Psychiatry Research 318 (2022) 114937

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Do we all grieve the same? A multigroup test of the dimensional structure of prolonged grief disorder among Danish bereaved partners and children

M.L. Vang [a,b,*], H.G. Prigerson [c], A. Elklit [a], K.B. Komischke-Konnerup [d], M. O'Connor [d]

[a] National Centre for Psychotraumatology, Department of Psychology, University of Southern Denmark, 5000 Odense, Denmark
[b] Dept. for Occupational and Environmental Medicine, Odense University Hospital, 5000 Odense, Denmark
[c] Department of Medicine, Weill Cornell Medicine, Cornell Center for Research on End-of-Life Care, New York City, 10021 NY, United States of America
[d] Unit for Bereavement Research, Department of Psychology and Behavioural Sciences, Aarhus University, 8000 Aarhus, Denmark

ARTICLE INFO

Keywords:
Prolonged grief disorder
Confirmatory factor analysis
ICD-11 PGD
Bereavement

ABSTRACT

Prolonged Grief Disorder (PGD) is a newly recognized mental disorder in ICD-11 and DSM-5-TR. Several studies using exploratory factor analysis have found a unidimensional structure of the Prolonged Grief-13 (PG-13) measure of PGD. The recently published ICD-11 proposal proposes a distinction between two clusters of symptoms: Separation distress symptoms and associated cognitive, emotional and behavioral symptoms. The aim of the current study is to test competing factor structures of PGD in Danish samples of bereaved. Confirmatory factor analysis was used to test competing models of PGD among two samples of in total 1093 adults that completed the questionnaires 6 months post loss of either a parent or a partner. Convergent and divergent validity was tested via the relationship to depression, anxiety, post-traumatic stress disorder (PTSD) and general wellbeing using regression analysis. The Danish version of the PG 13 appeared to be both valid and reliable. A two-factor model reflecting the division of core- and associated symptoms of prolonged grief disorder provided the best description of the PG-13 among Danish bereaved adults and there was evidence of partial structural invariance of the latent structure of PGD across bereavement types. Convergent and divergent validity analysis supported the validity of the two-factor model of PGD.

Significant outcomes: : A latent variable model differing between core- and associated symptomatology of grief is supported. The Danish translation of PG-13 is a valid measure of prolonged grief symptomatology.

1. Introduction

Recently, the ICD-11 and DSM-5 has recognized prolonged grief as a distinct psychiatric disorder (Boelen et al., 2018; O'Connor et al., 2019; Prigerson et al., 2021) characterized by symptoms such as persistent preoccupation and longing for the deceased accompanied with intense emotional pain and impairment of daily functioning (WHO, 2018). A recent meta-analysis found a pooled prevalence rate of probable cases of prolonged grief disorder (PGD) of 9.8% (Lundorff et al., 2017) and prior research has suggested that more than one third of general psychiatric outpatients exhibited moderate or severe levels of PGD symptoms (Piper et al., 2001), while other studies have reported more conservative prevalence rates of 3–4% (Prigerson et al., 2021; Rosner et al., 2021). PGD is associated with reduced quality of life, increased suicidality, and other types of psychological distress such as depression, anxiety, and posttraumatic stress disorder (PTSD) as well as physical distress such as heart attack and high blood pressure (Boelen and Prigerson, 2007; Latham and Prigerson, 2004; Prigerson et al., 1995; 1997;2009; 2021; Simon et al., 2007). Specifically, a recent meta-analysis of 23 studies reported that 70% of bereaved participants with probable PGD concurrently experienced symptoms of depression, anxiety, and/or PTSD (Komischke-Konnerup et al., 2021). This meta-analysis included samples with traumatic loss which may in part explain the high rates of co-occurrence with PGD and other types of complicated bereavement reactions. Several studies however also support the distinctiveness of PGD as it uniquely predicts psychological functioning and suicidal ideation (Boelen and Prigerson, 2007; Bonanno et al., 2007; Prigerson et al., 1995, 1996). Additionally, studies have suggested that bereavement of a partner or a child are among the losses associated with the highest levels of PGD-symptomatology (Shear, 2022) compared to loss of a parent or other close relationships (Tang and Xiang, 2021).

Due to the ubiquity of death and dying in the wake of a global

* Corresponding author.
E-mail address: mlvang@health.sdu.dk (M.L. Vang).

https://doi.org/10.1016/j.psychres.2022.114937
Received 13 April 2022; Received in revised form 27 October 2022; Accepted 30 October 2022
Available online 31 October 2022

pandemic and the casualties of war in Ukraine, compounded with the severe mental and physical health consequences of PGD, it is important that clinicians are mindful of unresolved and potentially prolonged grief reactions among bereaved clients, for example by screening for symptoms of PGD (Jordan and Litz, 2014). The PG-13 has been widely used and international research has supported the validity of the PG-13 to identify symptoms of PGD among American (Prigerson et al., 2009), Swedish (Pohlkamp et al., 2018), Turkish (Isikli et al., 2020) and Taiwaneese (Tsai et al., 2018) populations. Most recently, Prigerson et al. (2021) have presented a revised version of the PG-13 that maps onto the DSM-5-TR criteria for PGD (PG-13-R). A number of adaptions were made from the original PG-13 (Prigerson et al., 2009). For example, the PG-13-R (Prigerson et al., 2021) relates to how the respondent currently feels and if this has been present since or as a result of the death (instead of on the last month), the response format was adapted so all items were based on intensity (in PG-13 the first four items were based on frequency), and the wording was changed to a more active formulations in all items. Finally, to adapt to the DSM-5-TR PGD some items from the PG-13 were excluded (not able to trust others, lack of acceptance of the loss, feeling shocked or dazed) while new items were included (preoccupation, loneliness) (Prigerson et al., 2021). Prigerson et al. (2021) used EFA to test the internal structure of the new PG-13-R, supporting a continued unilateral structure across American, Dutch, and British samples. Data for this analysis was originally collected to test earlier but similar versions of diagnostic criteria for a grief disorder in the United States (Prigerson et al., 2009), the Netherlands (Boelen et al., 2015), and the United Kingdom (Smith and Ehlers, 2019) using the PG-13 or previous versions of this scale. Findings from Prigerson et al. (2021) initial analyses suggested that the revised scale has good psychometric properties, but the PG-13-R still awaits psychometric evaluation. Other PGD scales that map onto ICD-11 (Killikelly et al., 2020) and both ICD-11 and DSM-5-TR (Lenferink et al., 2022) have been developed based on PG-13 and previous versions of this scale and validated in new samples. These are promising screening tools for ICD-11 and DSM-5-TR PGD but still need to be tested in different types of samples and to be validated against structured clinical interviews. Furthermore, as these scales are based on the same empirical and theoretical foundation as the PG-13, it is still relevant to ensure the validity of PGD as a construct.

Evidence for the internal structure of PG-13 has primarily been derived from studies using exploratory factor analyses (EFA) that has consistently supported a unidimensional structure of the measure (Isikli et al., 2020; Pohlkamp et al., 2018; Prigerson et al., 2009). However, once a hypothesized structure of a measure has been established, a direct test of this hypothesized structure using confirmatory factor analysis (CFA) enables researchers to provide a stronger argument for the validity of the internal structure if the hypothesized model is tested against and performs better than competing alternative models. To date, we are only aware of one study that has tested the unilateral model against competing models using CFA. Sveen et al. (2020) used EFA to identify a 3-factor model consisting of factors representing separation distress, traumatic distress, and reorientation/identity that displayed superior fit in a sample of 123 bereaved Swedes. The authors confirmed the superiority of the three-factor model against a unidimensional and two-dimensional model using CFA in the same sample. Sveen et al. (2020) tested their models in a convenience sample recruited for a study focused on the effect of potentially traumatic events, where a total of $n = 72$ participants indicated the bereavement as the index trauma. It is therefore unclear whether the superiority of the 3-factor model will replicate in a general population sample, how the 3-factor model performs against the unidimensional model supported in EFA-studies, and whether these models will be outperformed by a two-factor model reflecting the suggested division of symptoms into core- (separation distress) and associated (cognitive, emotional and behavioral symptoms) symptomatology as proposed in the ICD-11 and DSM-5 conceptualizations of grief-disorders. A direct comparison of these alternative models to the more broadly supported unidimensional structure found using EFA is an important step towards establishing or challenging the validity of splitting prolonged grief disorder into core- and associated symptomatology as suggested in the new diagnoses of prolonged grief. Additionally, while evidence suggests that grief-reactions are more severe among those who have lost a partner compared to those who have lost a parent (Tian and Xiang, 2021), there is a dearth of studies testing the invariance of the dimensional structure across these groups of bereaved, which is a prerequisite for the direct comparison of severity of PGD.

The present study aimed to test competing models of the internal structure of the Danish PG-13 among two subsamples of bereaved individuals that have lost a partner or a parent using confirmatory factor analysis. Three models were tested: a unidimensional model representing the best fitting model in existing research (Isikli et al., 2020; Pohlkamp et al., 2018; Prigerson et al., 2021), a two-dimensional model representing the proposed division of the disorder into core- and associated symptomatology as described in ICD-11 and DSM-5, and finally, the three-factor structure proposed by Sveen et al. (2020) as the best descriptor of dimensionality in a traumatically bereaved sample. Based on existing research, we expected the unidimensional model to provide the best fit to the data in both groups and that the dimensional structure of prolonged grief would be invariant across the subgroups. To test the validity of the best-fitting factor model, concurrent and divergent validity analyses were conducted on the relationship between the latent factor(s) of PGD and measures of anxiety, depression, PTSD and general well-being.

2. Methods

The current study is based on data from The Aarhus Bereavement Study (TABstudy), which is an ongoing multi-wave cohort study (previous findings are published elsewhere; for example Lundorff et al., 2021). The TABstudy is under the surveillance of the Danish Data Protection Agency [registration number: 2015–57–0002- 62,908–266], follows the General Data Protection Regulation of The European Union [2016/679]. The original study was pre-registered at ClinicalTrials.org [NCT03049007].

2.1. Participants and procedures

Participants were identified through extractions from the Danish Civil Registration System (DCRS), containing information on all individuals, aged 18 or older, who in 2017 and the first couple of months of 2018 lost a spouse and lived in the metropolitan area of Aarhus in Denmark. One-month post-loss, potential participants were sent a condolence letter followed by a phone interview, in which they were invited to participate in the study. The adult children of those bereaved spouses that agreed to participate and believed that their children may be interested in participating in the study were also invited. All participants provided written informed consent and received questionnaires either via postal or online mail at several time points after their loss. The current study is based on data collected 6 months post-loss (T2). In total, 1224 participants responded to some of the questionnaires six months post loss. Out of these, 1093 completed the PG-13 measure, however, 30 participants were not registered as being either the spouse or child of the deceased and therefore, a final sample of 1063 were included in the current study.

2.2. Measures

Demographics: Information on gender (1=man, 2=woman), age (measured in years), educational attainment (primary and secondary, vocational and higher education), and relationship to the deceased (1=partner, 2=parent) were collected at T1.

PG-13: The Prolonged Grief-13 scale (PG-13, Prigerson et al., 2009) was used to measure symptoms of PGD. The scale is scored on a 5-point

Likert-scale and ordered into 3 sections. Section 1 consists of question 1 and 2 asking the respondent about yearning for the deceased and emotional pain associated with the loss. For these questions, the 5-point scale is anchored to frequency indicators (1= not at all, 5= several times per day). The section is concluded with a question measuring duration of symptoms (at least 6 months, scored yes/no). Section 2 consists of 2 questions of associated grief-symptomatology (i.e., avoidance and feelings of being stunned, dazed, or shocked by the death) scored on a 5-point scale anchored to frequency indicators. Section 3 consists of 7 questions on associated grief-symptomatology (i.e., feeling that a part of oneself died, trouble accepting the loss, interpersonal trust issues, bitterness, difficulty moving on, emotionally numb, and meaningless) scored on the 5-point Likert-scale where indicators are linked to intensity of symptomatology (1= not at all, 5= overwhelmingly). The scale is usually scored as one total score including item 1–2 and 4–12 (all Likert scale items). Symptoms were considered endorsed with a score of 4 or more (Prigerson et al., 2009). Cronbach's alpha in the current study was 0.91. Supplementary Table 1 displays item correlations and item-total correlations.

WHO-5: The 5-item Well-Being Index (WHO-5; Heun et al., 2001) is a self-report scale of well-being (Topp et al., 2015) and was used in the current study to measure general psychological well-being. Cronbach's alpha in the current study was 0.92.

CES-D 10: The Center for Epidemiologic Studies Depression Short Form (CES-D 10) was used to measure symptoms of depression. CES-D-10 consists of 10 items mapping depression symptomatology (e.g., "I felt that everything I did was an effort" and "I thought my life had been a failure") (Björgvinsson et al., 2013; Radloff, 1977). Cronbach's alpha in the current study was 0.87.

GAD-7: Symptoms of anxiety was measured with a 7-item self-report scale for Generalized Anxiety Disorder (GAD-7), which is a brief measure of anxiety symptoms (e.g., "Not being able to stop or control worrying" and "Feeling nervous, anxious or on edge"; Spitzer et al., 2006). Cronbach's alpha in the current study was 0.90.

PCL-5: Bereavement-related posttraumatic stress symptoms (PTSD) was measured with the posttraumatic stress disorder (PTSD) Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5; Ashbaugh et al., 2016; Weathers et al., 2013). To capture bereavement-related PTSD "the death" was used instead of the more general term "the stressful experience" (e.g., Repeated, disturbing dreams of *the death*?). As death of a close one is considered a criterion A event, this alteration is unlikely to impact the psychometric properties of the PCL. Cronbach's alpha in the current study was 0.93.

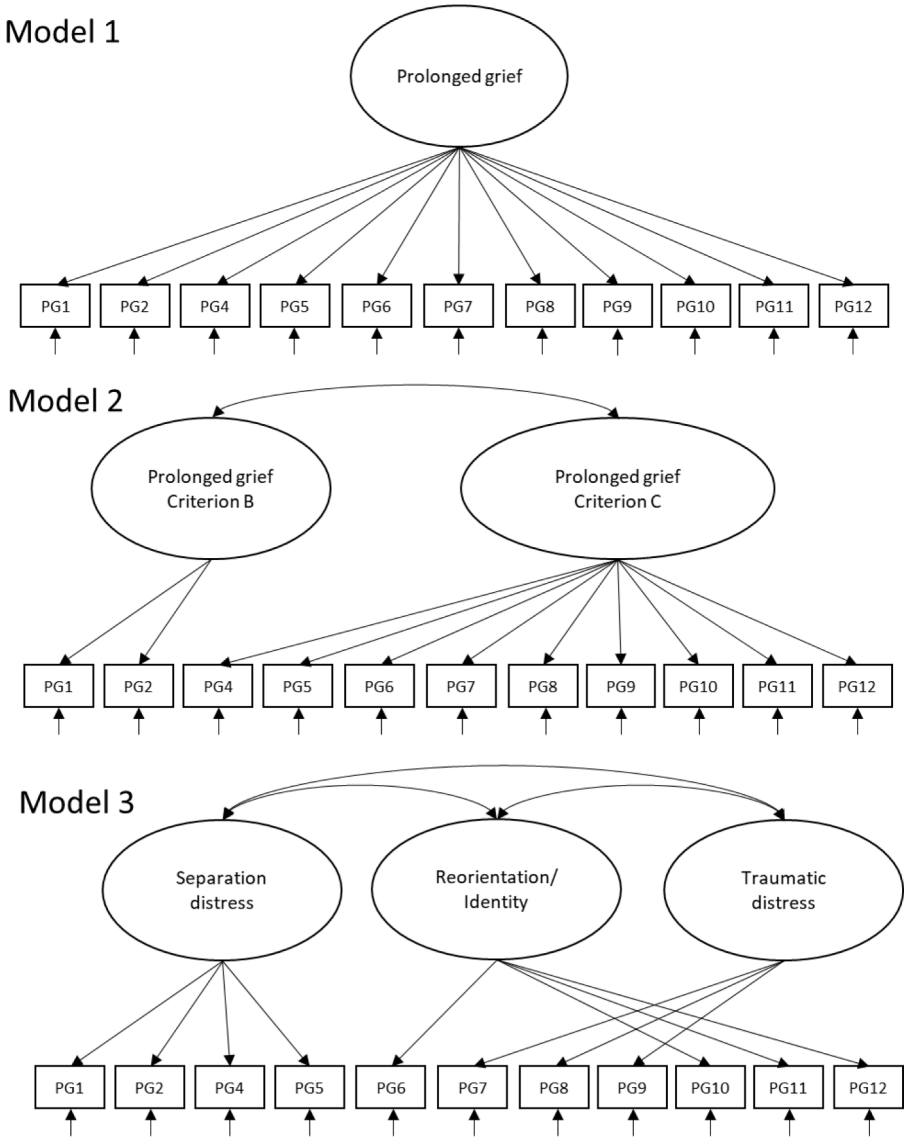

Fig. 1. Competing models of the latent structure of Prolonged Grief as measured by PG-13

2.3. Data analysis

Analyses progressed in three phases testing dimensional structure and invariance across the samples, convergent validity, and divergent validity. Phase 1, testing dimensional structure and invariance, was conducted in four steps. First, three alternative factor models were formulated to find the best fitting model to describe the internal structure of the PG-13. Model 1 represented the unidimensional model supported in EFA studies (e.g. Isikli et al., 2020; Pohlkamp et al., 2018; Prigerson et al., 2021) where all items loaded uniformly on one latent factor. Model 2 represented a two-factor solution with item 1 and 2 loading onto one factor, reflecting core-symptomatology, and items 4 to 12 loading onto another, reflecting associated symptomatology. Finally, Model 3 reflected the Sveen et al. (2020) 3-factor model with items 1, 2, 4 and 5 loading onto one factor, reflecting separation distress, items 6, 10, 11 and 12 loading onto a factor representing reorientation/identity, and items 7, 8 and 9 loading onto a third factor, representing traumatic distress. The models are illustrated in Fig. 1 and had 44, 43 and 36 parameters, respectively. These models were tested across both subsamples to identify the best fitting baseline model (step 1). Subsequently, invariance tests of the dimensional structure of prolonged grief were tested using the approach described by Byrne (2012). Specifically, three increasingly strict criteria for invariance between the subsamples were employed: Step 2 tested configural invariance (that the pattern of factors and factor loadings are identical), step 3 tested measurement invariance (assuming configural invariance and testing whether the magnitude of factor loadings are equivalent) and finally, step 4 tested structural invariance (assuming measurement invariance and testing whether the factor variances and covariances are equivalent) across the subsamples.

The relative fit of the models was evaluated using a range of model fit indices across incremental, absolute and parsimony-corrected fit-statistics. The Comparative Fit Index (CFI, Bentler, 1990) and Tucker-Lewis Index (TLI, Tucker and Lewis, 1973) are considered incremental fit statistics and indicate the relative improvement in fit of the hypothesized model compared to a restricted baseline model. Values of ≥ 0.90 and ≥ 0.95 are reflective of acceptable and excellent fit. The chi-square test (χ^2), Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMR) were used as absolute fit indices (Jöreskog and Sörbom, 1993). Models that have a non-significant χ^2-test are usually considered reflective of an acceptable fit, however, research has shown the chi-square test to be overly restrictive in larger samples (Tanaka, 1987), and model rejection should therefore not be based on a significant chi-square test alone. For the Root Mean Square Error of Approximation (RMSEA, Jöreskog and Sörbom, 1993), values below ≤ 0.08 and ≤ 0.05 are taken to reflect acceptable and excellent model fit, respectively. Chen (2007) has suggested differences of 0.015 as reflective of meaningful differences between models. SRMR values below ≤ 0.05 reflect a well-fitting model. Finally, we used the Bayesian Information Criterion (BIC, Schwarz, 1978) to compare the relative fit of the models. The BIC is a parsimony-corrected fit index that penalizes models with increasing complexity. Previous research found that a difference of 10 or more points lower on the BIC indicating superior model fit of the model with the lowest score (Raftery, 1995). Relationship between the best fitting model and demographics (sex, age, educational level) was tested using bivariate and multiple regression analyses.

In phase 2 of the analysis, bivariate and multiple regression analysis were used to test convergent validity of the best-fitting factor-solution. Convergent validity was estimated through the relationship of the dimensional structure of grief with sum-scores on anxiety, depression, and PTSD. The third phase consisted of testing the divergent validity analyses that were conducted as described in phase 2 and tested through the relationship between the dimensional structure and indicators of general well-being. Analyses were conducted in Mplus version 8.1 (Muthén and Muthén, 2018) using robust maximum likelihood (Yuan and Bentler, 2000) and SPSS version 26. The percentage of missing values in the included sample at six months post loss ($N = 1093$) was acceptable (1.2%) and data were missing completely at random (Little's MCAR test = *ns*). Missing data was handled using EMA (Twala, 2009).

3. Results

3.1. Descriptive results

Sixty-nine percent ($n = 758$) had lost a partner and thirty-one percent ($n = 335$) had lost a parent. Table 1 displays demographic information on the participants. Overall, those bereaved of a parent were significantly younger and more likely to have completed higher levels of education, whereas comparable rates completed vocational education across the subsamples. Table 2 and supplementary Table 2 displays symptom means and frequency of endorsement on PG13, respectively. Those bereaved of a partner scored significantly higher on all symptom compared to parental loss. This pattern was also reflected in endorsement rates apart from bitterness, trust issues and functional impairment, where there were no statistically significant differences in endorsement rates. Participants most frequently endorsed the core-/ separation anxiety-symptoms of the PG-13, and a minority ranging from 2.9% (PG8) to 27.7% (PG7) endorsed associated symptoms of the PG-13. Overall, 4.4% ($n = 54$) endorsed symptoms in a pattern reflective of a probable diagnosis of PGD at 6 months after the loss. There were no statistically significant differences in probable diagnostic rates across the subsamples.

4. Phase 1: dimensional structure and invariance testing

In step 1, the three hypothesized models were tested separately for the full sample and each subsample. Supplementary Table 3 displays fit statistics from the analyses that were consistently indicating that model 2 provided the best fit for the full sample as well as for the subsamples of partner- and parent loss. However, RMSEA values of 0.083 and 0.087 for partner- and parental-loss, respectively, indicated that there were relevant sources of misfit present for both subsamples. Modification indices suggested that these were partly overlapping. For those who had lost a parent, the highest modification indices were found in the cross-loading of item 7 (trouble accepting) on core-symptomatology (MI = 22.70, standardized EPC = 0.60). For those who had lost a partner, the highest modification indices were found in cross-loadings of item 5 (stunned) on core-symptomatology (MI = 39.47, standardized EPC = 0.35) and item 7 (trouble accepting) on core-symptomatology (MI = 33.19, standardized EPC = 0.34), respectively.

Including the cross-loading of item 7 on core-symptomatology among the subsample that had lost a parent improved fit of the model significantly indicated by ΔBIC= 28.62, and displaying overall satisfactory fit ($\chi^2(42)=126.96$, $p<.001$, RMSEA [90% CI] = 0.078

Table 1
Demographic information.

	Bereaved of partner	Bereaved of parent	Significance test
Age (M, SD)	70.2 (9.7)	44.2 (10.2)	t(709.66)=41.44, $p<.001$
Gender (n/% women)	565 (70%)	225 (59.2%)	$\chi^2(2)=13.06$, $p<.001$ Adj residual: 3.7
Education (n/%)			$\chi^2(2)=61.82$, $p<.001$
Primary or secondary	236 (29.9%)	45 (11.8%)	Adj residual: 6.8/ −6.8
Vocational	224 (28.4%)	98 (25.8%)	Adj residual: 0.9/ −0.9
Tertiary	329 (41.7%)	237 (62.4%)	Adj residual: −6.6/ 6.6

Table 2
Mean scores and standard deviations for PG-13 items.

Item		Total M (SD)	Partner-loss M (SD)	Parental loss M (SD)	t(df)	p
PG1	Yearning	3.51 (1.15)	**3.77** (1.08)	2.93 (1.04)	t(653.76)=12.06	<0.001
PG2	Emotional pain	2.90 (1.22)	**3.12** (1.20)	2.42 (1.10)	t(1061)=9.41	<0.001
PG4	Avoidance	1.69 (1.11)	**1.74** (1.15)	1.57 (1.02)	t(706.48)=2.43	.021
PG5	Stunned	1.93 (1.14)	**2.08** (1.21)	1.90 (1.09)	t(825.99)=6.74	<0.001
PG6	Identity loss	2.23 (1.13)	**2.38** (1.11)	1.90 (1.09)	t(642.01)=6.62	<0.001
PG7	Trouble accepting	2.70 (1.22)	**2.83** (1.19)	2.41 (1.22)	t(1061)=5.30	<0.001
PG8	Trust issues	1.35 (0.76)	**1.37** (0.78)	1.27 (0.68)	t(716.36)=2.10	0.036
PG9	Bitterness	1.90 (1.11)	**1.94** (1.10)	1.79 (1.08)	t(1061)=2.12	0.034
PG10	Difficult moving on	1.94 (1.07)	**2.17** (1.07)	1.46 (0.89)	t(753.05)=11.30	<0.001
PG11	Emotionally numb	1.86 (1.01)	**1.98** (1.04)	1.60 (0.88)	t(1061)=739.68	<0.001
PG12	Meaningless	1.99 (1.13)	**2.15** (1.15)	1.61 (0.93)	t(772.52)=8.10	<0.001
Total score		23.98 (8.83)	**25.53** (8.57)	20.57 (8.28)	t(1061)=8.81	<0.001

Note: Score range is 1–5. Bold writing indicates highest mean in *t*-test of mean differences between subsamples that lost a partner or a parent.

[0.063–0.094], CFI=0.942, TLI=0.925, SRMR=0.045, BIC = 8073.55). Including the cross-loading of item 5 on core-symptomatology among the subsample that had lost a partner also improved fit of the model significantly as indicated by ΔBIC = 39.33 ($\chi^2(42) = 233.18$, $p<.001$, RMSEA [90% CI] = 0.077 [0.067–0.087], CFI=0.945, TLI=0.928, SRMR=0.043, BIC = 20,745.93). PG7 still presented with a high MI (45.55, standardized EPC = 0.32) and was subsequently included in the final model. Model fit of the final model was significantly improved ΔBIC = 49.74 ($\chi^2(41) = 177.06$, $p<.001$, RMSEA [90% CI] = 0.067 [0.057–0.078], CFI=0.958, TLI=0.944, SRMR=0.036, BIC = 20,696.19). These modified versions of model 2 was carried forward for configural invariance testing.

Step 2: Testing configural invariance

The first stage of measurement invariance testing consists of configural invariance, indicating that the dimensional structure of the construct consists of the same number of factors and factor loading patterns across the subsamples. Specifically, this corresponds to estimating the baseline-models for each subsample simultaneously with no invariance-restrictions. Table 3 displays fit statistics for the invariance tests. The fit statistics for the configural model was satisfactory.

Step 3: Testing measurement invariance

In this step, we tested the invariance of the baseline model reflecting the division of core- and associated symptomatology across subsamples of those bereaved of a parent or a partner. Thus, factor loadings in the overall factor model were constrained to be equal across the subsamples, whereas the sample-specific modification remained unconstrained, thereby corresponding to a test of partial invariance by allowing for the subsample specific cross-loading of item 5 to core-symptomatology among those bereaved of a partner, while testing the invariance of the other factor loading patterns. The fit statistics for this model are displayed in Table 3 and were satisfactory, indicated a significant improvement over the configural model through ΔBIC = −29.37.

Step 4: Testing structural invariance

In this final step, we tested invariance of structural parameters in the model across subgroups, e.g. factor variances and covariances. The fit statistics for this model were satisfactory. SRMR and CFI values indicated slightly higher levels of misfit in the structural invariance model compared to the measurement invariance model. The differences between the models were negligible as indicated by ΔBIC = −0.76 and ΔRMSEA = 0.010, suggesting that the models assuming measurement and structural invariance can largely be considered equivalent. Table 4 displays standardized factor loadings from the structural invariance model and Table 5 displays relationships to demographic variables.

For both subsamples, younger age was associated with higher levels of associated symptomatology in multivariate analyses. Younger age was also associated with higher levels of core-symptomatology among those bereaved of a parent, and female gender was associated with higher levels of core- and associated symptomatology for parental bereavement only when controlling for other demographics. Educational attainment was unrelated to severity of prolonged grief symptomatology.

Phase 2 and 3: Convergent and divergent validity

Table 6 displays the relationship between core- and associated symptomatology of PGD and other mental health outcomes. In bivariate analyses, similar tendencies in direction and magnitude were observed in the relationship between core- and associated symptomatology and other mental health indicators for both subsamples. Associated symptoms were equally or more strongly related to all outcomes compared to core-symptomatology of PGD. In multiple regression, there was a distinct pattern of reversed relationships between other mental health outcomes and core-symptomatology compared to associated symptoms. Notably however, correlations between core- and associated symptomatology was $r = 0.72$, $p<.001$, suggesting that multicollinearity is likely a problem for the analyses and that caution should be exhibited in interpreting these findings.

5. Discussion

The aim of the current study was to test the dimensional structure of the PG-13 measure of PGD and its invariance across a representative Danish sample of adults bereaved of a partner or parent. Out of 3 competing models, the model representing a two-factor structure consistent with recent diagnostic proposals in ICD-11 and DSM-5 outperformed the unidimensional model of PGD symptomatology and the

Table 3
Fit statistics for invariance testing of model 2 across subsamples.

Model	Chi² (df)	p	CFI	RMSEA (90% CI)	SRMR	BIC	ΔBIC
Configural invariance	299.04 (83)	<0.001	0.925	0.070 (0.062–0.079)	0.039	28,824.12	–
Measurement invariance	320.30 (93)	<0.001	0.950	0.068 (0.060–0.076)	0.051	28,794.47	−29.37
Structural invariance	338.35 (96)	<0.001	0.947	0.069 (0.061–0.077)	0.055	28,795.23	0.076

Table 4
Standardised first order factor loadings from the structural invariance model.

	PG1	PG2	PG4	PG5	PG6	PG7	PG8	PG9	PG10	PG11	PG12
Loss of partner											
Core	0.79	0.91		0.24		0.36					
Associated			0.44	0.60	0.77	0.44	0.50	0.65	0.62	0.81	0.80
Loss of parent											
Core	0.82	0.94				0.37					
Associated			0.53	0.82	0.79	0.45	0.57	0.65	0.70	0.86	0.89

Table 5
Regression analysis of the relationship between demographics and latent variables.

	PG1	PG2	PG4	PG5	PG6	PG7	PG8	PG9	PG10	PG11	PG12
	Core-symptoms		Associated symptoms								
	β	p	β	p							
Loss of partner											
Gender											
Bivariate	**0.10**	.001	**−0.09**	.004							
Multivariate	0.08	.064	−0.08	.106							
Age											
Bivariate	**0.07**	.015	**−0.15**	<0.001							
Multivariate	−0.02	0.63	**−0.20**	<0.001							
Vocational education											
Bivariate	0.02	.477	−0.03	.304							
Multivariate	−0.01	.915	−0.10	.052							
Higher education											
Bivariate	0.00	.969	0.03	.416							
Multivariate	−0.03	.577	**−0.11**	.033							
Loss of parent											
Gender											
Bivariate	**0.18**	<0.001	−0.02	.646							
Multivariate	**0.27**	<0.001	**0.16**	<0.001							
Age											
Bivariate	**−0.14**	<0.001	**−0.16**	<0.001							
Multivariate	**−0.37**	<0.001	**−0.40**	<0.001							
Vocational education											
Bivariate	**0.08**	.047	−0.03	.351							
Multivariate	0.12	.095	0.09	.184							
Higher education											
Bivariate	0.03	.418	0.03	.418							
Multivariate	0.04	.602	0.09	.215							

Note: All factor loadings were significant at $p < .001$. Core- and associated symptomatology was correlated at $r = 0.72$, $p<.001$ for both subsamples.

Table 6
Regression analysis of the relationship between latent variables and mental health outcomes.

	Anxiety		Depression		PTSD		General well-being	
	β	p	β	p	β	p	B	p
Loss of partner								
Core-symptoms								
Bivariate	**0.58**	<0.001	**0.71**	<0.001	**0.76**	<0.001	**−0.54**	<0.001
Multivariate	−0.08	.104	−0.07	.086	**−0.13**	.002	0.06	.246
Associated symptoms								
Bivariate	**0.72**	<0.001	**0.79**	<0.001	**0.81**	<0.001	**−0.68**	<0.001
Multivariate	**0.78**	<0.001	**0.85**	<0.001	**0.90**	<0.001	**−0.73**	<0.001
Loss of parent								
Core-symptoms								
Bivariate	**0.65**	<0.001	**0.71**	<0.001	**0.83**	<0.001	**−0.59**	<0.001
Multivariate	0.08	.292	−0.07	.307	0.05	.454	−0.10	.194
Associated symptoms								
Bivariate	**0.74**	<0.001	**0.71**	<0.001	**0.86**	<0.001	**−0.67**	<0.001
Multivariate	**0.67**	<0.001	**0.86**	<0.001	**0.83**	<0.001	**−0.59**	<0.001

Note: Estimates reported are standardized beta coefficients.

Sveen et al. (2020) three-factor structure in both subsamples. Findings from the current study thus support the diagnostic algorithm of ICD-11 dividing PGD symptomatology in two criterion sets, one of separation distress and one of other forms of related distress, while they are inconsistent with existing research on the internal structure of the PG-13 reporting PGD as a unidimensional construct (Isikli et al., 2020; Pohlkamp et al., 2018; Prigerson et al., 2009; 2021). This is not an unusual finding when comparing EFA-solutions to CFA-solutions of the same measure (Hyland, 2015), and high correlations between the factors may call into question the necessity of separating the clusters. Specifically, while the distinction between core- and associated symptomatology was supported by fit-statistics, the two factors displayed similar relationships to predictors and outcomes in bivariate analyses, except for women displaying higher severity of core-symptoms following loss of a parent.

Findings from invariance testing indicated that the PG-13 satisfied the criterion for partial structural invariance as initial tests of baseline models suggested that feeling stunned by the loss (item 5) loaded onto both core- and associated symptomatology for partners. Additionally, trouble accepting the loss (item 7) loaded weakly onto core- and associated symptomatology for both subsamples. As participants in the current study were surveyed 6 months after the loss, future research is necessary to investigate whether cross-loadings on core-symptomatology is a transient phenomenon that subside with the passing of time.

The three-factor model by Sveen et al. (2020) also provided an improved fit compared to a unidimensional model of prolonged grief, however, fit statistics suggested that it was outperformed by model 2, thereby raising the question whether there might be population specific latent models of the PG-13 across general population samples and samples exposed to trauma or traumatic loss. Factor correlations in the three-factor model were high (ranged between $r = 0.84$ and $r = 0.87$). Taken in conjunction with the high factor correlations in model 2, findings from the current study would support the relevance of distinguishing between core- and associated symptoms of PGD while also cautioning against making firm distinctions between these clusters. Specifically, the reversal of the direction of the relationship between core-symptomatology and other mental health outcomes across the bivariate and multiple regression analyses are likely due to a suppressor effect of the associated symptomatology caused by the high correlation between core- and associated symptoms of PGD.

An important topic for future research would be to explore the distribution of symptoms of PGD using person-centered approaches to further investigate whether different combinations of core- and associated symptomatology exist and whether these profiles would be differentially related to comorbid disorders or reflect different populations. In the Sveen et al. (2020) study, it was unclear how indicators were distributed in the two-factor model. Future studies are therefore also needed to compare the performance of the two-dimensional model against the unidimensional and three-factor model in general population and traumatically bereaved samples.

Limitations and directions for future research: The current study is however limited due to the use of self-report data. Additionally, conclusions of the validity of the ICD-11 division of PGD into core- and associated symptomatology are limited by the assessment of PGD-symptoms with PG-13 instead of a measure designed to operationalize the full range of symptoms as defined in the most recent diagnostic entities. Hence, future replication studies are required that use measures tailored to the ICD-11 and DSM-5 PGD-diagnoses. Additionally, future research is needed that test the invariance between populations of traumatic vs. non-traumatic loss as findings from the current study compared to Sveen et al. (2020) may suggest that there could be population specific models of grief related to the circumstances of the loss. Finally, more studies testing the temporal stability of the dimensional structure are required with a particular focus on the cross-loading of the associated symptoms of trouble accepting the loss and feeling stunned on the proposed core-symptomatology.

Conclusion: Taken together, findings from the current study supports the PG-13 as a valid and reliable measure of symptoms of PGD among Danish bereaved adults that is partially invariant across subsamples of those bereaved of a partner or a parent. Findings also supported the division of symptoms into highly correlated factors of core- (separation distress) and associated (other forms of distress) symptoms as proposed in the ICD-11 revision.

5.1. Data availability statement

Due to restrictions on data sharing stipulated by The General Data Protection Regulation (GDPR) the EU organization that has tightened the data protection rules. To protect participant privacy according to the GDPR these data can therefore not be made available.

Declaration of Competing Interest

There are no conflicts of interest by any of the authors or in relation to funding.

Acknowledgements

This work was supported by a grant from the Aarhus University Research Foundation (AUFF) awarded to the last author [grant number AUFF-E-2015-FLS-8–63]. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2022.114937.

References

Ashbaugh, A.R., Houle-Johnson, S., Herbert, C., El-Hage, W., Brunet, A., 2016. Psychometric validation of the english and french versions of the posttraumatic stress disorder checklist for DSM-5 (PCL-5). PLoS ONE 11 (10), e0161645. https://doi.org/10.1371/journal.pone.0161645.

Bentler, P.M., 1990. Comparative fit indexes in structural models. Psychol. Bull. 107 (2), 238.

Björgvinsson, T., Kertz, S.J., Bigda-Peyton, J.S., McCoy, K.L., Aderka, I.M., 2013. Psychometric properties of the CES-D-10 in a psychiatric sample. Assessment 20 (4), 429–436. https://doi.org/10.1177/1073191113481998.

Boelen, P.A., Prigerson, H.G., 2007. The influence of symptoms of prolonged grief disorder, depression, and anxiety on quality of life among bereaved adults. Eur. Arch. Psychiatry Clin. Neurosci. 257 (8), 444–452. https://doi.org/10.1007/s00406-007-0744-0.

Boelen, P.A., de Keijser, J., Smid, G., 2015. Cognitive–behavioral variables mediate the impact of violent loss on post-loss psychopathology. Psychol. Trauma 7 (4), 382–390. https://doi.org/10.1037/tra0000018.

Boelen, P.A., Lenferink, L.I.M., Nickerson, A., Smid, G.E., 2018. Evaluation of the factor structure, prevalence, and validity of disturbed grief in DSM-5 and ICD-11. J. Affect. Disord. 240, 79–87. https://doi.org/10.1016/j.jad.2018.07.041.

Bonanno, G.A., Neria, Y., Mancini, A., Coifman, K.G., Litz, B., Insel, B., 2007. Is there more to complicated grief than depression and posttraumatic stress disorder? A test of incremental validity. J. Abnorm. Psychol. 116 (2), 342–351. https://doi.org/10.1037/0021-843X.116.2.342.

Byrne, B.M., 2012. Structural Equation Modeling With Mplus: Basic Concepts, Applications, and Programming. Routledge, New York, NY.

Chen, F.F., 2007. Sensitivity of goodness of fit indexes to lack of measurement invariance. Struct. Equation Model. 14 (3), 464–504. https://doi.org/10.1080/10705510701301834.

Heun, R., Bonsignore, M., Barkow, K., Jessen, F., 2001. Validity of the five-item WHO Well-Being Index (WHO-5) in an elderly population. Eur. Arch. Psychiatry Clin. Neurosci. 251 (Supl2), 27–31. https://doi.org/10.1007/BF03035123.

Hyland, P., 2015. Application of bifactor models in criminal psychology research: a guide to researchers. J. Crim. Psychol. 5 (2), 65–74.

Işıklı, S., Keser, E., Prigerson, H.G., Maciejewski, P.K., 2020. Validation of the prolonged grief scale (PG-13) and investigation of the prevalence and risk factors of prolonged grief disorder in Turkish bereaved samples. Death Stud. 1–11.

Jordan, A.H., Litz, B.T., 2014. Prolonged grief disorder: diagnostic, assessment, and treatment considerations. Professional Psychol. 45 (3), 180.

Jöreskog, K.G., Sörbom, D., 1993. LISREL 8: Structural Equation Modelling With the SIMPLIS Command Language. Lawrence Erlbaum Associates, Inc, Chicago, IL, US. Hillsdale, NJ:Scientific Software International.

Killikelly, C., Zhou, N., Merzhvynska, M., Stelzer, E.-.M., Dotschung, T., Rohner, S., Sun, L.H., Maercker, A., 2020. Development of the international prolonged grief disorder scale for the ICD-11: measurement of core symptoms and culture items adapted for Chinese and german-speaking samples. J. Affect. Disord. 277, 568–576. https://doi.org/10.1016/j.jad.2020.08.057.

Komischke-Konnerup, K.B., Zachariae, R., Johannsen, M., Nielsen, L.D., O'Connor, M, 2021. Co-occurrence of prolonged grief symptoms and symptoms of depression, anxiety, and posttraumatic stress in bereaved adults: a systematic review and meta-analysis. J. Affect. Disord. Reports, 100140.

Latham, A.E., Prigerson, H.G., 2004. Suicidality and bereavement: complicated grief as psychiatric disorder presenting greatest risk for suicidality. Suicide Life-Threat. Behav. 34 (4), 350–362. https://doi.org/10.1521/suli.34.4.350.53737.

Lenferink, L.I.M., Eisma, M.C., Smid, G.E., de Keijser, J., Boelen, P.A., 2022. Valid measurement of DSM-5 persistent complex bereavement disorder and DSM-5-TR and ICD-11 prolonged grief disorder: the traumatic grief inventory-self report plus (TGI-SR+). Compr. Psychiatry 112, 152281. https://doi.org/10.1016/j.comppsych.2021.152281.

Lundorff, M., Holmgren, H., Zachariae, R., Farver-Vestergaard, I., O'Connor, M, 2017. Prevalence of prolonged grief disorder in adult bereavement: a systematic review and meta-analysis. J. Affect. Disord. 212, 138–149.

Lundorff, M., Johannsen, M., O'Connor, M, 2021. Time elapsed since loss or grief persistency? Prevalence and predictors of *ICD-11*prolonged grief disorder using different applications of the duration criterion. J. Affect. Disord. 279, 89–97. https://doi.org/10.1016/j.jad.2020.09.116.

Muthén, L.K., Muthén, B.O., 2018. Mplus (Version 8.1). Muthén & Muthén, Los Angeles, CA.

O'Connor, M., Lasgaard, M., Larsen, L., Johannsen, M., Lundorff, M., Farver-Vestergaard, I., Boelen, P.A., 2019. Comparison of proposed diagnostic criteria for pathological grief using a sample of elderly bereaved spouses in Denmark: perspectives on future bereavement research. J. Affect. Disord. 251, 52–59. https://doi.org/10.1016/j.jad.2019.01.056.

Piper, W.E., Ogrodniczuk, J.S., Azim, H.F., Weideman, R., 2001. Prevalence of loss and complicated grief among psychiatric outpatients. Psychiatric Serv. 52 (8), 1069–1074.

Pohlkamp, L., Kreicbergs, U., Prigerson, H.G., Sveen, J., 2018. Psychometric properties of the Prolonged Grief Disorder-13 (PG-13) in bereaved Swedish parents. Psychiatry Res. 267, 560–565. https://doi.org/10.1016/j.psychres.2018.06.004.

Prigerson, H.G., Bierhals, A.J., Kasl, S.V., Reynolds, C.F., Shear, M.K., Day, N., Jacobs, S., 1997. Traumatic grief as a risk factor for mental and physical morbidity. Am. J. Psychiatry 154, 616–623.

Prigerson, H.G., Boelen, P.A., Xu, J., Smith, K.V., Maciejewski, P.K., 2021. Validation of the new DSM-5-TR criteria for prolonged grief disorder and the PG-13-Revised (PG-13-R) scale. World Psychiatry 20 (1), 96–106. https://doi.org/10.1002/wps.20823.

Prigerson, H.G., Horowitz, M.J., Jacobs, S.C., Parkes, C.M., Aslan, M., Goodkin, K., Maciejewski, P.K., 2009. Prolonged grief disorder: psychometric validation of criteria proposed for DSM-V and ICD-11. PLoS Med. (8), 6. https://doi.org/10.1371/journal.pmed.100012.

Prigerson, H.G., Maciejewski, P.K., Reynolds III, C.F., Bierhals, A.J., Newsom, J.T., Fasiczka, A., Miller, M, 1995. Inventory of Complicated Grief: a scale to measure maladaptive symptoms of loss. Psychiatry Res. 59 (1–2), 65–79.

Prigerson, H.G., Shear, M.K., Newsom, J.T., Frank, E., Reynolds Iii, C.F., Maciejewski, P. K., Houck, P.R., Bierhals, A.J., Kupfer, D.J., 1996. Anxiety among widowed elders: is it distinct from depression and grief? Anxiety 2 (1), 1–12. https://doi.org/10.1002/(SICI)1522-7154(1996)2:1≤1::AID-ANXI1≥3.0.CO;2-V.

Radloff, L.S., 1977. The CES-D Scale: a self-report depression scale for research in the general population. Appl. Psychol. Meas 1 (3), 385–401. https://doi.org/10.1177/014662167700100306.

Raftery, A.E., 1995. Bayesian model selection in social research. Sociol. Methodol. 25, 111–163.

Rosner, R., Comtesse, H., Vogel, A., Doering, B.K., 2021. Prevalence of prolonged grief disorder. J. Affect. Disord. 287, 301–307.

Shear, M.K., 2022. Grief and mourning gone awry: pathway and course of complicated grief. Dialogues. Clin. Neurosci.

Schwarz, G.E., 1978. Estimating the dimension of a model. Ann. Statistics 6 (2), 461–464.

Simon, N.M., Shear, K.M., Thompson, E.H., Zalta, A.K., Perlman, C., Reynolds, C.F., Silowash, R., 2007. The prevalence and correlates of psychiatric comorbidity in individuals with complicated grief. Compr. Psychiatry 48 (5), 395–399.

Smith, K.V., Ehlers, A., 2019. Cognitive predictors of grief trajectories in the first months of loss: a latent growth mixture model. J. Consult. Clin. Psychol. https://doi.org/10.1037/ccp0000438.

Sveen, J., Bondjers, K., Heinsoo, J., Arnberg, F.K., 2020. Psychometric evaluation of the swedish version of the prolonged grief disorder-13 (PG-13) in a bereaved mixed trauma sample. Front. Psychiatry 1420.

Spitzer, R.L., Kroenke, K., Williams, J.B.W., Löwe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch. Intern. Med. 166 (10), 1092–1097. https://doi.org/10.1001/archinte.166.10.1092.

Tanaka, J.S., 1987. How big is big enough?": sample size and goodness of fit in structural equation models with latent variables. Child Dev. 58 (1), 134–146. https://doi.org/10.2307/1130296.

Tang, S., Xiang, Z., 2021. Who suffered most after deaths due to COVID-19? Prevalence and correlates of prolonged grief disorder in COVID-19 related bereaved adults. Global Health 17 (1), 1–9.

Topp, C.W., Østergaard, S.D., Søndergaard, S., Bech, P., 2015. The WHO-5 Well-Being Index: a Systematic Review of the Literature. Psychother. Psychosom. 84 (3), 167–176. https://doi.org/10.1159/000376585.

Tsai, W.I., Kuo, S.C., Wen, F.H., Prigerson, H.G., Tang, S.T., 2018. Prolonged grief disorder and depression are distinct for caregivers across their first bereavement year. Psychooncology 27, 1027–1034. https://doi.org/10.1002/pon.4629.

Tucker, L.R., Lewis, C., 1973. A reliability coefficient for maximum likelihood factor analysis. Psychometrika 38 (1), 1–10.

Twala, B., 2009. An empirical comparison of techniques for handling incomplete data using decision trees. Appl. Artific. Intell. 23 (5), 373–405. https://doi.org/10.1080/08839510902872223.

Yuan, K.-.H., Bentler, P.M., 2000. Three likelihood-based methods for mean and covariance structure analysis with nonnormal missing data. Sociol. Methodol. 30 (1), 165–200. https://doi.org/10.1111/0081-1750.00078.

Weathers, F.W., Litz, B.T., Keane, T.M., Palmieri, P.A., Marx, B.P., & Schnurr, P.P. (2013). *The PTSD Checklist for DSM-5 (PCL-5)*. https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp.

World Health Organization. (2018). International classification of diseases for mortality and morbidity statistics (11th revision). Retrieved from https://icd.who.int/browse11/l-m/en.