Review Article

Latent classes of prolonged grief and other indicators of mental health in bereaved adults: A systematic review

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ABSTRACT

Background: The loss of a significant other can lead to variety of responses, including prolonged grief disorder (PGD), depression, and posttraumatic stress disorder (PTSD). Latent class analysis (LCA) is a person-centered statistical approach that finds subtypes of related cases based on item-responses. There has been a growing interest in conducting LCA on PGD, but no research synthesis exists to date. Aim of this systematic review was to provide a comprehensive overview of the state of research on LCAs on PGD and other indicators of mental health in bereaved adults and to rate the quality of these LCA studies.
Method: A systematic literature search was conducted in PsycInfo, Psyndex, Web of Science and PubMed in September 2022. Inclusion criteria required that a LCA was conducted including PGD and additional mental health indicators in bereaved adults. Quality of LCAs was rated using Guidelines for Reporting on Latent Class Analyses (GRoLCA).
Results: Twenty-one studies published between 2014 and 2022 with a median of 308 participants were reviewed. Studies comprised samples from six continents confronted with violent ($k = 9$), natural losses ($k = 8$) or both ($k = 4$). In addition to PGD symptoms as principal latent class indicators, studies included PTSD ($k = 5$), depression ($k = 3$), or both ($k = 10$). The majority of studies identified three ($k = 16$, 76%) or four latent classes ($k = 4$, 19%). Most studies found a resilient ($k = 19$, 91%) and a high symptom ($k = 20$, 95.2%) class. Fourteen studies (66.7%) found classes predominantly marked by PGD symptoms.
Discussion: Despite the diversity of included samples and LCA indicators of mental health, several types of latent classes were similar across studies. Caution, however, is warranted when comparing results across studies, since inconsistencies about interpreting and reporting LCA models limited the comparability of studies. Recommendations to improve the quality of LCA reporting are provided.

1. Background

At some point throughout life, most people will be confronted with the loss of a significant other. Grief is the natural response to loss and often involves reactions such as yearning, preoccupation with the loss, and might also include avoidance behavior, anger or emotional numbness (Prigerson et al., 1995). Grief responses differ in severity and duration and commonly diminish with time, as individuals gradually adapt to the consequences of their loss (Bonanno and Malgaroli, 2020; Nielsen et al., 2019; Tsai et al., 2016). For some, grief can become

overwhelming and might lead to psychological distress. This may take up the form of prolonged grief disorder (PGD). PGD was included in the 11th edition of the International Classification of Diseases (ICD-11; World Health Organization, 2019) and is now also included in the Diagnostic and Statistical Manual of Mental Diseases - 5 – Text Revision (DSM-5-TR) (American Psychiatric Association, 2022). PGD is marked by longing for or persistent preoccupation with the deceased and several cognitive, emotional, and behavioral symptoms (e.g., difficulties moving on, feeling emotionally numb, sense of unrealness), which need to last at least 6 or 12 months after a loss, according to ICD-11 and

DSM-5-TR, respectively.

PGD is only one of several common mental health responses to bereavement. Bereavement-related depression and, particularly in cases of violent loss, posttraumatic stress disorder (PTSD) have similarly been linked to post-loss distress. Comorbidity between PGD, depression and PTSD is frequent (Heeke et al., 2019; Komischke-Konnerup et al., 2021). On the symptom level, PGD overlaps with PTSD as both disorders exhibit symptoms of re-experiencing (intrusive memories of the traumatic event vs. intrusive memories related to the death) and avoidant behavior (avoidance of remembering the traumatic event vs. avoidance of reminders of the loss) (Maercker and Znoj, 2010). PGD also overlaps with symptoms of depression, e.g., an inability to experience positive mood or feelings of guilt. Despite these commonalities, research using factor and network analysis has shown that PGD is distinguishable from bereavement-related PTSD and depression (Boelen et al., 2010; Djelantik et al., 2020; Lenferink et al., 2021; Malgaroli et al., 2018; O'Connor et al., 2010).

Some researchers used latent class analyses (LCAs) in determining whether differential responses to loss in form of symptom profiles exist. LCA in grief research has mainly been employed to classify subgroups according to symptoms of PGD, depression or PTSD (Boelen, 2021; Nickerson et al., 2014). LCA is a person-centered statistical approach that identifies groups or classes of individuals based on their response patterns to a set of observed variables (Colins and Lanza, 2010). Each individual is probabilistically assigned to a latent class, that represents a group of individuals holding a most similar set of characteristics and is most distinct from other subgroups (Berlin et al., 2014). LCA uses binary indicators to identify these subgroups as compared to Latent Profile Analysis (LPA) that uses continuous indicators.

There are several important advantages of LCA compared to other statistical approaches. One advantage of LCA is that it allows for the identification of unobserved or latent heterogeneity in a population. This means that LCA can reveal subgroups of individuals with similar characteristics that may not be apparent through traditional statistical methods such as regression analysis.

Another advantage is that LCA can be used to analyze different disorders simultaneously by allowing for the identification of subgroups of individuals with similar patterns of symptoms across multiple disorders. Since LCA estimates the probability of membership in each identified subgroup, this information can be used to assign individuals to a subgroup. These subgroups are often linked to specific risk factors, symptom severity and to treatment responsivity (Boelen and Lenferink, 2019; Lanza and Rhoades, 2013). The advantage of LCA over conventional person-centered clustering approaches such as k-means clustering is that LCA uses predefined fit statistics to derive classes. This allows researchers to evaluate the goodness of fit of different models and to identify the best-fitting model for their data (Jain et al., 1999). Overall, the advantages of LCA make it a powerful tool for understanding and characterizing heterogeneity in populations, identifying subgroups of individuals with different characteristics or needs, and thus aid at developing targeted interventions or treatments.

Although there has been a growing body of research examining latent classes of PGD in the last decade, to date no research synthesis exists that gives an overview of LCA studies investigating latent classes of PGD and related constructs. It thus remains unknown whether previous studies produced similar findings, for example, whether comparable classes were found across different samples. Also, little is known on how LCAs were applied, i.e., whether analyses were adequately conducted and reported. A research synthesis on LCAs of PGD can help answer these questions by comparing the current evidence and detecting similarities and differences. This may also lead to new findings and highlight knowledge gaps, which is an important advantage over the interpretation of single study results.

The aim of this systematic review was to provide a comprehensive overview of the state of research on LCAs on PGD and other mental health indicators. We aimed to explore which aspects of mental health have been studied using LCAs, and whether the extracted classes were comparable across studies. A further aim of this systematic review was to rate the quality of studies including the methods applied to extract classes. Last, we aim to give recommendations for improving reporting of LCA research after bereavement, which may help comparing and interpreting LCA findings in future research.

2. Methods

2.1. Search strategy and data sources

A systematic literature search was employed by searching the databases PsycInfo, Psyndex, Web of Science and PubMed using the search terms "prolonged grief disorder" OR "complicated grief" OR "persistent complex bereavement disorder" OR "prolonged grief" AND "latent class analysis" OR lca OR latent OR class* OR subtype*. The literature search was conducted on 9th of November 2020 and rerun October 5th 2021 and September, 14th 2022 to look for new articles that had been published in the meantime. The protocol was pre-registered in Prospero (registration no. CRD42021283316).

2.2. Inclusion criteria

Journal articles, books, book chapters, and dissertations, published and unpublished were considered for inclusion. No exclusion criteria were applied regarding language or publication date. Inclusion criteria required that a LCA must have been conducted on PGD and at least one other construct related to psychopathology or mental health (e.g., PTSD, posttraumatic growth). We included studies that assessed any conceptualization of "complicated" or "prolonged" grief reactions in relation to bereavement. Even though slight differences exist between these criteria-sets (Eisma et al., 2022; Lenferink et al., 2019), we use the label prolonged grief throughout this manuscript. Study participants needed to be 18 years or older.

2.3. Screening procedure

A two-stage screening process was conducted to select studies for the current systematic review. After the systematic literature search, titles and abstracts were reviewed. In a second step, full texts were retrieved and rated against the inclusion and exclusion criteria. Two authors (CH, MF) decided independently on the inclusion or exclusion of each study. In case of disagreement, consensus was reached by discussion after each step. Interrater reliability was calculated using Cohen's kappa for categorical variables (Orwin, 1994).

2.4. Data extraction

Information on sample characteristics, method and results were extracted for each study. Two authors (CH, MF) independently conducted the data extraction for a randomly selected half of the studies (*k* = 11) to avoid systematic mistakes. One of the authors (CH) extracted data for all remaining studies.

2.5. Quality assessment/ risk of bias

Quality assessment was performed using an adjusted list based on the Guidelines for Reporting on Latent Trajectory Studies (GRoLTS) checklist (van de Schoot et al., 2017). We adjusted this list with permission from the developer and named it "Guidelines for Reporting on Latent Class Analyses (GRoLCA). The adapted list contains 16 items (examples: "Are the total number of fitted models reported, including a one-class solution?"; "Is entropy reported"?). The list can be accessed in Supplementary Material. Items were rated as "no", indicating high risk of bias and "yes", indicating low risk of bias, or "not applicable" for questions that were not applicable to a study. A randomly selected half of the

included studies ($k = 11$) was rated independently by two authors (LL, CH). The interrater reliability was calculated using Cohen's kappa for categorical variables (Orwin, 1994). In case of disagreement, consensus was reached by discussion. One author (LL) rated all remaining studies.

3. Results

3.1. Article selection process

Fig. 1 displays the selection process and reasons for study exclusion. We identified 601 records in the data base searches. After deletion of duplicates ($k = 281$), title and abstracts of 320 records were screened, which led to the exclusion of 276 records. The majority of these studies were excluded because they did not use LCAs or did not include PGD. Forty-four full-texts were screened. Of those, 23 records were excluded since they did not use LCA ($k = 16$), did not report LCA on PGD ($k = 5$) and other reasons (see Fig. 1). Finally, 21 studies that had been published between 2014 and 2022 fulfilled the inclusion criteria. We decided to include two studies that had participants 16 years and older since they mainly focused on adults (Kokou-Kpolou et al., 2021a; Zhou et al., 2018). Interrater reliability for the full-text screening was 'almost perfect' ($\kappa=0.87$) according to the nomenclature of Landis and Koch (1977).

3.2. Description of studies

Individual study characteristics, such as sample size, type of loss, and extracted classes are displayed in Table 1. The 21 studies collected samples in 11 countries across the following continents (Africa, $k = 2$; Asia, $k = 5$; Australia, $k = 3$; Europe, $k = 9$; North America, $k = 1$, South America, $k = 1$). The total sample included $N = 10,338$ participants and the median sample size across studies was 308 (range: 159–2964; $M = 493$, $SD = 600.06$). Nine studies (42.9%) had participants who mainly had lost their significant other to a violent loss (defined as >75% of the sample experienced loss due to accident, suicide or homicide), whereas in eight studies, participants mainly lost their significant other to a non-violent loss (defined as >75% loss not due to accident, suicide, or homicide). The remaining four studies were balanced with respect to the distribution of violent and non-violent losses ($k = 2$) (Djelantik et al., 2020; Kokou-Kpolou et al., 2021a) or did not report the cause of loss ($k = 2$) (Grafiadeli et al., 2022; Tay et al., 2019).

The most commonly used instruments to assess PGD were those developed by Prigerson and colleagues: The Inventory of Complicated Grief ($k = 6$, ICG; Prigerson et al., 1995), Inventory of Complicated Grief-Revised ($k = 2$, ICG-R; Prigerson et al., 1999), and Prolonged Grief Disorder – 13 ($k = 3$, PG-13; Prigerson et al., 2009). Others used the Traumatic Grief Inventory-Self Report (Plus) or Clinician version ($k = 4$,
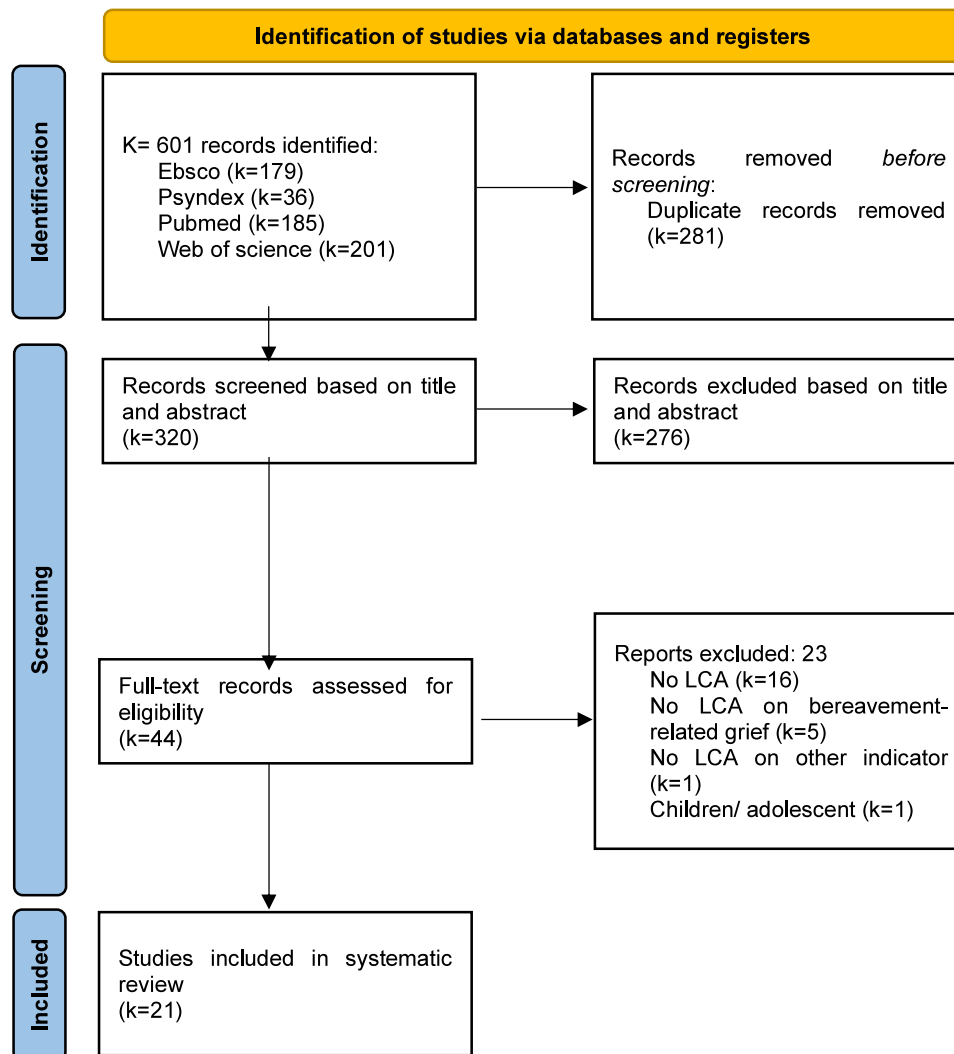

Fig. 1. PRISMA flow diagram on the identification and selection of studies

From: Page MJ, maMcKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71 For more information, visit: http://www.prisma-statement.org/.

Table 1
Key characteristics of included studies.

Study	Country of data collection	Sample size	Description of sample: Age, Gender	Loss type	Mental health indicators in LCA, instrument	Soft-ware	Fit statistics	Extracted classes
Boelen (2021)	The Netherlands	436	$M = 46.0$, $SD=12.2$ 86.2% Female Gender	Bereaved individuals, natural loss: 89.7% violent loss: 10.3%	PGD (PGD scale) PTSD (PSS-SR)	Mplus	AIC, BIC, SSa-BIC, VLRT, Entropy	1 Low symptom class (34.2%), 2 predominantly PGD class (38.7%), 3 high symptom class (27.0%)
Boelen & Lenferink (2019)	The Netherlands	322	$M = 55.46$ years, $SD =$ 14.03 73.6% Female Gender	Individuals bereaved ≤ 6 months prior to survey; Natural loss: 91.3% Violent loss: 8.7%	PGD (PGD scale) PTSD (PSS-SR) Depression (HADS)	Latent Gold	AIC, BIC, SSa-BIC, BLRT, Entropy	1 Low symptom class (35.4%), 2 predominantly PGD class (29.8%), 3 high symptom class (34.8%)
Boelen et al. (2016)	The Netherlands	245	$M = 40.9$ years, $SD =$ 12.4 80% Female Gender	Bereaved individuals with a loss due to accident, suicide, or homicide; 100% violent loss	PGD (ICG-R) Depression (SCL)	Mplus	AIC, BIC, SSa-BIC, Entropy	1 resilient (25.3%), 2 PGD (39.2%), combined PGD/ depression (35.5%)
Cozza et al. (2019)	USA	454	$M = 54.8$ years, SD=11.9 83% Female Gender	Family members of individuals who died during the terror attacks 9/1; violent loss	PGD (ICG) PTSD (PCL-5) Depression (PHQ) Anxiety (Generalized Anxiety Disorder Assessment) Functional impairment (WSAS)	Mplus	AIC, BIC, SSa-BIC, Entropy	1 healthy (66.1%), 2 comorbid/ no PTSD (21.3%), 3 comorbid/ PTSD (12.6%)
Djelantik et al. (2021)	Bali, Indonesia	301	$M = 44.2$, $SD=15.2$ 43% Female Gender	Loss of close kin to traffic accidents in the three years before survey; 100% violent loss	PGD (TGI -SR) PTSD (PCL-5) Depression (QIDS)	Mplus (version 8)	AIC, BIC, SSa-BIC, VLMRT, Entropy	1 PTSD class (13%), 2 PGD class (11%), 3 resilient class (76%)
Djelantik et al. (2020)	The Netherlands	458	$M = 49.1$ years, $SD =$ 12.2 29% Female Gender	Traumatized patients with history of traumatic experiences in the first 3 months after admission; Patients with history of a violent loss: 45%	PGD (TGI -SR) PTSD (PCL-5) Depression (BSI)	Mplus (version 8)	AIC, BIC, SSa-BIC, BLRT, VLMRT, Entropy	1 no prominent PGD, PTSD, and depression symptoms (13%), 2 prominent PTSD/ depression (23%), 3 PGD and PTSD symptoms (20%), 4 prominent PGD, PTSD, and depression symptoms (45%)
Djelantik et al. (2017)	The Netherlands	496	$M = 54.6$ years, $SD =$ 13.3 75% Female Gender	Participants had experienced a loss < 3 years earlier; violent loss: 11% non-violent causes: 89%	PGD (PGD scale) PTSD (PSS-SR) Depression (BDI)	Mplus (version 7)	AIC, BIC, SSa-BIC, Entropy	1 PGD class (48%), 2 mixed PGD/PTSD class (27%), 3 resilient class (25%)
Eisma et al. (2019)	China	803	$M = 46.72$ years, $SD =$ 15.1 36.9% Female Gender	Bereaved Sichuan earthquake survivors; 100% violent loss	PGD (ICG) PTSD (PCL-C)	LatentGold (version 5.0)	AIC, BIC, SSa-BIC, BLRT, Entropy	1 CG class (26%), 2 PTSD/CG class (25.5%), 3 no PTSD/ partial CG class (18.1%), 4 partial PTSD/CG class (16.9%), 5 resilient class (13.4%)
Grafiadeli et al. (2022)	Germany	159	$M = 40.62$, $SD=12.67$ 89.3% Female Gender	Help-seeking bereaved individuals; violent/non-violent loss n.r.	PGD (ICG) PTSD (IES) Depression (BDI)	RStudio, version 4.0.0	AIC, BIC, Entropy	1 resilient class (16%), 2 PGD/PTSD class (34%), 3 PGD class (50%)
Heeke et al. (2022)	The Netherlands/ Germany	433	$M = 43$, $SD=16.89$ 81.3% Female Gender	Bereaved Dutch and German adults; natural loss: 77.1%, violent loss: 22.9%	PGD (TGI-CA) PTSD (PCL-5) Depression (PHQ)	LatentGold	AIC, BIC, SSa-BIC, BLRT, Entropy	1 no symptoms (47%), 2 moderate PGD/low depression/PTSD class (32%); 3 high PGD/ moderate depression/ PTSD class (21%)
Heeke et al. (2017)	Colombia	308	$M = 48.5$ years, $SD =$ 12.7 61.7%	Bereaved survivors of armed conflict in Colombia; violent loss 75%; loss to	PGD (PG-13) PTSD (PCL-C)	Mplus	AIC, BIC, SSa-BIC, VLMRLRT, BLRT,	1 resilient class (23.6%), 2 PTSD-class (23.3%), 3 predominately PGD class (25.3%), 4 high distress-class

Table 1 (*continued*)

Study	Country of data collection	Sample size	Description of sample: Age, Gender	Loss type	Mental health indicators in LCA, instrument	Soft-ware	Fit statistics	Extracted classes
			Female Gender	disappearance: 25%			Entropy	
Kokou-Kpolou et al. (2021a)	Togo	162	$M = 56.04$; $SD=11.07$ 88.3% Female Gender	Widowed people; natural anticipated loss: 44.5%; sudden or brutal loss: 55.5%	PGD (ICG-R) Posttraumatic Growth (PTGI)	Mplus (8.0)	AIC, BIC, SSa-BIC, BLRT, Entropy	1 combined grief/growth class (36.6%); 2 predominantly growth class (32.6%); 3 low-medium growth class (30.9%)
Kokou-Kpolou et al. (2021b)	Togo	230	$M = 22.81$, $SD=4.37$ (16 years and older) 54.3% Female Gender	Bereaved young and middle-aged adults Natural anticipated loss: 60.4%, sudden loss: 21.1% violent loss: 18.5%	PGD (ICG) Depression (CESD)	Mplus (v. 8)	AIC, BIC, SSa-BIC, BLRT, Entropy	1 resilient (20.6%), 2 predominantly PGD (44.7%), 3 combined PGD and depression (34.7%)
Lenferink et al. (2017)	The Netherlands	167	$M = 52.49$ years, $SD = 15.65$ 59.3% Female Gender	Participants lost loved ones in Ukrainian plane crash; 100% violent loss	PGD (TGI -SR) PTSD (PCL-5) Depression (QUIDS)	LatentGold (v. 5)	AIC, SSa-BIC, BLRT, Entropy	1 Resilient class (20.0%); 2 PGD class (41.8%), 3 Combined (38.2%)
Maccallum & Bryant (2018)	Australia	285	$M = 48.89$ years, $SD = 14.62$ 79.1% Female Gender	Bereaved individuals; medical conditions: 77.3% accident: 12.2% suicide: 9.4% homicide: 1.1%	PGD (PG-13) Depression (BDI)	Mplus (v. 7)	AIC, BIC, SSa-BIC, VLMRT, Entropy	1 High PGD/depression (56.8%); 2 depression class (21.6%); 3 low class (21.6%)
Maccallum & Bryant (2019)	Australia	185	$M = 49.9$ years, $SD = 13.57$ 83.2% Female Gender	Bereaved individuals; medical condition: 78.9%, accident/ suicide/ homicide: 21.1%	PGD (PG-13) PTSD (CAPS)	Mplus (v. 7)	AIC, BIC, SSa-BIC, VMLRT, Entropy	1 PGD/PTSD (37.3%), 2 PGD (30.8%), 3 low symptom (31.9%)
Nickerson et al. (2014)	Australia	248	$M = 38.31$ years, $SD = 14.53$ 52% Female Gender	Mandaean refugees (from Iraq) exposed to trauma and loss; 100% violent loss	PGD (ICG) PTSD (HTQ)	Mplus (v. 6)	AIC, BIC, SSa-BIC, Entropy	1 PTSD/PGD (16%), 2 PTSD class (25%), 3 PGD class (17%), 4 resilient class (43%)
Rees et al. (2017)	Timor Leste	2964	$M = 36.4$ years, $SD = 14.4$ 49% Female Gender	Bereaved survivors of mass conflict; 100% violent loss	PGD (self-developed) PTSD (HTQ) Anger (Community measure of explosive anger)	Mplus (v.7)	AIC, BIC, SSa-BIC, VLMR, LMR, Entropy	1 grief (25%), 2 grief-anger (24%), 3 low symptom (51%)
Soydas et al. (2021)	UK	923	$M = 43.46$, SD=14.45 75.4% Female Gender	Adult homicidally bereaved individuals; 100% violent loss	PGD (ICG) PTSD (IES) Depression (PHQ) Anxiety (GAD-7)	Mplus (v. 8.1.6)	AIC, BIC, SSa-BIC, VLMRT, BLRT, Entropy	1 moderate PGD, PTSD GAD/ low MDD (12%); 2 high PGD, PTSD, GAD/ moderate MDD (43%); 3 high PGD, PTSD, GAD, and MDD (45%)
Tay et al. (2019)	West Papua, Indonesia	486	$M = 35.8$ years, $SD = 0.65$ 44.1% Female Gender	Bereaved refugees from West Papua; violent/non-violent loss not reported	PGD (self-developed) PTSD (self-developed)	Mplus (v. 7)	AIC, BIC, SSa-BIC, VLMR, LMR, Entropy	1 complicated bereavement class (11%), 2 posttraumatic bereavement class (10%), 3 PTSD class (11%), 4 low-symptom class (67%)
Zhou et al. (2018)	China	273	$M = 38.9$ years, $SD = 12.8$ (16 years and older) 57.5% Female Gender	Participants (16 years and older) bereaved > 6 months prior to survey; disease: 92.3%, traumatic: 4.4%, other: 1.8%.	PGD (Prolonged Grief Disorder Scale) Posttraumatic Growth (PTGI)	MPlus (v. 7.11)	AIC, BIC, SSa-BIC, VLMR, BLRT, entropy	1 resilient (38.3%), 2 grief/ growth class (21.7%), 3 growth class (40.0%)

AIC: Aikaike Information Criterion, BIC: Bayesian Information Criterion, BLRT: Bootstrap Likelihood Ratio Test; LMR: Lo-Mendell-Rubin adjusted Likelihood Ratio Test; SSa-BIC: Sample-Size-Adjusted BIC; VMLRT: Vuong-Lo-Mendell-Rubin Likelihood Ratio Test; BDI: Beck Depression Inventory; BSI: Brief Symptom Inventory; CAPS: Clinician Administered PTSD Scale; CESD: Center for Epidemiological Studies Depression; GAD-7: General Anxiety Disorder-7; HADS: Hospital Anxiety and Depression Scale; HTQ: Harvard Trauma Questionnaire, IES: Impact of Event Scale; ICG: Inventory of Complicated Grief; QIDS: Quick Inventory of Depressive Symptomatology; PG-13: Prolonged Grief Disorder-13; PGD: Prolonged Grief Disorder; PHQ: Patient Health Questionnaire; PSS-SR: PTSD Symptom Scale-Self-Reported; PTGI: Posttraumatic Growth Inventory; PTSD: Posttraumatic Stress Disorder; PCL: Posttraumatic Checklist; QUIDS: Quick Inventory of Depressive Symptomatology; SCL: Symptom Checklist; TGI: Traumatic Grief Inventory; UK: United Kingdom; USA: United States of America; WSAS: Work and Social Adjustment Scale; n.r.: not reported.

TGI; Boelen and Smid, 2017; Lenferink et al., 2023), the Prolonged Grief disorder scale ($k = 3$; Boelen, 2012) or self-developed instruments (Rees et al., 2017; Tay et al., 2019).

3.3. Synthesized findings

3.3.1. Mental health indicators

Per inclusion criteria, all 21 reviewed studies used symptoms of PGD and at least one further mental health outcome as indicators in LCA. In addition to PGD symptoms as principal latent class indicators, most studies used either symptoms of PTSD ($k = 5$), depression ($k = 3$), or both ($k = 10$) as further latent class indicators. Other latent class indicators were anxiety symptoms ($k = 2$) and functional impairment items ($k = 1$) in addition to depression and PTSD symptoms (Cozza et al., 2019; Soydas et al., 2021), and anger ($k = 1$) (Rees et al., 2017). By including posttraumatic growth, two studies also examined positive indicators of mental health alongside psychopathology (Kokou-Kpolou et al., 2021a; Zhou et al., 2018).

Of the 21 reviewed studies, nine investigated two mental health outcomes (e.g., PGD and depression) and ten studies investigated three mental health outcomes (all PGD, depression, and PTSD). The remaining two studies investigated four and five mental health outcomes, respectively (Cozza et al., 2019; Soydas et al., 2021).

The number of indicators included in the LCAs ranged between 5 and 50 ($M = 23.8$, SD=10.2). In $k = 15$ studies, the investigators selected a subset of items from the respective mental health instruments. The most common reasons stated for using only a selected number of items was that the sample size limited the number of items that could be included in the LCA, or that the selected subset of items represented criteria according to a specific diagnostic algorithm. The selection rationale was not always conclusive or supported through references.

3.3.2. Extracted classes

Despite using different amount and types of mental health outcomes, in most studies, the final class solution had three classes ($k = 16$, 76.2%), whereas four classes were extracted in four studies (19.0%). Only one study found five classes (Eisma et al., 2019). All ($k = 19$, 90.5%), except for two studies, found a class marked by low symptom severity across most mental health indicators. These classes were termed "resilient", "healthy" or "low symptom" class and their proportion ranged between 13.0 and 76.0% ($M = 35.2\%$, SD $= 18.9$). Similarly, twenty studies (95.2%) found a class characterized by medium to high symptom severity across most investigated mental health indicators. These classes were often labelled "high symptom", "high distress" or "combined" class and their proportion ranged between 10.0 and 56.8% ($M = 30.5\%$, SD $= 11.3$).

Classes were not only distinguishable based on the symptom severity but also on the dominance of a particular mental health outcome. Fourteen out of 21 studies (66.7%) found classes marked by high symptom severity of PGD symptoms and low to medium symptom severity of the other examined mental health outcomes. These classes were labelled "grief", "PGD" or "predominantly PGD" class and their proportion ranged between 11.0 and 55% ($M = 31.2\%$, SD $= 13.0$). Moreover, seven studies found classes where one other mental health outcome was predominant, while the remaining showed low symptom severity: of the 15 studies that included PTSD symptoms as latent class

indicators, four studies (26.7%) found a predominantly PTSD class (Djelantik et al., 2021; Heeke et al., 2017; Nickerson et al., 2014; Tay et al., 2019). Only one of 13 studies (7.7%) that included depression symptoms as LCA indicators, found a depression only class (Maccallum and Bryant, 2018). Both studies that included posttraumatic growth (PTG) as LCA indicators, found a unique posttraumatic growth class (Kokou-Kpolou et al., 2021a; Zhou et al., 2018).

3.3.3. PGD, PTSD, depression

PGD, PTSD, and depression symptoms were the most commonly studied mental health outcomes. Of the ten studies that investigated PGD, PTSD and depression, nine found a three-class solution and one study a four-class solution. Nine studies found a resilient class, nine studies found a combined class marked by medium to high symptom severity across most mental health indicators, and six found a PGD class. Extracted classes that did not fit into these categories comprised a PTSD class ($k = 1$) and six classes with different symptom severities of depression, PTSD and PGD symptoms, e.g. "moderate PGD/low depression/PTSD class".

3.3.4. Violent vs non-violent loss

More than 40% ($k = 9$) of the studies in this systematic review used data collected from mainly survivors of violent loss. Among these, PTSD was the most widely studied mental health syndrome ($k = 7$) followed by depression ($k = 5$), and four studies examined both PTSD and depression in addition to PGD. All but one violent loss study found a "resilient" class and all but one found a "combined/ high symptom" class. Further, seven studies found a PGD class and three found a PTSD class.

Eight studies (38.0%) were conducted with survivors of mainly non-violent loss. Here, depression was the most widely used additional mental health indicator ($k = 6$) followed by PTSD ($k = 5$) and again, four examined both depression and PTSD. All studies in bereaved people after non-violent loss found a "resilient" class and a "combined/ high symptom" class. Five out of eight studies found a PGD class in non-violently bereaved people.

The proportion of the resilient class in the violent loss samples was on average 39.8% (range: 13.4–76%) and in the non-violent loss sample 31.8% (20.6–47.0%). The proportion of the combined/high symptom class among violent loss survivors was on average 28.1% (range: 12.6–45.0%) and in the non-violent loss sample 32.5% (21.0–56.8%).

3.3.5. PGD and posttraumatic growth

Two studies examined positive indicators of mental health, i.e., by including posttraumatic growth (PTG), alongside PGD symptoms. These two studies both identified a three-class solution with a PTG only class, a combined grief/growth class and a resilient/ low-medium growth class (Kokou-Kpolou, et al., 2021a; Zhou et al., 2018). Moreover, the classes were fairly similarly distributed, the growth class encompassed between 32.6 and 40%, the combined class between 21.7 and 36.6% and the resilient/low-medium growth class 30.9 and 38.3%.

3.4. Comparison of methodology

To conduct the LCAs, investigators mainly relied on the software Mplus ($k = 16$, 76.2%), while the remaining used LatentGold ($k = 4$) and Rstudio ($k = 1$). To determine the optimal number of classes, several criteria were taken into account. Fit statistics were the primary source of information for decision-making on the number of extracted classes. All studies used the Aikaike Information Criterion (AIC) and all but one the Bayesian Information Criterion (BIC). Nineteen studies further used the sample size adjusted Bayesian Information Criterion (SSa-BIC). Likelihood-Ratio-Tests, either Vuong-Lo-Mendell-Rubin Likelihood Ratio Test ($k = 8$) or Bootstrap Likelihood Ratio Test ($k = 6$), or both ($k = 2$), were performed in 16 studies. Entropy, an indicator of classification accuracy, was reported by all studies. A secondary source of information for decision-making on model selection were non-statistical criteria, e.g. the principle of parsimony, size and interpretability of classes. These were considered in 13 studies.

After extraction of classes using LCA, twenty studies examined correlates of class-membership. To this end, multinomial regression analyses was the method of choice in 18 studies. In two studies it remained unclear which method was used for examining correlates of class-membership (Cozza et al., 2019; Grafiadeli et al., 2022). When examining the relationship between class-membership and an auxiliary variable, the 3-step approach is recommended in order to take inaccuracy of class assignment into account (Asparouhov and Muthén, 2014). This approach was used in $k = 9$ studies.

Correlates of class membership covered a wide array of topics which restricted comparability between studies. The majority focused on sociodemographic variables (e.g., gender, age and education) and loss-related variables (e.g., recency of loss and relationship to the deceased) to examine relationships with class-membership. A few also examined other variables, such as trauma exposure (Cozza et al., 2019; Heeke et al., 2017; Rees et al., 2017), spirituality/religiosity (Djelantik et al., 2021; Kokou-Kpolou et al., 2021b), or negative cognitions (Boelen and Lenferink, 2019; Maccallum and Bryant, 2019).

3.5. Quality rating

The quality ratings of reporting on LCAs using the Guidelines for Reporting on Latent Class Analyses (GRoLCA) criteria can be accessed in the Supplementary Material. Interrater reliability for the quality rating was 'almost perfect' ($\kappa = 0.88$) (Landis and Koch, 1977). Results show that several aspects have been reported in almost all studies, such as the software used to conduct the LCA ($k = 21$, 100%), whether the model comparison and selection tools were described from a statistical perspective ($k = 21$, 100%), the total number of fitted models ($k = 20$, 95.2%), entropy values ($k = 21$, 100%), and the characteristics of the final class solution ($k = 21$, 100%%). Most studies also informed about how indicators were dichotomized ($k = 20$, 95.2%), but did not always justify their dichotomization decision. The majority included a plot of the final class solution ($k = 18$, 85.7%). In case they did not provide a plot, the probability estimates were provided in a table.

The quality ratings also highlighted areas that were reported with less rigor. Only 12 studies (57.1%) described how missing data were dealt with. Twenty out of 21 studies examined correlates of class-membership, but only nine of them ($k = 9$, 42.9%) corrected for classification error using the 3-step approach. Merely six studies (29%) reported that the dataset was available upon request or through supplemental materials.

Last, studies rarely reported the missing data mechanism ($k = 2$, 9.5%) and what variables were related to missing data ($k = 0$), the number of random start values and final iterations ($k = 1$, 4.8%), the number of cases per class for each model ($k = 2$, 9.5%), or provided plots for all class solutions ($k = 2$, 9.5%). None of the reviewed studies made their syntax file available.

4. Discussion

4.1. Summary of findings

There is a growing interest in examining latent classes of prolonged grief and bereavement-related syndromes in bereaved adults, illustrated by an increasing body of research on this subject since the first publication on symptom-profiles of PGD and related syndromes in bereaved people by Nickerson and colleagues in 2014. The aim of this systematic review was to provide a comprehensive overview of the state of research on LCAs of PGD and other indicators of mental health. We aimed to examine which aspects of mental health have been studied using LCA, and whether the extracted classes were comparable across studies. A secondary aim of this systematic review was to rate the quality of reporting on LCAs in the field of grief.

We reviewed twenty-one studies, including in total 10,338 bereaved adults. In addition to PGD as principal latent class indicators, a range of additional indicators were used, the most common being symptoms of depression and PTSD. Our first main finding was that almost all studies found a resilient class (i.e., low symptomatology across various syndromes) and a combined symptom class (i.e., medium to high symptomatology across various syndromes). This indicates that symptom profiles differed in terms of the severity of symptoms. On average, the "resilient" classes had the highest proportion (35%) and the "combined symptoms" classes the lowest proportion (31%). Low symptom endorsement was thus often the modal response to loss, albeit there was considerable heterogeneity across studies. This aligns with responses after exposure to other potential traumatic events. For instance, a systematic review on longitudinal trajectories of trauma-related responses to major life stressors and potential trauma indicated that most people do not develop long-lasting complaints (Galatzer-Levy et al., 2018). Our findings indicate once more that only a minority of people might be in need of treatment after experiencing a (violent) loss of a loved one.

Moreover, we also found that two thirds of LCAs identified a PGD only class. This further supports the notion that for some bereaved persons, PGD symptoms are the primary and only symptomatic response to loss. Further, it shows that PGD is distinguishable from PTSD and depression. This is in line with factor analytic studies showing that PGD is related to PTSD and depression, and yet forms a distinct construct (Boelen and van den Bout, 2005; Lenferink et al., 2021; O'Connor et al., 2010). Less common were classes characterized by PTSD or depression only, meaning that after a loss, it might be rather an exception that people develop complaints related to depression or PTSD without also endorsing comorbid PGD symptoms. This aligns with research examining reciprocal associations between PGD, PTSD, and depression, which shows that increases in PGD levels precede changes in PTSD and depression levels, and not vice versa (Djelantik et al., 2018; Lenferink et al., 2019; O'Connor et al., 2015). Taken together, these findings indicate that early screening and treatment of PGD may prevent developing long-lasting comorbid symptoms of PTSD and depression.

Furthermore, three out of four studies that found a PTSD only class, were studies conducted among bereaved people who additionally had been exposed to potentially traumatic events in the context of war or state terrorism (e.g., refugees or internally displaced people exposed to loss and trauma). It seems plausible that classes marked by the presence of only PTSD symptoms rather emerge in people exposed to multiple traumatic events. Beyond this finding, no discrepant differences were found in the type and size of extracted latent classes between violent and non-violent loss survivors. It seems therefore warranted to focus on PTSD and PGD in screening and treatment of people who have been exposed to trauma and loss in the context of violent conflicts (de Heus et al., 2017; Eddinger et al., 2021; Smid et al., 2015).

Two studies also investigated a positive aspect of mental health alongside PGD, namely posttraumatic (Kokou-Kpolou et al., 2021a; Zhou et al., 2018). Both studies found comparable classes, including a class marked by the presence of both PGD and PTG symptoms. These

results indicated that grief-related distress and the experience of positive life changes after a loss can occur at the same time and are not mutually exclusive, which mirror findings on latent symptom-profiles of PTSD and PTG found in non-bereaved trauma-exposed samples (Shin et al., 2023; Zhou et al., 2020).

4.2. Quality rating

The quality rating using the GRoLCA highlighted that most studies reported key information, including, among others, the software used to conduct the LCA, model comparison and selection tools, and the characteristics of the final class solution. Other areas were inconsistently or poorly reported. Almost half of studies did not report on how missing data on LCA indicators or on correlates of class-membership were dealt with. Some studies did not have missing data, but in these cases it is recommended to report a 100% response rate as was done in some studies (Grafiadeli et al., 2022; Tay et al., 2019). Those who provided a description on how missing data was dealt with used listwise case-deletion (i.e., complete case-analysis) (Cozza et al., 2019; Djelantik et al., 2020; Kokou-Kpolou et al., 2021a) or used Full Information Maximum Likelihood Estimation (e.g., Eisma et al., 2019; Nickerson et al., 2014; Soydas et al., 2021). The latter is recommended and implemented within the most commonly used software for LCAs (Muthén and Muthén, 1998–2017).

While almost all studies reported how they dichotomized LCA indicators, not all studies provided justification for their approach. Some authors dichotomized total scales (e.g., threshold of 30 on Inventory of Complicated Grief) or subscales using a cut-off to reduce the number of indicators, leading to loss of information. Most rated the highest three answer options on a 5-point Likert scale as symptom present, while a few used the highest 2 answer options as indication of symptom endorsement. For depression, indicators often had a 4-point scale that was recoded such that the two highest scores reflected symptom endorsement, however one study deviated from this and used the highest three answer options as symptom presence (Maccallum and Bryant, 2018). Discrepancies across studies in how scales were dichotomized likely affect the outcomes and thus limit the comparability of LCA findings. A universal dichotomization approach of LCA indicators is desirable to facilitate comparability of results for future studies.

Only six studies reported about the availability of their dataset (Grafiadeli et al., 2022; Heeke et al., 2022, 2017; Kokou-Kpolou et al., 2021a; Rees et al., 2017; Zhou et al., 2018). It would be desirable that authors include a data availability statement to increase transparency.

In summary, for full transparency and replicability, good reporting is essential. Reporting guidelines, such as the guidelines developed and used in this systematic review (i.e., GRoLCAs), might help researchers to increase the quality of reporting and might allow other researchers to comprehend decision making and allow for replicability. The high level of agreement in the quality rating of studies included in this systematic review demonstrates that the GRoLCAs can be easily applied to aid the quality of reporting.

4.3. Methodology

There were several sources of inconsistencies regarding the methodology of the LCAs. Even though all authors stated which fit indices they used to select classes, details of model specification and selection were not always explicitly stated and discrepancies across studies regarding the number and type of fit indices were observed. While all studies used at least two fit information criteria (i.e., AIC, BIC, sample-sized adjusted BIC) and all reported the accuracy of classification via entropy, less consistency was observed in the use statistical tests, such as Likelihood Ratio Tests, which indicate whether one model is statistically better than a model with one less class. A further source for decision-making were non-statistical criteria such as the size and interpretability of classes, which were reported by about 60% of the studies.

Particularly in cases of ambiguous results between the different fit statistics as well as the non-statistical criteria, it is essential for study authors to state the reasons for opting for a certain class solution and to discuss why alternative solutions were disregarded. Providing plots of all class solutions, including alternative solutions, further helps the reader to understand reasons for model selection. Plots of all class solutions were, however, only presented in two studies included in this review; it is recommended to include plots of all class-solutions in standard reporting of LCA to facilitate transparent research practices.

Furthermore, LCA models comprised anywhere between 5 and 50 indicators. In various studies, items from mental health scales were collapsed or left out without a conclusive rationale. The choice of indicators is constitutive for model identification and an arbitrary selection of items thus reduces comparability between studies. In cases of a small sample size limiting the number of indicators that can be integrated in the LCA, the choice of indicator variables should have a theoretical basis (Weller et al., 2020). Authors are thus advised to closely follow prior research or diagnostic guidelines (DSM-5 or ICD-11) when reducing the number of indicators considered for an LCA. Many PGD scales published so far assess the presence of more items than mandatory according to either of the classification systems. For PTSD, ICD-11 relies on only six criteria in comparison to 20 criteria needed for assessing DSM-5 PTSD, which provides another possibility to reduce the number of indicators. In any case, authors should report all models that have been tested in the supplementary material.

One further source of inconsistencies is the labeling of latent classes, which is subjectively assigned by investigators. Similar labels may be given to classes merely because previous research exists that used these labels even though classes might be very different. Study authors might also favor catchy labels that oversimplify results, e.g. by labeling a class "resilient", while not only low but also moderate probability estimates were found for PGD and PTSD symptoms. Consequently, researchers should take a closer look at item probabilities as labels given to latent classes may be misleading. In summary, in addition to using reporting guidelines such as the GRoLCAs, authors would benefit from considering best practice guidelines for conducting and interpreting LCAs (e.g., Weller et al., 2020).

4.4. Limitations

Several limitations should be taken into account when interpreting the results of this systematic review.

Within the included studies, a range of instruments to assess PGD were used that differ with regard to number and content of symptoms. This is not surprising, given that PGD criteria were recently added to the most recent editions of the DSM and ICD, but it remains to be studied whether this has affected the comparability of our findings across studies using different conceptualizations and measures for PGD. Furthermore, investigators often selected a subset of items from a mental health instrument to conduct their LCA. Both reasons affect the model identification and thus limit the comparability of study results. Moreover, most studies were conducted with self-selected samples, which reduces the generalizability of findings. The type and number of examined correlates of class-membership differed extensively across studies, which did not allow us to provide a systematic overview of correlates of class-membership. Furthermore, all studies included a cross-sectional design, which precluded us to draw conclusions about stability of latent classes over time. Longitudinal latent class analyses, such as latent transition analysis (Lenferink et al., 2022; Wen et al., 2022), are needed to shed light upon stability of the latent classes. On a general note, this review may be limited with regard to publication bias and selection of studies for inclusion. Studies with negative results, i.e. when LCAs did not converge, may not have been published. Some important publications may have been missed due to the choice of data bases that were consulted for this literature search.

4.5. Conclusion

This is the first systematic review that provides a comprehensive overview of LCAs on PGD and other indicators of mental health in bereaved adults. We noticed a high diversity in the included studies regarding, among others, type of loss (violent vs natural loss), country of data assessment, instruments to measure PGD, and choice of indicators and correlates of class-membership. Despite this diversity, we found that several identified types of latent classes were comparable across studies and that almost all studies found a resilient and a combined psychopathology class. Moreover, two thirds of studies identified a particular PGD class. This review further showed that most studies reported key information related to the execution of LCAs, but also uncovered areas for optimizing reporting. We thus provided reporting guidelines that might help to improve reporting.

Understanding the heterogeneity of responses to loss and the respective clinical manifestations is crucial to develop tailored treatment approaches. Promising research exists on the co-treatment of PGD and PTSD using cognitive therapy combined with eye movement desensitization and reprocessing (EMDR) or exposure-based interventions (Eddinger et al., 2021; Lenferink et al., 2020; van Denderen et al., 2018); nonetheless, outcomes have yielded heterogenous findings. Some Randomized Controlled Trials (RCTs) investigating grief-specific Cognitive Behavioral Therapy (CBT) included depression as secondary outcome and reported significant reductions in depressive symptoms (Bryant et al., 2014; Rosner et al., 2015). There is also potential in expanding existing transdiagnostic interventions, e.g. Common Elements Treatment Approach (CETA; Murray et al., 2014) or Unified Protocol (Farchione et al., 2012), to the treatment of PGD. Transdiagnostic interventions focus on shared underlying mechanisms of mental disorders but also allow for component selection, sequencing and dosage adjusted to the patient's symptom presentation and comorbidity.

Whereas LCAs have thus far been used as an exploratory analysis approach, future research could build upon the results of this systematic review by using confirmatory LCA (CLCA) to test specific hypotheses about the nature and number of latent classes (see also Finch and Bronk, 2011). Furthermore, it would be favorable for future research to make use of the identified classes to study whether latent classes predict changes of distress over time and differential responses to treatment.

Supplementary material

Supplementary Material 1: Adapted Guidelines for Reporting on Latent Class Analyses (GRoLCA) Checklist

Supplementary Material 2: Quality ratings using Guidelines for Reporting on Latent Class Analyses (GRoLCA)

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Contributors

CH, and LL designed the study and wrote the protocol. CH and MF discussed inclusion and exclusion criteria, conducted the literature search, and screening and inclusion of articles. Data were extracted and coded by CH and MF. LL and CH conducted the risk of bias rating. CH drafted the manuscript in collaboration with LL. The manuscript was critically revised by CK and MF. All authors contributed to and have approved the final manuscript.

Data availability statement

The data used to support the findings of this study can be found in an online repository at https://osf.io/qswa4

Declaration of Competing Interest

The authors declare having no competing interests.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jadr.2023.100654.

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