self-thought	4.03	2.26	2.00	1.92	1.35	1.11	5.25	1.45
Disturbed relationships	4.50	2.09	2.00	2.14	3.88	2.29	5.44	1.13
Anxiety	17.62	8.89	11.95	8.27	11.38	7.07	20.43	8.06
Depression	25.00	9.94	17.36	10.13	19.85	11.33	28.19	8.05
Stress	25.29	8.78	20.32	10.08	21.07	7.62	27.59	7.74
Well-being	5.83	4.04	9.00	5.01	7.08	4.42	4.64	3.00

loading of 1 and an explained variance of 100% in the respective indicator. Although residual errors of 0 are unlikely, this procedure provides theoretically possible estimates with the smallest possible changes to the estimates produced by the model.

Discriminant validity was assessed using the criteria suggested by Rönkkö and Cho (2022), where the inclusion of 1 in the 95% confidence intervals around correlations between latent variables suggests severe problems with discriminant validity. This criterion was used as a basis for eliminating redundant factors and rejecting otherwise well-fitting models.

In addition to previously tested ITI validation models (Bachem et al., 2024; Bondjers et al., 2019; Gelezelyte et al., 2022), we included a bifactor model, as this has been found useful for describing other multidimensional data (Frost et al., 2020; Reise, 2012; Rodriguez et al., 2016). This model was specified by using three orthogonal latent variables: one general factor (G-factor) loading on all ITI items, one PTSD factor loading on PTSD items only, and one DSO factor loading on DSO items only. Latent variable variances were fixed to 1 for identification purposes (Figure 1).

External variables were operationalized by means of latent variables representing each subscale of the DASS and the WHO-5 scale. Each latent variable was modelled and adjusted separately until adequate model-fit was attained.

All models based on the ITI, which were evaluated to have satisfactory fit and no severe discriminant validity issues, were included in full structural equation models where associations with other constructs were estimated. Models including external constructs (depression, anxiety, stress, and well-being) were estimated separately due to the discrepancy between model complexity and sample size. This process was done in three steps: (1) adapting latent variable operationalizations of each construct, (2) estimating associations between CPTSD and external latent variables, and (3) testing whether transdiagnostic factors, in the form of higher-order factors or general factors from bifactor models, account for associations between CPTSD and the external constructs.

All statistical models were repeated using the type = complex command in the Mplus software (Muthén & Muthén, 2019). These models provided standard errors and chi-square tests which were adjusted for potential dependencies due to multiple participants being rated by the same interviewer. We chose not to include these results, as all models issued a warning that parameter estimates for standard errors may not be trustworthy due to a non-positive definite first-order derivative product matrix. This indicates that the model attempted to estimate more parameters than the data could support. Nevertheless, all main findings were replicated in these models, i.e. model selection criteria, significance of factor loadings, and the direction and significance of associations with external variables. CFA and SEM models were done in Mplus version 8.8 utilizing the mean and variance adjusted weighted least squares (WLSMV) estimator to account for the ordinal level indicators (Flora & Curran, 2004). Descriptive results presented in Table 1 were extracted in STATA (Gutierrez, 2010) version 16.

3. Results

3.1. Sample

The sample included 124 treatment-seeking veterans, 96%% were male and the mean age was 41.8 years old (SD = 9.2).

The subsample of 111 respondents that responded to the TLEQ reported minimum 1 trauma and a maximum of 15 where the median number of trauma was 6, while the mean was 6.5 (SD = 3.0). The most frequently reported trauma included combat or war (84.7%), sudden death of a friend or loved person (72.1%), threats of death or serious harm (58.6%) and lethal/invalidating harm of a significant other (55.0), and other traumatic events (50.2%).

Table 1 shows the means, standard deviations (SD), and bivariate correlations between ITI items. A total of 124 respondents were rated on all items with the exception of TH1 and TH2 which had 123 ratings. Means ranged from 1.68 for RE2 to 2.77 for TH1, and the SDs ranged from 0.86 for AD1 to 1.32 for RE1. All bivariate correlations were significant at least at the $p < .05$ level and varied between 0.27 (between RE2 and NSC2) to 0.84 (between DR1 and DR2). Overall, correlations appear to have a relatively narrow distribution as all, except three bivariate correlations (DR1 with DR2; NSC1 with NSC2; RE2 with NSC2), fall in the range of 0.30 and 0.59.

The intraclass correlation coefficient (ICC) is reported due to the involvement of 25 different raters assessing the 124 individuals. Four raters conducted only one interview, while the most active rater assessed 15 individuals. On average, each rater interviewed five individuals. The size of the ICC provides an estimate of the proportion of variance which can be accounted for by rater ID. We find a significant rater effect ranging from approximately 16% to 33%. This dependency on data is likely to lead to standard errors which are too small, if not accounted for in the model. Consequently, models that ignore the rater effect are likely to include an increased prevalence of statistical significant estimates (Kreft & Yoon, 1994).

Table 2 presents the descriptive statistics for the ITI. A total of 80 (65%) of the sample met diagnostic criteria for ICD-11 CPTSD, and 17 (14%) met criteria

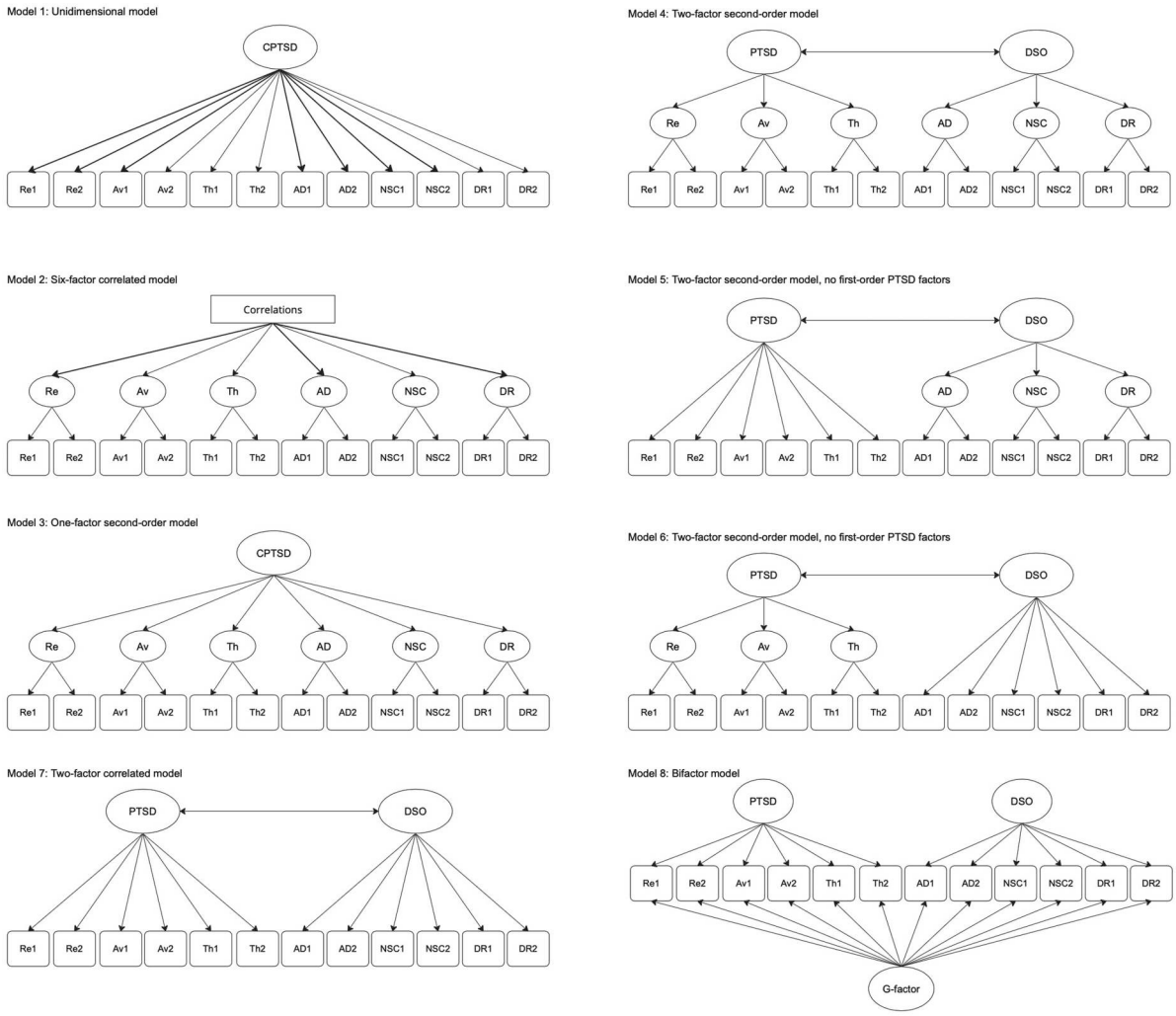

Figure 1. Alternative models of the latent structure of ICD-11 PTSD and CPTSD symptoms.

for ICD-11 PTSD. Consequently, 26 (21%) of the sample did not qualify for either diagnosis.

Overall, both total symptom scores and sub-scores show a consistent pattern across diagnostic categories: individuals diagnosed with CPTSD report higher symptom levels than those diagnosed with PTSD who, in turn, report higher levels compared to those with no trauma-related diagnosis. ANOVA tests of each symptom (line in the table) were all statistically significant ($p < .000$) and was supported by a multivariate analysis of variance (MANOVA), which provided support for assumptions that the diagnostic groups differed across the combined set of symptoms ($p < .000$).

There are only two minor exceptions to this tendency where individuals with no trauma-related diagnosis score slightly higher than those with PTSD on subscales of negative self-thought and anxiety.

Table 3 presents the model comparison for various alternative operationalizations of the ITI. Models that

Table 3. Model fit statistics for alternative models of ICD-11 CPTSD based on the ITI.

Models	Description	df	Chi-square	*P*-value	CFI	TLI	RMSEA	AIC	BIC	Heywood case	Lack of discriminant validity
M1	Unidimensional model	54	165.3	.000	0.85	0.82	0.13	3397	4098	No	No
M2	Six-factor correlated model	39	34.7	.664	1.00	1.00	0.00	3896	4040	Yes	Yes
M3	**One-factor second-order model**	**48**	**52.3**	**.319**	**0.99**	**0.99**	**0.03**	**3896**	**4014**	**No**	**No**
M4	Two-factor second-order model	47	49.5	.373	1.00	1.00	0.02	3895	4016	Yes	Yes
M4*	Two-factor second-order model	48	49.6	.418	1.00	1.00	0.02	3893	4011	No	Yes
M5	Two-factor second order model, no first order PTSD factors	50	53.7	.335	1.00	1.00	0.00	3893	4006	Yes	Yes
M5*	Two-factor second order model, no first order PTSD factors	51	53.7	.371	1.00	1.00	0.02	3891	4001	No	Yes
M6	Two-factor second order model, no first order DSO factors	50	137.8	.000	0.88	0.85	0.12	3977	4090	Yes	No
M7	PTSD with DSO	53	142.7	.000	0.88	0.85	0.12	3976	4080	No	No
M8	Bifactor model	42	65.3	.012	0.97	0.95	0.07	3921	4056	No	No

converged with standardized factor loadings that were greater than 1 were re-estimated with residual errors constrained to 0 for the affected indicator. Constrained models are indicated with an asterisk (*).

Three of the eight models converged with impermissible values as indicated by standardized factor loadings or correlations above 1. In M4 and M5 the factor loading of AD on DSO was 1.021. Consequently, M4 and M5 were re-estimated by fixing the residual error of AD to 0. This resulted in a slight improvement in model fit as indicated by the AIC and BIC. M2 was not re-estimated as this model also had multiple issues relating to the lack of discriminant validity between factors.

Overall, M3 appears to be the superior model in light of the very good model fit and the lack of problems with discriminant validity. M8 also appear to have adequate model-fit, but suffers from a significant chi-square test. Factor loadings and residual errors of M3 are shown in Figure 2.

Models M3, M4*, M5*, and M8 show excellent fit to the data according to the CFI, TLI, and RMSEA. M2, M3, M4*, and M5* have non-significant chi-square tests, indicating good fit. However, M2, M4*, and M5* show a lack of discriminant validity as they include correlations that are indistinguishable from 1 (according to 95% CI). This problem is evident in four correlations in M2 and for the correlations between PTSD and DSO in models M4* and M5*.

Figure 2 shows the standardized factor loadings and residual errors of M3. Factor loadings range between 0.73 and 0.96. They are all statistically significant at $p > .000$. The H-factor appears well defined as all factor loadings are generally high. The lack of significant residual errors for AD, AV, and RE (only significant residual errors are shown), implies that the H-factor explains all, or close to all, variance in these constructs.

Table 4 shows model fit and standardized regression coefficients from models where the H-factor was regressed on each of the external variables. We estimated individual CFA models for each construct prior to including them in the final model. The latent variable for anxiety was estimated with correlated residual errors for items 9 and 20, which both refer to baseless fear, and between items 15 and 19 that both relate to physical discomfort. The latent variable for depression was estimated with correlated residual errors for items 5 and 42 referring to the lack of initiative, between items 17 and 38 which both relate to the lack of purpose, and for items 8 and 10 which relate to the lack of enthusiasm and enjoyment. Finally, the latent variable for stress was estimated with three pairs of residual error correlations including items 32 and 35 relating to the lack of tolerance for disturbances, between items 12 and 33 which refer to nervousness, and between items 1 and 11 relating to feeling annoyed. Model fit for these latent variables were sub-optimal for anxiety (CFI = 0.93, RMSEA = 0.08), depression (CFI = 0.95, RMSEA = 0.09), stress (CFI = 0.93, RMSEA = 0.09) and for well-being (CFI = 0.98, RMSEA = 0.09).

The final models, including both ITI items and external variables, all demonstrated acceptable to excellent for CFI, TLI, and RMSEA. Particularly, the model including well-being had excellent fit in light of the near perfect CFI and TLI as well as the non-significant chi-square test. An important interpretation of these models is that the associations between the H-factor and external variables are statistically indistinguishable from the factor loadings between the higher-order factor and lower-level factors (illustrated in Figure 3).

4. Discussion

The main results of this investigation suggest that data from ITI interviews with a clinical population of Danish treatment-seeking veterans do not support the ICD-11 operationalization of PTSD and CPTSD. The symptoms reported by participants in our study do not correlate in a manner which is consistent with the assumption of distinct PTSD and DSO factors. Rather, we found that a single higher-order factor explained associations between all symptoms assessed by the ITI as well as their associations with well-being, stress, depression, and anxiety. This indicates that ICD-11 PTSD, CPTSD, and other symptoms of internalizing disorders appear to reflect a single latent construct in this study population.

When comparing the various models based on the commonly used model fit statistics, we find excellent fit for M2, M3, M4, and M5, while M8 shows acceptable fit. This provides an example of statistical equivalence which is common across CFA studies based upon the ITI and ITQ (Ben-Ezra et al., 2018; Bondjers et al., 2019; Choi et al., 2021; Gelezelyte et al., 2022; Gilbar, 2020; Haselgruber et al., 2020; Hyland et al., 2017; Murphy et al., 2018). If model selection were based on this information alone, we would conclude in favour of M5 or M5* as these models show close to perfect fit according to CFI, TLI, and RMSEA.

We rejected the six-factor correlated-model (M2) and the different operationalizations of the two-factor model (M4 and M5) as these models included correlations which were statistically indistinguishable from 1. Other studies have also reported equally strong correlations between PTSD and DSO but have not considered this to be a fundamental problem (Choi et al., 2021; Haselgruber et al., 2020).

While our choice to reject the six-factor correlated-model (M2) and the different versions of the two-factor models (M4 and M5) are due to different interpretations of model diagnostics and criteria for model selection, we suspect that the unusually good model

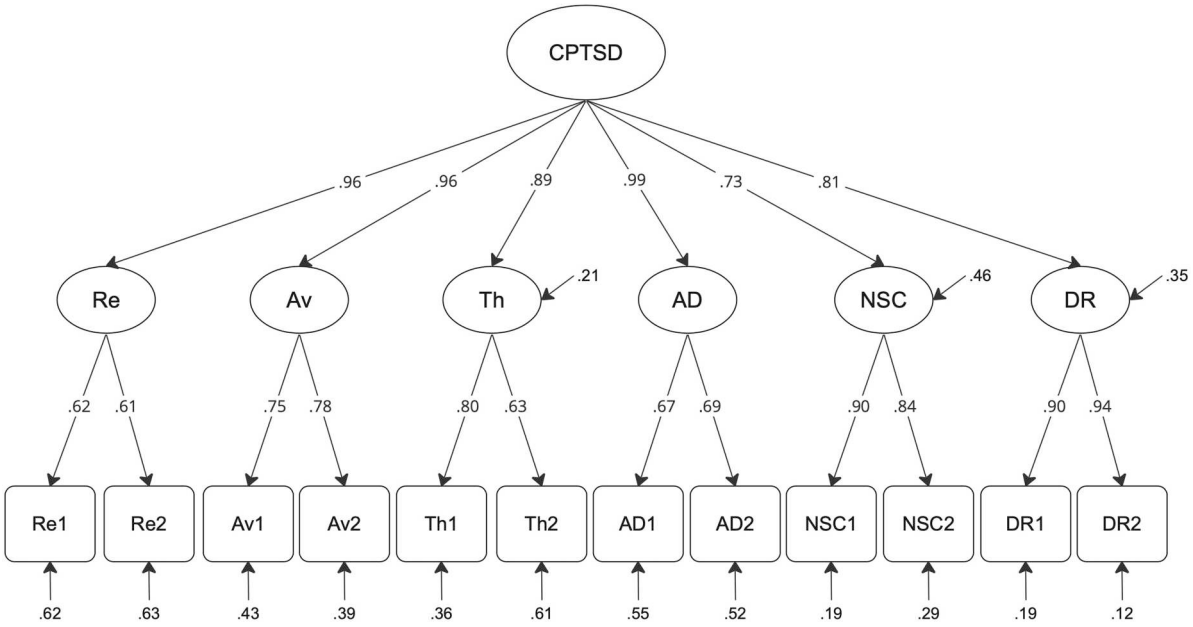

Figure 2. Models showing standardized factor loadings and residual errors for the single-factor higher-order model (M3).

fit for the single-factor higher-order model could be due to the unique characteristics of the current study population.

It seems likely that the high prevalence of CPTSD in our study population contributes to the lack of discriminant validity between PTSD and DSO and the convergence into a single-factor higher-order model. Given that a CPTSD diagnosis requires the endorsement (2 points or above) on all symptom clusters in the ITI, it appears unlikely that CFA models will be able to differentiate between PTSD and DSO factors in clinical populations where most participants qualify for the CPTSD diagnosis.

The prevalence of CPTSD in our study population is substantially higher than what is found in other ITI studies (Bachem et al., 2024; Bondjers et al., 2019; Gelezelyte et al., 2022). In fact, 65% of the participants in our study were diagnosed with CPTSD and the overall average ITI total score was 26.05. In contrast, Bondjers et al. (2019) and Gelezelyte et al. (2022) found 6% and 21% of participants to have CPTSD with overall average ITI total scores of 9.6 and 13.2, respectively. Bachem and colleagues (2024) included two different samples where CPTSD was identified in 53.1% of a civilian sub-population and 21% in a military sub-population. However, neither Bachem et al. (2024) nor Gelezelyte et al. (2022) present tests of comparable single factor-higher order models, or present their correlation matrix, making it impossible to compare results.

Table 4. Standardized regression coefficients between the H-factor in Figure 1 and the external variables.

	Anxiety	Depression	Stress	Well-being
Beta	0.37*	0.45*	0.51*	−0.49*
CFI	0.94	0.95	0.95	0.99
TLI	0.93	0.94	0.95	0.99
RMSEA	0.05	0.05	0.05	0.03
Chi-square	384	394	373	125
Df	290	288	289	112
p-value	0.00	0.00	0.00	0.19

*$p < .001$.

This speculation, and a wide range of other important questions, could be answered if future ITI and ITQ studies, share their bivariate correlation matrix. This would allow for the possibility of comparing results across study populations, irrespective of which models are presented in each unique study. Consequently, this could accelerate the understanding of measurement properties of the ITI and ITQ, which in turn would be helpful for the understanding of ICD-11 PTSD and CPTSD as constructs.

Our results align with the HiTOP model (Kotov et al., 2021), as associations between symptoms measured in the ITI fit well as indicators of an internalizing spectrum. The HiTOP model suggests that PTSD is an indicator of distress, along with major depressive disorder, dysthymia, generalized anxiety disorder, and borderline personality disorder. Distress, in turn, is proposed as an indicator of internalization, along with sexual problems, eating pathology, fear, and mania (Kotov et al., 2021). These are all symptoms which have been found to be comorbid with PTSD (Otto et al., 2004; Scharff et al., 2021; Yehuda et al., 2015; Zoellner et al., 2014) suggesting that indicators of these constructs could be relevant to test in similar models as those presented in the current investigation. It is important to note that the current investigation is not designed as a formal test of the HiTOP model, and future studies should provide more stringent analyses of whether this is a suitable framework for the understanding of CPTSD and the high levels of comorbidity associated with this disorder.

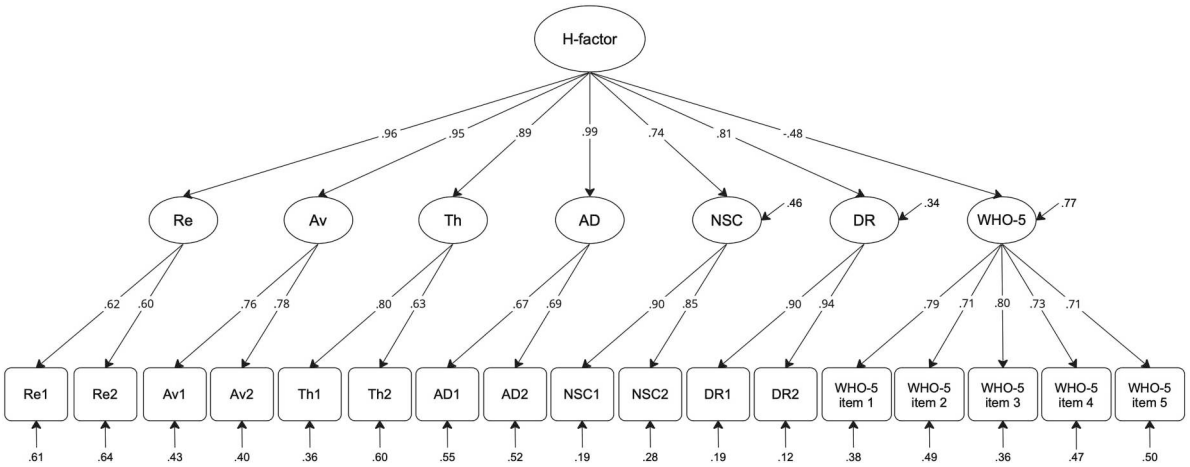

Figure 3. A single-factor higher-order model explaining the relationship between CPTSD and well-being.

4.1. Strengths and limitations

This study has several strengths, including assessments by trained clinical psychologists and the evaluation of a substantial number of relevant models. We have provided a correlation matrix and extensive information about model diagnostics to facilitate replicability of models and transparency in model selection. As the only ITI study to date, we have reported ICC estimates to highlight the interviewer effect on the variation in symptom assessment. We have tested all models while accounting for the clustering effect of raters and while it does not appear to be a major influence on model fit and statistical estimates, we cannot be entirely confident in the precision of the reported standard errors. A larger sample and/or a more balanced distribution of participants per clinician would likely have provided more robust estimates.

The relatively homogeneous sample of military veterans with high levels of psychopathology is a significant strength, as it provides a relevant use case for the ITI. Validity and reliability across different populations are crucial, and the included sample may be seen as a relevant test for how the psychometric models perform as baseline measures of a treatment study.

We also acknowledge several limitations. First, the relatively small sample size ($N = 124$) may be considered a limitation, but two out of three published ITI studies utilize smaller samples for their CFA models (Bachem et al., 2024; Gelezelyte et al., 2022), suggesting that this is should not be considered a fundamental limitation for the generalizability of the presented results.

As with all statistical studies, larger sample sizes are often desirable for increased precision of estimates. Small samples sizes also increase the risk of impermissible values, which has been identified in several CFA studies based upon the ITQ (Choi et al., 2021; Karatzias et al., 2021; Vang et al., 2021) and the ITI (Bondjers et al., 2019; Gelezelyte et al., 2022). However, we have openly reported these issues and have presented results for all considered models both with and without relevant statistical accommodations.

Finally, the presented results are based on cross-sectional data. This precludes the tests of any hypotheses regarding temporal or dynamic properties which may explain the relationship between symptoms and factors.

4.2. Implications

We believe that our results warrant further examination before making specific clinical recommendations. However, if replicated, our findings suggest that interventions targeting internalizing psychopathology could have potential in preventing and treating ICD-11 PTSD and CPTSD.

5. Conclusions

Our results contribute to important evidence regarding two important aspects of the validity of the ITI. First, we conclude that the two-factor higher-order model produces redundancy in the current sample, as PTSD and DSO factors lack discriminant validity in relationship to each other. Second, we find that symptoms assessed by the ITI are reflective of a higher order factor which also accommodates well-being and internalizing symptoms including stress, depression, and anxiety. It is not clear whether these novel results are due to sample-specific characteristics or to differences in methodological approaches between our study and previous validation studies.

We encourage future studies to critically evaluate and build on our results by providing further empirical evidence to advance the understanding of PTSD, CPTSD, and psychopathology more broadly.

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Data availability statement

Due to privacy and data protection regulations of the Danish Defense, data from the current study cannot be shared.

Ethical approval

In Denmark, studies that do not include interventions or human biological material should not be subjected to the National Committee on Health Research Ethics. All participants provided informed consent.

Author statement

Ole Melkevik: conceptualization, formal analysis, writing – original draft preparation, methodology. Anni B.S. Nielsen: writing – review & editing. Katrine Friis: data collection, writing – review & editing. Caroline Lund: data curation, writing – review & editing. Bjarke W. Schmidt: data curation, writing – review & editing. Sofie Folke: conceptualization, data collection, writing – review & editing.

ORCID

Ole Melkevik http://orcid.org/0000-0003-4679-8807
Anni B. S. Nielsen http://orcid.org/0000-0003-1260-2933
Caroline Lund http://orcid.org/0009-0000-5122-0116
Bjarke W. Schmidt http://orcid.org/0009-0007-7640-529X
Sofie Folke http://orcid.org/0000-0003-3871-1580

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