Psychometric properties of the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition (PCL-5) in bereaved individuals

Anna Kirchhoff
S2138948
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University of Twente
BMS Faculty
Department of Psychology

1st supervisor: Dr L. I. M. Lenferink, Assistant Professor
2nd supervisor: Dr P. M. ten Klooster, Assistant Professor

Abstract

Objective A possible sequalae to the loss of a loved one is the development of a posttraumatic stress disorder (PTSD). One of the most prevalently used self-report measures assessing related complaints is the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition (DMS-5; PCL-5). The objective of the current study was to investigate the psychometric properties of this scale in bereaved individuals. Overall, (a) factor structure, (b) internal consistency, (c) test-retest reliability, (d) convergent validity, (e) known-groups validity, and (f) potential cut-off scores for classifying probable caseness of the PCL-5 were considered.

Methods The sample of the current study consisted of 211 Dutch-speaking bereaved people who took part in a telephone interview at the first point of measurement and a questionnaire study six months after the interview. The statistical analysis of the current study included a confirmatory factor analysis (CFA), calculations of McDonald's Omega and Pearson correlation coefficients, Mann-Whitney U tests, and a receiver operating characteristic analysis.

Results The CFA indicated excellent fit of the four-factor Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition (DSM-5) model. No significant improvements were found when employing alternative factor models. McDonald's Omega valued indicated excellent internal consistency (.75 - .83). Test-retest reliability demonstrated acceptable temporal stability (.57 - .76). Furthermore, indications of convergent and known-groups validity were found. Lastly, a potential cut-off score of 25 was estimated, which demonstrated good accuracy.

Conclusion The Dutch translation of the PCL-5 appears to be a valid and reliable measure of PTSD symptoms in bereaved individuals. Further research in a clinically diagnosed sample is needed to establish its usability in such a setting.

Keywords: PCL-5, DSM-5, psychometric properties, validation, posttraumatic stress disorder, bereavement, traumatic loss

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Psychometric properties of the PTSD checklist for diagnostic and statistical manual of mental disorders–fifth edition (PCL-5) in bereaved individuals

Most people will be exposed to a traumatic event (TE) at least once in their life. What constitutes a TE is defined by the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5; APA, 2013). Such an experience encompasses the exposure to actual or threatened death, severe injury, or sexual violence. A further distinction can be made between experiencing a traumatic event yourself, witnessing a traumatic event, finding out that a close loved one experienced a traumatic event or a violent or accidental death, and being routinely exposed to extreme evidence of traumatic events (APA, 2013). Traffic accidents, sexual assault, or the traumatic loss of a loved one are examples of this. The lifetime prevalence of exposure to a TE in the general Dutch population is estimated to lie between 65.6 and 80.7 % (Benjet et al., 2015; de Vries & Olff, 2009; Knipscheer et al., 2020). Several studies have identified sudden and/or violent bereavement to be the most common potential TE that people encounter in their lifetime (de Vries and Olff, 2009; Kersting et al., 2001; Kristensen et al., 2012). A common sequela of exposure to TEs is the formation of a post-traumatic stress disorder (PTSD).

The American Psychological Association (APA) defines PTSD as a mental disorder characterised by the "development of characteristic symptoms following exposure to one or more traumatic events" (APA, 2013, p.274). The symptomatic characteristics of PTSD are oriented along four categories. First, re-experiencing symptoms are labelled criterion B and include symptoms such as recurrent intrusive distressing memories and recurrent distressing dreams. Second, criterion C symptoms account for symptoms aligned with avoidance patterns (i.e., avoidance of memories and/or avoidance of external reminders of the traumatic event). Third, alterations in cognition and mood are referred to as criterion D symptoms (e.g., issues with remembering aspects of the traumatic event, diminished interest, feelings of detachment, etc.). Fourth, criterion E symptoms represent hyperarousal (e.g., reckless or self-endangering behaviours, issues with concentration, hypervigilance, etc.). Furthermore, these reactions must result from the exposure to a TE, as defined by the DSM-5, which is also called the A criterion. Moreover, there are additional criteria that need to be met to reach a PTSD diagnosis (i.e., complaints should last at least one month and lead to significant distress and there should not be other explanations for the complaints; APA, 2013). In order to qualify for a PTSD diagnosis at least one symptom of criterion B and C, at least two symptoms of criterion D and E, and all additional criteria need to be met. The general Dutch population exhibits a PTSD lifetime prevalence ranging from 4.0 to 7.4 % (Darves-Bornoz et al., 2008; de Vries & Olff, 2009). One

measure intended to assess PTSD complaints is the PTSD checklist for diagnostic and statistical manual of mental disorders–fifth edition (PCL-5).

The PCL-5 is one of the most commonly used self-report measures to assess PTSD symptomology. The scale assesses all 20 symptoms (i.e., criterions B, C, D, and E) on a 5-point Likert-scale, scored zero to four with higher scores indicating more severe PTSD complaints (Weathers et al., 2013). The scale is divided into four subscales, namely: re-experiencing, avoidance, cognition and mood, and hyperarousal. This division is reflected in the correlated DMS-5 factor structure. This model suggests that the four criteria account for the variability of the scores on the 20 items in the PCL-5. However, several studies have found alternative factor models that better account for the clustering of items. First, the anhedonia model makes two important changes: (a) splitting the criterion concerning cognition and mood into anhedonia and negative affect; (b) splitting hyperarousal into anxious and dysphoric arousal (Lui et al., 2014). Second, the externalization model largely maintains the proposed structure of the DSM-5 model but splits the hyperarousal factor into externalizing behaviour, anxious arousal, and dysphoric arousal (Tsai et al., 2015). Third, the hybrid model includes the alterations made by both latter models (Armour et al., 2015). Previous studies have largely indicated a superior fit of the anhedonia model and the hybrid model over the DSM-5 model and the externalization model (Blevins et al., 2015, Bovin et al., 2016). Similar findings were observed for the Dutch translation of the PCL-5 (D-PCL-5) in a study employing a sample of Dutch speaking bereaved individuals as well as in a study of traumatically brain injured individuals (Lenferink et al., 2021; van Praag et al., 2020).

When investigating additional psychometric properties of the PCL-5 there are several measures of validity and reliability to consider. Overall, the internal consistency of the PCL-5 appears to be excellent across several studies, ranging from .94 to .96 for all 20 items and from .75 to .92 for the subscales (Ashbaugh et al., 2016; Blevins et al., 2015; Bovin et al., 2016; Krüger-Gottschalk et al.,2017; Wortmann et al., 2016). Similarly, excellent test-retest reliability has been established, ranging from .82 to .86 (Blevins et al., 2015; Bovin et al., 2016). Lastly, previous studies have indicated that the PCL-5 demonstrates good discriminant and convergent validity, with scales measuring non-related constructs resulting in lower correlation values, while scales assessing highly related constructs showed high positive correlation (Ashbaugh et al., 2016; Blevins et al., 2015; Wortmann et al., 2016). Thereby indicating that the PCL-5 is a reliable and valid measure of PTSD complaints.

Two previous studies have set out to investigate the psychometric properties of the D-PCL-5. First, van der Meer and colleagues (2017) investigate the validity and reliability of the

D-PCL-5 in trauma exposed police officers. The sample of this study consisted of 89 participants who mainly reported work-related trauma exposure. Internal consistency was excellent across subscales and the total scale (i.e., α total: .93, α re-experiencing: .87, α avoidance: .84, α cognition and mood: .83, and α hyperarousal: .76). Similarly, they reported good convergent validity with high positive correlations found with the Clinically Administered PTSD Scale (CAPS-5) scores. Lastly, the study established an optimal cut-off score for clinically relevant symptom severity of 31, with a sensitivity of 89% and a specificity of 65% (van der Meer, 2017). Secondly, van Praag and colleagues (2020) studied the psychometric properties of the D-PCL-5 in 495 Dutch speaking civilians who sustained traumatic brain injuries. Similar to the first study, internal consistency of the measure was reportedly excellent (i.e., α total: .93, α re-experiencing: .90, α avoidance: .80, α cognition and mood: .84, α hyperarousal: .79). Additionally, the study found high positive correlations with related constructs, indicating good convergent validity. Neither study investigated test-retest reliability. Thereby, indicating that further investigation of the validity and reliability of the D-PCL-5 is necessary.

As mentioned before the loss of a loved one is considered to be the most common potentially TE. Due to the high lifetime prevalence of such events occurring, it is important to further examine the psychometric properties of PTSD measures in this population. No earlier studies have set out to study the psychometric properties of the D-PCL-5 in Dutch-speaking bereaved individuals. While one other study has used the scale in this population, their aim was to investigate the factor structure of the D-PCL-5 but did not consider other psychometric properties (Lenferink et al., 2021). Therefore, it appears that more research is needed to further validate the D-PCL-5 in bereaved individuals.

The first aim of the current study was to investigate the factor structure of the PCL-5 in bereaved people. It was expected that the DSM-5 factor model and the externalization model would yield an acceptable fit, while the anhedonia and the hybrid model would result in a superior fit. This hypothesis was based on both previous research on the D-PCL-5 as well as the original version (Blevins et al., 2015; Bovin et al., 2016; Lenferink et al., 2021; van Praag et al., 2020).

The second aim was to evaluate additional psychometric properties of the D-PCL-5 in bereaved individuals. The study will focus on internal consistency, test-retest reliability, convergent validity, known-groups validity, and cut-off scores. It is expected that the D-PCL-5 will yield good to excellent internal consistency as demonstrated in prior studies (Lenferink et al., 2021; van der Meer et al., 2017; van Praag et al., 2020). While no previous studies have

investigated the test-retest reliability of the D-PCL-5, studies of the original version and other translations have reported good reliability ranging from .82 to .91 (Ashbaugh et al., 2016; Blevins et al., 2015; Krüger-Gottschalk et al.,2017). Similar results are expected in the current study. Convergent validity will be evaluated by examining associations with other related constructs (i.e., depression, functional impairment, and prolonged grief) based on the level of severity of PTSD complaints. It is anticipated that higher PTSD symptom severity is associated with higher rates of depressive symptoms, reported functional impairment, and symptoms associated with prolonged grief. In order to evaluate known-groups validity four aspects will be considered. It is expected that participants who do not meet the A criterion of a PTSD diagnosis will report a significantly lower score compared to those who meet the A criterion. That is, the cause of death as well as its expectedness will be considered. First, violent deaths (i.e., homicide and suicide) are expected to result in higher PTSD complaints than non-violent deaths, as reported in a previous study by Kristensen et al. (2012). Second, the expectedness of the death of a loved one and its influence on the rate of PTSD complaints will be investigated. Additionally, common risk factors of PTSD severity such as gender (i.e., being female; Carmassi et al., 2020; de Vries and Olff, 2009; Greene et al., 2016) and a lower level of education (Carmassi et al., 2020; Greene et al., 2016), will also be investigated as possible known groups. Moreover, an optimal cut-off score for probable caseness between 31 and 33 is expected as this range is found in most prior literature (Ashbaugh et al., 2016; Blevins et al., 2015).

Methods

Participants and Procedure

The current post-hoc study employs data from a longitudinal study titled ‘TGI-CA Assessment after Loss in Europe (TALE) project’ (Lenferink et al., 2019). Its aim was to develop an interview-based measure to assess prolonged grief disorder using the diagnostic criteria of the DSM-5-TR and the ICD-11 and to evaluate its psychometric properties. Eligible for participation were Dutch and German-speaking adults who had suffered a loss in their social circle (i.e., a spouse, family member or friend) at least six months ago. People that indicated suicidality and/or the presence of psychotic disorders were excluded from participation. The study employed a variety of sampling methods, for instance social media advertisement, convenience sampling (i.e., members of the research team approached their own social network), and snowball sampling (i.e., participants were asked to recommend the study to their own social circle). Participation of the study was not rewarded, except for first year psychology students who received course credits as a reward. Both the Ethics Committee

Psychology of the University of Groningen and the Ethics Committee of the Freie University Berlin approved the study.

Data collection began in November of 2019 and concluded in September of 2020. Additionally, all participants provided written informed consent prior to participation. The study consisted of a 30-45 minute telephone interview as well as a follow-up questionnaire filled in six months after the completion of the interview. 14 undergraduate and graduate psychology students conducted the interviews after completing a six-hour training by at least one member of the project team. These members provided expert knowledge on the theoretical background of the interview (i.e., phenomenology of PTSD, disturbed grief, and depression) as well as on the skills of interviewing, and allowed for the practicing of such. Throughout the data collection, monthly supervision meeting with interviewers and members of the research team took place.

Measures

From the TALE project the D-PCL-5 was used. Furthermore, the Dutch translation of the Patient Health Questionnaire-9 (PHQ-9), the Dutch version of the Work and Social Adjustment Scale (WSAS), and the Traumatic Grief Inventory – Clinician Administered (TGI-CA) were selected due to the similarities of the measured constructs with the aim of establishing convergent validity.

PTSD levels

The D-PCL-5 (Boeschoten et al., 2014) was used to assess the extent to which participants were burdened by PTSD symptoms after the death of a loved one during the past month. The scale consists of 20 items (e.g., “In the past month, how much have you been bothered by repeated, disturbing, and unwanted memories of the death of your loved one?”; Weathers et al., 2013) scored on a 5-point Likert scale ranging from 0 (i.e., not at all) to 4 (i.e., very strongly). If administered by a clinician this scale can be used to provide a provisional diagnosis. However, the PCL-5 also allows for the assessment of total symptom severity. In this case, the sum of all scores (i.e., 0 - 80) indicates the severity of symptomatic complaints with a cut-off score of clinical significance usually between 31 and 33.

Depression levels

Depressive symptomology was measured using the Dutch translation of the PHQ-9 (Kroenke et al., 2001; van Steenbergen-Weijenburg et al., 2010). This self-report scale consists of 9 items (e.g., Over the last two weeks how often have you felt bothered by little interest or pleasure doing things?) on a 4-point Likert scale ranging from 0 (i.e., not at all) to 3 (i.e., nearly every day). A sum score was calculated ranging from 0 to 27 indicating symptom

severity. Psychometric properties of the PHQ-9 were good based on prior research (Beard et al., 2016; Kroenke et al., 2010; Löwe et al., 2004).

Functional impairment

The Dutch version of the WSAS (Mundt et al., 2002) was used to assess functional impairment in participants (de Graaf et al., 2009). The scale contains 5 items enquiring about the impairment of function in a person's (i) work, (ii) household chores, (iii) social activities, (iv) leisure activities, and (v) close relationships. When inquiring about work, the option "not applicable" was added. When calculating a sum score values ranging from 5 to 45 were possible. Prior research established adequate psychometric properties for the WSAS (Mundt et al., 2018; Pedersen et al., 2017).

Prolonged Grief Disorder symptoms

Prolonged grief disorder (PGD) symptoms were measured with the TGI-CA which was developed for the purposes of the original study (https://osf.io/a6hmc/). It is based on the Traumatic Grief Inventory – Self Report Plus which consists of 22 items and has been positively evaluated based on reliability and validity (Lenferink et al., 2022). Adjustments were made to account for the interview version. Items were rephrased as questions and the instructions were altered to include the names of the deceased person or the participants relationship to them (e.g., "Albert" or "your husband"). The items were rated on a 5-point Likert scale ranging from 1 (i.e., "never") to 5 (i.e., "always"), resulting in a score range from 22 to 110.

Statistical analyses

Statistical analyses were performed using Mplus version 8.4 (Muthén & Muthén, 1998-2019), IBM SPSS Statistics version 28.0 (IBM Corp., 2022), and JASP (JASP Team, 2022).

Descriptive statistics

Frequencies and/or central tendencies of all relevant variables (i.e., PTSD levels, depression levels, functional impairment levels, prolonged grief levels, data concerning the death of a loved one, and biographical data) were calculated.

Confirmatory factor analysis

In order to assess the goodness of fit of the previously established factor models of the D-PCL-5 within the population of bereaved individuals, several confirmatory factor analyses (CFAs) were run using Mplus version 8.4 (Muthén & Muthén, 1998-2019). Robust maximum likelihood estimation was used to correct for non-normality in the data. For each of the proposed factor models the Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI)

were estimated in which values above 0.90 indicate acceptable fit and values above 0.95 indicate excellent fit (Kline, 2011). Furthermore, the root-mean-square error of approximation (RMSEA) with a confidence interval of 90 % (90% CI) and standardized root-mean-square residual (SRMR) were evaluated, whereby values below 0.10 represent acceptable fit und below 0.05 excellent fit (Kline, 2011). Additionally, Akaike, Bayesian, and Sample-Size adjusted Bayesian information criteria (AIC, BIC, and SS-BIC) were used to compare models, with lower values indicating superior fit. Lastly, as recommended by Muthén and Muthén (2021) the Satorra-Bentler scales Chi-Square test was employed to compare nested models. For measurement quality, factor loadings above .4 are considered meaningful (Floyd & Widaman, 1995).

Internal consistency

Internal consistencies of the D-PCL-5 total scale, the re-experiencing, mood and cognition, and hyperarousal subscales as well as the avoidance subscale were measured using the OMEGA extension to SPSS (Hayes, 2021) and JASP (JASP Team, 2022), respectively. The McDonald's omega (ω) was used, as it accounts for non-equal factor loadings using a maximum likelihood factor analysis. Values above .70 indicate acceptable internal consistency (Hayes & Coutts, 2020).

Test-retest reliability

In order to investigate temporal stability of the measure, the test-retest reliability was estimated. A subsample of the initial participants (N = 88), after the exclusion of 109 missing responses at the second point of measurement, was investigated. Summed D-PCL-5 scores of both the interview and the following questionnaire were examined using Pearson Correlation Coefficients. This was done for the total scale as well as all four subscales. Values higher than 0.70 indicate acceptable reliability, values higher than 0.80 good reliability (Babbie, 2016).

Convergent validity

Convergent validity of the D-PCL-5 was estimated by calculating bivariate Pearson's correlation coefficients between the subscale scores of the D-PCL-5, the PHQ-9, the WSAS, and the TGI-CA. Values ranging from 0.10 to 0.30 were considered as weak, values ranging from 0.30 to 0.50 as moderate, and values larger than 0.50 as large correlation (Rosenthal, 1991).

Known-groups validity

Known-groups validity was estimated using the Whitney-Mann U test, as it accounts for non-normality of the dependent variable. First summed D-PCL-5 scores were estimated. Additionally, all relevant ordinal variables (i.e., cause of death, expectedness, and level of

education) were dichotomized. Significance of difference between the groups (i.e., gender (women vs. men), educational level (lower than university vs. university), expectedness of death (expected vs. unexpected), and cause of death (natural vs. unnatural)) was investigated.

Cut-off scores

The optimal cut-off score of the summed score of all 20 PCL-5 items was determined using the Receiver Operating Characteristic (ROC) analysis. Probable caseness of PTSD was calculated using the DMS-5 diagnostic scoring rule as indicated above. The ROC curve is used to plot the true-positive rate (i.e., sensitivity) against the false-positive rate (i.e., 1-specificity) for every possible cut-off score. Values of the area under the curve (AUC) score above .90 indicate excellent accuracy of the score when distinguishing probable caseness and probable non-caseness. AUC values between 0.80 and 0.90 denote good accuracy, scores between 0.70 and 0.80 fair accuracy, and values below 0.70 poor accuracy (Ferraris, 2019). Furthermore, the Youden's Index (i.e., sensitivity rate – (1-specificity rate)) was calculated for each possible cut-off score. A Youden's Index closer to 1 indicate higher diagnostic effectiveness (Schisterman et al., 2005).

Results

Participants characteristics

Overall, 211 Dutch-speaking individuals took part in the study. On average participants were 41 years old and 81.0 % consisted of women (see Table 1). Slightly more than half of the sample had received a university education. When considering loss specific characteristics, natural causes of death were the most prevalent. About 3 out of ten losses were considered very unexpected or completely unexpected. A mean sum score of PTSD symptom severity of 12.0 (*SD* = 11.0) was reported, indicating complaints below the clinical threshold.

Table 1

Participant characteristics (N = 211)

Characteristic	
Age, M (SD)	41.3 (16.7)
Gender, N (%)	
Man	40 (19.0)
Woman	171 (81.0)
Other	0 (0)
Level of education, N (%)	
Primary school	2 (0.9)
High school	51 (24.2)
Vocational education	41 (19.2)
University	117 (55.5)
Kinship to the deceased, N (%)	
Partner/spouse	64 (30.3)
Child	16 (7.6)
Parent	63 (29.9)
Sibling	4 (1.9)
Grandparent	39 (18.5)
Friend	11 (5.2)
Other	14 (6.6)
Cause of death, N (%)	
Natural cause	165 (78.2)
Suicide	32 (15.2)
Accident	9 (4.3)
Homicide	1 (0.5)
Other	4 (1.9)
Number of losses, N (%)	
1	125 (59.2)
2	44 (20.9)
3	28 (13.3)
4	11 (5.2)
5 or more	3 (1.4)
Expectedness of death, M (SD)	3.1 (1.6)

Time since the loss in years, M (SD)	5.28 (6.6)

Note. Expectedness of death was scored using a 5-point Likert scale (i.e., 0 = Totally not unexpected, 5 = Completely unexpected)

Factor structure of the D-PCL-5

When considering the dimensionality of the D-PCL-5 scale in bereaved individuals, Table 2 offers an overview of the fit indices. Overall, the DSM-5 model showed an excellent fit, as indicated by CFI and TLI values above .95, SRMR and RMSEA values at and below .05 respectively. While the Anhedonia model and the Externalisation model both demonstrated a superior fit within the sample, as indicated by larger CFI and TLI values as well as smaller AIC and SS-BIC values, these differences were not significant, as denoted by a non-significant $\chi 2$ difference tests. Similarly, the Hybrid model did not yield significant improvements compared to the Anhedonia and the Externalisation model. Nevertheless, the model did show larger CFI and TLI values combined with smaller AIC, BIC, and SS-BIC values, suggesting a superior fit within the sample. The original DSM-5 model was retained, as no other model yielded significant improvements.

For measurement quality, the factor loadings of this model largely exceeded the previously established threshold of .4, except for items 2 (i.e., repeated, disturbing dreams of the death of your loved one), 8 (i.e., trouble remembering important parts of the death of your loved one), and 16 (i.e., taking too many risks or doing things that could cause you harm) (see Table 3). Furthermore, intercorrelations between factors ranged from moderate to high (see Table 4). The avoidance subscale showed the weakest correlations with other subscales (.45 - .54). Intercorrelations between the remaining subscales (i.e., re-experiencing, mood and cognition, and hyperarousal) showed large positive correlations ranging from .83 to .92, indicating limited discriminant validity of DSM-5 factor model.

Table 2

Model Fit Statistics of the PCL-5 (N = 211)

	χ^2	df	Δχ2	CFI	TLI	SRMR	RMSEA	AIC	BIC	SS-BIC	Nested in
1. DSM-5	200.00**	164		.963	.957	.05	0.032 [0.05 – 0.07]	9704.09	9925.31	9716.18	-
2. Anhedonia	172.59	155	23.17	.982	.978	.05	0.023 [0.00 – 0.04]	9676.69	9928.08	9690.43	1
3. Externalisation	185.35*	155	13.82	.968	.961	.05	0.030 [0.00 – 0.05]	9696.06	9947.45	9709.80	1
4. Hybrid	161.82	149	2 vs. 4: 10.05 3 vs. 4: 19.83	.987	.983	.05	0.020 [0.00 – 0.04]	9671.10	9942.60	9685.95	2,3

Note. * indicates $p < .05$; ** indicates $p < .01$

Values in square brackets indicate the 90 % confidence interval;

CFI = Comparative Fit Index, TLI = Tucker Lewis Index, SRMR = Standardized Root-Mean-Square Residual, RMSEA = Root-Mean-Square Error of Approximation, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, SS-BIC = Sample-Size Adjusted Bayesian Information Criterion

Table 3

Standardized Factor Loadings for the DSM-5 Model (N = 211)

	Re-experiencing	Avoidance	Mood and cognition	Hyperarousal
Repeated memories	0.68**			
Repeated dreams	0.40**			
Reliving experience	0.60**			
Upset when reminded	0.76**			
Physical reaction when reminded	0.78**			
Avoidance of thoughts		0.78**		
Avoidance of reminders		0.92**		
Trouble remembering			0.40**	
Negative beliefs			0.62**	
Distorted blame			0.63**	
Negative feelings			0.72**	
Loss of interest			0.70**	
Feeling detached			0.68**	
Lack of positive feelings			0.70**	
Irritable behaviour				0.54**
Reckless behaviour				0.16*
Hypervigilance				0.60**
Exaggerated state				0.70**
Difficulty concentrating				0.67**
Trouble sleeping				0.60**

Note. * indicates $p < .05$; ** indicates $p < .01$

Table 4

Inter-Factor Correlations of the DSM-5 Model of PTSD (N = 211)

	Re-experiencing	Avoidance	Mood and cognition
Re-experiencing			
Avoidance	.48**		
Mood and cognition	.85**	.54**	
Hyperarousal	.83**	.48**	.92**

Note. * indicates $p < .05$; ** indicates $p < .01$

Internal consistency

The internal consistency of the total D-PCL-5 was found to be excellent (see Table 5). When considering the individual subscales of the PCL-5, all four subscales showed acceptable internal consistency with McDonald's omega scores ranging from .75 to .83.

Table 5

Internal Consistency and Test-Retest Reliability of the PCL-5

Scale	Number of items	Internal consistency		Test-retest reliability	
		n	McDonald's ω	*n*	Pearson's *r*
Total scale	20	211	.91	89	.76**
Re-experiencing	5	211	.81	89	.65**
Avoidance	2	211	.82	89	.57**
Mood and Cognition	7	211	.83	89	.70**
Hyperarousal	6	211	.75	89	.65**

Note. ** indicates $p < .01$ (two sided)

Test-retest reliability

Overall, 89 participants completed the D-PCL-5 at the second point of measurement. At the first measurement point their mean sum score was 12.8 (*SD* = 10.61) and 11.52 (*SD* = 11.39) at the retest. The test-retest reliability of the D-PCL-5 total scale was acceptable, $r = .76$, $p < .01$ (see Table 5). Pearson's *r* values for the subscales ranged from .57 to .70, indicating poor to questionable temporal stability.

Convergent validity

As hypothesized, D-PCL-5 total scores were strongly positively correlated with TGI-CA scores (r = .88), as the most closely related concept (see Table 6). Strong positive correlations were also found between PCL-5 scores and the PHQ-9 and the WSAS scores. When considering correlations of subscales with PHQ-9 scores, larger positive correlations were found for mood and cognition as well as hyperarousal. Re-experiencing and avoidance scores were moderately positively correlated. Furthermore, WSAS scores were only weakly to moderately correlated with three of the four subscales. Mood and cognitions scores were strongly and positively correlated with the functional impairment measure. Lastly, three of the four subscales were strongly positively correlated with scores indicating prolonged grief. However, the avoidance scores were moderately positively correlated.

Table 6

Convergent and Discriminant Validity of the PCL-5 (N = 211)

	Depression	Functional impairment	Prolonged grief
Total scale	.63**	.54**	.88**
Re-experiencing	.44**	.38**	.75**
Avoidance	.36**	.28**	.48**
Mood and Cognition	.60**	.53**	.85**
Hyperarousal	.59**	.48**	.70**

Note. ** indicates $p < .01$ (two-sided)

Depression = PHQ-9; Functional Impairment = WSAS; Prolonged Grief = TGI-CA

Known-groups validity

When considering known-groups validity, the results of the Mann-Whitney U test indicated that the D-PCL-5 score was greater in participants who had lost a loved one due to unnatural causes (*Mdn* = 32.5) than in participants whose loved one died due to natural causes (*Mdn* =28.0). This difference was significant, U ($N_{\text{natural cause}}$ = 165 , $N_{\text{unnatural cause}}$ = 46) = 3035.5, z = -2.08, p = .038. Similarly, participants who had been able to anticipate the death of their loved one reported lower scores on the D-PCL-5 (*Mdn* = 26.0) than those whose loved one died unexpectedly (*Mdn* = 31.0). The difference between these groups was significant, U ($N_{\text{expected death}}$ = 87, $N_{\text{unexpected death}}$ = 124) = 4128.0, z = -2.90, p = .004. Unexpectedly no significant difference was found between men (*Mdn* = 28) and women (*Mdn* = 29), U (N_{men} = 40, N_{women} = 171) = 3012.0, z = -1.18, p = .240. Similarly, no significant

difference between university educated participants (*Mdn* = 29) and participants with other forms of educations (*Mdn* = 29) was found, U ($N_{\text{university}}$ = 117, $N_{\text{not university}}$ = 94) = 5368.5, z = -.3, p = .767.

Cut-off scores

Probable caseness of PTSD was established using the DSM-5 diagnostic scoring rule, which resulted in a total 16 probable cases in the current sample. Unexpectedly, the optimal cut-off score for probable caseness of the D-PCL-5 was 25, AUC = 0.985 (95% CI: 0.97 – 1.00). Using this score, 100 % of cases were correctly identified as probable PTSD cases and 7.2 % were incorrectly identified as probable PTSD cases (see Appendix A). Furthermore, a Youden's index of 0.93 denounces good accuracy of this cut-off score.

Discussion

The current study is the first longitudinal study to assess the psychometric properties of the D-PCL-5 in bereaved individuals. The factor structure, internal consistency, temporal stability, convergent validity, known-groups validity and possible cut-off scores of the scale were examined. Overall, the current study suggests that the D-PCL-5 is a valid and reliable measure of PTSD complaints in bereaved individuals.

The first main finding of the current study concerns the factor structure of the D-PCL-5. As expected, the four-factor DSM-5 model showed an excellent fit. This implies that the interrelation among items of the D-PCL-5 is well accounted for using the original four latent factors suggested by the DSM-5 model. Unexpectedly, model fit was not significantly improved upon through the alterations made by the anhedonia, the externalisation, and the hybrid model, respectively. This finding is largely not reflected in previous studies, which reported a superior fit of the anhedonia and hybrid model (e.g., Blevins et al., 2015; Bovin et al., 2016, Lenferink et al., 2021; van Praag et al., 2020). However, one recent study reported inconclusive results when comparing model fit of the PCL-5 (Krüger-Gottschalk et al.,2017). Nevertheless, their results also did not suggest superior fit of the DSM-5 model.

Moreover, factor loadings for items 2 (i.e,.repeated dreams), 8 (i.e., trouble remembering), and 16 (i.e., Recklessness/self-destructive behaviour) were low. Related findings have been made in previous research, in which items 8 and 16 had comparatively lower factor loadings (Keane et al., 2014; Krüger-Gottschalk et al., 2017; van Praag et al., 2020). In the current study the three items showed high skewness with 65.4 to 89.1 % of responses falling into the "not at all" response category (see Appendix B). This implies that their inclusion offers little information that can discriminate varying levels of symptom

severity in a bereaved sample. Thereby, limiting its use in measuring their respective latent constructs. Furthermore, inter-factor correlations were moderate to high in the current study. Several prior studies have found similar results for other alternative factor models of the PCL-5 (e.g., Amour et al., 2015; Liu et al., 2014). In the study of Krüger-Gottschalk and colleagues (2017), correlations between factors of the DSM-5 model ranged from .69 to .93, indicating high dependencies between factors. Strong positive correlations between factors may indicate their redundancy, meaning that highly correlated factors measure the same latent construct. However, when considering the face validity of the re-experiencing, mood and cognition, and hyperarousal factors, it appears more likely that the measured symptom clusters influence and reinforce each other. For instance, hyperarousal related symptoms such as difficulties concentrating (i.e., item 19) might result in or reinforce strong negative beliefs about oneself (i.e., item 9). As a result, strong correlations between factors might not indicate limited discriminant validity.

The second main finding was that the D-PCL-5 showed to be a moderately reliable measure in bereaved individuals. Consistent with previous research the D-PCL-5 showed excellent internal validity, as indicated by acceptable to excellent ω values of the total scale and all subscales (Lenferink et al., 2021; van der Meer et al., 2017; van Praag et al., 2020). Moreover, the test-retest reliability indicated an acceptable temporal stability of the total scale. However, the test-retest reliability for the subscales was poor to moderate. Previous studies on the PCL-5 generally show larger correlations between points of measurement, which had been expected in this study as well (Ashbaugh et al., 2016; Blevins et al., 2015; Krüger-Gottschalk et al.,2017). One explanation for this might be the length of time between points of measurement. Other longitudinal studies validating the PCL-5 reported shorter timespans between measurements than the present study (i.e., 6 to 21 days; Blevins et al., 2015; Krüger-Gottschalk et al., 2017). Since the time between points of measurement in the current study is significantly longer (i.e., 6 months) it is possible that the differences in scores represent true changes that are based on natural fluctuations in the severity of PTSD complaints (Crocker & Algina, 1986, as cited in Blevins et al., 2015). Additionally, the method of data collection (i.e., telephone interview vs. survey) differed between points of measurement. Research designs that employ longitudinal data gathered using mixed data collection methods are open to higher rates of measurement error, since levels of self-disclosure and social desirability may differ (de Leeuw, 2005). Future longitudinal studies could benefit from a consistent use of data collection methods as well as from a shorter time

span between points of measurement. Thereby, allowing for a more accurate estimation of temporal stability.

The third main finding indicates that the validity of the D-PCL-5 in bereaved individuals is partially supported. For instance, sum scores of the D-PCL-5 showed large positive correlations with the sum scores of related measures assessing depressive symptoms, functional impairment, and prolonged grief symptoms. Similarly, subscale total scores correlated more highly with those measures that assess related constructs. The finding that rates of PTSD complaints were highly correlated with these similar constructs implies convergent validity, which had not yet been established for the D-PCL-5.

Furthermore, as hypothesised, there was a significant difference in D-PCL-5 sum scores based on the fulfilment of the A-criterion. Significantly higher PTSD complaints were reported in participants who had lost a loved one to an unnatural cause of death, compared to losses related to natural causes. Moreover, higher sum scores were found in participants who had not been able to anticipate the death of their loved one compared to those who could. Unexpectedly, women did not report statistically higher rates of PTSD symptoms. Previous research established being female as a significant risk factor for PTSD development (Carmassi et al., 2020; de Vries and Olff, 2009; Greene et al., 2016). One possible explanation is the underrepresentation of non-women in the current study. There is a high disparity of sample sizes between women (81.0 %) and men (19.0 %). Consequently, statistical power is reduced, meaning that significant differences might not be reflected in the data (Rusticus & Lovato, 2014). Moreover, no significantly higher PTSD symptom severity was found in participants with lower levels of education, as had been expected based on previous research (Carmassi et al., 2020; de Vries and Olff, 2009; Greene et al., 2016). A possible reason for this is that participants are usually asked for the highest level of education they completed. In doing so, current undergraduate university students, who often take part in psychological studies as part of their courses, would not be classified as having a university education. Thereby, the lower education group in this study might not have only consisted of people without a higher education, resulting in a non-significant difference between groups. A future study might ask for the time spend in education in years instead, as this would avoid such an issue.

Lastly, the cut-off score for probable clinically relevant PTSD symptom severity was lower than previously expected (i.e., 31 - 33), based on studies validating the original version of the scale as well as other translations (Ashbaugh et al., 2016; Blevins et al., 2015, Bovin et al., 2016). However, the estimated optimal cut-off score produced good sensitivity and

specificity. A study by Ibrahim and colleagues (2018) found a lower cut-off score of 23 in in a displaced population. While other studies have reported higher cut-off scores ranging from 36 to 49 in a variety of psychiatric populations (Boyd et al., 2021; Boysan et al., 2017; Fung et al.,2019; Pereira-Lima et al., 2019; Roberts et al., 2021). Hence, it is possible that the composition of the sample, influences the diagnostic cut-off. Furthermore, due to the non-clinical nature of the current sample, no official diagnosis could be used to determine caseness. Similarly, no reliable gold-standard instrument (e.g., CAPS-5) was employed in the current study. Instead, probable caseness was estimated using the scoring rules of the DMS-5 on the D-PCL-5 scores, which could have influenced the cut-off.

When interpreting the results of the current study, several limitations come to mind. One possible limitation would be the fact that the measure was administered using a telephone interview. Compared to face-to-face interview little non-verbal communication can occur between interviewer and interviewee. Thereby, limiting the accuracy of the data gathered, since possible hesitations or misunderstanding may have gone unnoticed. Furthermore, the mode of data collection also limits the generalisability of its results when considering the use of the D-PCL-5 in questionnaire surveys. At the same time, this modality also brings about unique advantages. For instance, the fact that no relation exists between participants and interviewers might also lower hesitancies in disclosing distressing information. This in turn might then improve the reliability of data. Secondly, the current study employed a non-clinical sample in which the majority of participants did not exhibit clinically relevant PTSD complaints. As a result, further investigation of the D-PCL-5 is needed for its use as a screening tool in a clinical setting.

In conclusion, the D-PCL-5 demonstrates acceptable validity and reliability in a sample of bereaved individuals, based on internal consistency, test-retest reliability, convergent validity, and known-groups validity. Additionally, an excellent fit of the DSM-5 model was observed. Moreover, a lower cut-off score appears to be advisable for a non-clinical bereaved sample. The implications of the current study on clinical practice are somewhat limited. While the study offers a valuable first insight into the psychometric properties of the D-PCL-5 (a) administered through phone interviews as well as (b) in a bereaved population, previously named limitations are to be considered. Nevertheless, clinicians might benefit from the results of this study, as it provides indications of diagnostic utility of the D-PCL-5 as an interview measure or screening tool. Furthermore, the validation of the D-PCL-5 in bereaved individuals is of use in the continued study of this population. This is of additional importance due to the high life-time prevalence of losing a loved one and

the far-reaching consequences of grief. It is for that reason that future studies should further investigate this scale as an interview measure in a clinically diagnosed bereaved sample.

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Appendix A

Sensitivity, Specificity, Youden's Indices of the D-PCL-5 cut-off scores of probable caseness

Table A1

Possible cut-off scores of the D-PCL-5 using the DSM-5 scoring rule

PCL-5 sum score	Sensitivity	1-Specificity	Youden's index
≤ 19	1	≥ .19	≤ .81
20	1	.16	.84
21	1	.14	.86
22	1	.13	.87
23	1	.11	.89
24	1	.09	.91
25	1	.07	.93
26	.94	.07	.87
27	.88	.07	.80
28	.88	.06	.81
29	.88	.05	.82
30	.81	.03	.79
≥ 31	≤ .81	≤ .02	≤ .80

Appendix B

Item means, standard deviations, and response frequencies

Table B1

Item analysis and response frequencies on the D-PCL-5 (N = 211)

Item	Mean (SD)	Response options, N (%)					Skewness (SE)
		0	1	2	3	4	
Repeated dreams	0.25 (.61)	176 (83.4)	20 (9.5)	14 (6.6)	0 (0.0)	1 (0.5)	2.79 (.17)
Trouble remembering	0.56 (.89)	138 (65.4)	40 (19.0)	22 (10.4)	10 (4.7)	1 (0.5)	1.55 (.17)
Reckless behaviour	0.17 (.54)	188 (89.1)	13 (6.2)	7 (3.3)	3 (1.4)	0 (0.0)	3.53 (.17)

Note. Response options range from 0 = “not at all” to 4 = “extremely”