An Evaluation of the Structure, Comorbidity, and Correlates of Posttraumatic Stress Responses in Older Adults Across Multiple National Samples

Robert Fox, B.A. (Hons)

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Head of Department: Prof. Andrew Coogan

Research Supervisors: Dr. Philip Hyland, Dr. Joanna McHugh Power, & Prof. Andrew Coogan

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Summary

Posttraumatic stress disorder (PTSD) and complex PTSD (CPTSD) are often chronic and debilitating conditions that can cause significant impairment in an individual's personal, professional, and social life. However, research pertaining to posttraumatic stress responses among older adults is lacking. The present thesis aimed to address this gap in the literature by evaluating the structure, psychiatric comorbidity, and correlates of posttraumatic stress responses among older adults. The most contemporary models of PTSD (as outlined in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* [*DSM-5*] and the eleventh version of the *International Classification of Diseases* [*ICD-11*]) provided a valid representation of PTSD among older adults. Four *DSM-5* symptoms demonstrated sex item-bias, with females being more likely to endorse three symptoms (B1: 'unwanted memories', B4: 'feeling upset', and E6: 'sleep problems') and males being more likely to endorse one symptom (E2: 'reckless or self-destructive behaviour'). Alternatively, there was no evidence of item-bias for the six *ICD-11* symptoms. Regarding comorbidity, a dimensional framework of psychopathology was successful in accounting for the psychiatric comorbidities of PTSD. More specifically, evidence supported the existence of two distinct subtypes of *ICD-11* PTSD psychiatric comorbidity classes among older adults, with the higher comorbidity class being associated with a history of attempted suicide. In terms of PTSD/CPTSD correlates, evidence of longitudinal relationships between subtypes of loneliness (social and emotional) and PTSD, and cross-sectional relationships between loneliness and CPTSD symptoms were found in older adults. These results have important implications for both research and clinical practice regarding the assessment and treatment of PTSD and CPTSD in later life. These findings imply that the current diagnostic models of PTSD are applicable in older adults; identify the psychiatric

disorders that are likely to manifest alongside PTSD in later life; and highlight loneliness as a clinically meaningful construct among trauma-exposed older adults.

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List of Abbreviations and Symbols

<	Less than
=	Equal to
>	Greater than
≤	Less than or equal to
≥	Greater than or equal to
2PL	2-parameter logistic model
2W-LCS	Two-wave latent change score
ACE	Adverse Childhood Experiences questionnaire
AIC	Akaike information criterion
Anh	Anhedonia
Anx-Ar	Anxious arousal
APA	American Psychiatric Association
ASD	Acute stress disorder
ASPD	Antisocial personality disorder
AUD	Alcohol use disorder
AUDADIS	Alcohol Use Disorder and Associated Disabilities Interview Schedule
Av	Avoidance
BIC	Bayes information criterion
BPD	Borderline personality disorder
CAPI	Computer-assisted personal interviewing
CAPS	Clinician Administered PTSD Scale
CBT	Cognitive Behaviour Therapy
CFA	Confirmatory factor analysis
CFI	Comparative Fit Index
CI	Confidence interval
CPT	Cognitive Processing Therapy
CPTSD	Complex posttraumatic stress disorder
d	Cohen’s d
df	Degrees of freedom
DIF	Differential item functioning

DSM	Diagnostic and Statistical Manual of Mental Disorders
DSO	Disturbances in Self-organisation
DUD	Drug use disorder
Dys	Dysphoria
Dys-Ar	Dysphoric arousal
EB	Externalised behaviour
ED	Eating disorder
EL	Emotional loneliness
EPC	Expected parameter change
F	Test statistic for Rao-Scott second-order correction
FIML	Full information maximum likelihood
GAD	Generalised anxiety disorder
HiTOP	Hierarchical Taxonomy of Psychopathology
Hyp	Hyperarousal
ICC	Item characteristic curve
ICD	International Classification of Diseases
Int	Intrusions
IQ	Intelligence quotient
IRT	Item response theory
ISEL-12	12-item Interpersonal Support Evaluation List
ITQ	International Trauma Questionnaire
LASA	Longitudinal Aging Study Amsterdam
LCA	Latent class analysis
LCS	Latent change score
LEC-5	Life Events Checklist for DSM-5
LMR-A	Lo–Mendell–Rubin adjusted likelihood ratio test
LRT	Likelihood ratio test
LSN	Living Arrangements and Social Networks study
M	Mean
MDD	Major depressive disorder
Mdn	Median

MI	Modification index
MIMIC	Multiple indicators multiple causes
MLR	Maximum likelihood estimator
n	Sample size
NACM	Negative Alterations in Cognitions and Mood
NCP	Noncentrality parameter
NCS-R	National Comorbidity Survey Replication study
NESARC	National Epidemiologic Survey on Alcohol and Related Conditions
NIAAA	National Institute on Alcohol Abuse and Alcoholism
OR	Odds ratio
p	P-value
PD	Personality disorder
PRISM-5	Psychiatric Research Interview for Substance and Mental Disorders, DSM-5 version
PSU	Primary sampling units
PTSD	Posttraumatic stress disorder
PTSS	Posttraumatic stress symptoms
r	Pearson's correlation coefficient
Re	Re-experiencing in the present
REBT	Rational Emotive Behaviour Therapy
Recent NLE	Recent negative life events
RMSEA	Root Mean Square Error of Approximation
SD	Standard deviation
SE	Standard error
SEM	Structural equation modelling
SES	Socio-economic status
SL	Social loneliness
SPD	Schizotypal personality disorder
SRIP	Self-Rating Inventory for Posttraumatic Stress Disorder
SRESC	Social Research Ethics Subcommittee
ssaBIC	Sample size-adjusted Bayes Information Criterion

SSU	Secondary sampling units
SUD	Substance use disorder
t	Test statistic for t-test
T1	Time 1
T2	Time 2
Th	Sense of current threat
TLI	Tucker-Lewis Index
U.K.	United Kingdom
U.S.	United States
VU	Vrije Universiteit
WHO	World Health Organization
WLSMV	Robust weighted least squares estimator
Z	Z-score
α	Cronbach's alpha; Significance level (probability of Type I error)
B	Unstandardised regression coefficient
β	Standardised regression coefficient
Δ	Change/difference in value
δ	Deviation
μ	Mean
ρ	Spearman's rank-order correlation coefficient
ρ_c	Composite reliability
σ^2	Variance
χ^2	Chi-square

Publications Arising from this Thesis

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Chapter 1

Introduction

1.1. Mental Health in Older Adults

The global population is rapidly aging with the number of older adults (taken to be those aged 60 years and older, according to the World Health Organization [WHO, 2017]) expected to nearly double from 12% in 2015 to 22% in 2050 (WHO, 2017). Research among older adults tends to focus on physical and cognitive trends in later life, with less emphasis being placed on mental health (Thomas et al., 2016). This has led to a relatively underdeveloped literature on psychiatric disorders among older adults, in comparison to their younger counterparts.

An interesting phenomenon observed among older adults is that despite cognitive and physical health often declining with age, epidemiological research indicates that mental health often improves in later life (Gum et al., 2009; Kessler et al., 2005; Thomas et al., 2016). A possible reason for this decline in psychiatric morbidity is that adults tend to display higher levels of resilience as they grow older (MacLeod et al., 2016). Resilience can be defined as a positive response to adversity or stressors (Angevaare et al., 2020). This may be due to older adults exhibiting better emotion regulation skills and problem-solving behaviours when faced with adverse or stressful situations, compared to younger adults (Gooding et al., 2012; Grossmann et al., 2010).

Older adults also display a greater tendency to favour positive over negative stimuli, referred to as the ‘positivity effect’, whereby they attend to more positive material and demonstrate positive biases in memory (Kennedy et al., 2004; Reed & Carstensen, 2012). This may partially explain the improved mental health observed in older adults (Thomas et al., 2016).

Additionally, improved mental health in later life can be explained through the Selective Optimization with Compensation (SOC; Baltes & Baltes, 1990) model of aging. This model posits that older adults choose fewer but carefully selected goals to focus on, optimise their resources to aid in attaining these goals, and compensate for losses, such as age-related resource losses, by adapting to biological, psychological, and socio-economic changes (e.g., through the use of assistive devices). This allows older adults to effectively maximise their gains and minimise their losses and can aid in reducing the negative impact of stressors and adverse events in later life (Ouwehand et al., 2007).

Much of the research on psychiatric morbidity in older adults focuses on mood and anxiety disorders. For example, there have been measures designed to specifically target depressive and anxiety symptoms in older adults (see Lutz et al., 2018). However, research pertaining to posttraumatic stress responses, such as posttraumatic stress disorder (PTSD), in later life is lacking. PTSD is one of the few disorders which requires the occurrence of an external event (i.e. trauma exposure) within its diagnostic requirements. As people age, they are more likely to have experienced a traumatic event (and possibly cumulative trauma exposure), simply due to the fact that they are living longer. This could plausibly be assumed to lead to increased rates of PTSD among older adults (Cook & Simiola, 2018), however, PTSD follows the same trend as many other forms of psychopathology in that it also decreases in later life (Gum et al., 2009; Kessler et al., 2005; Reynolds et al., 2016). This raises interesting questions about the nature of PTSD in later life and the reasons for observed declines in PTSD with older age. For example, whether these differences are entirely quantitative (e.g. PTSD rates are lower due to the resiliency of older adults) or qualitative (e.g. PTSD manifests differently in older adults, compared to younger adults). As such, it is important that research is conducted among older adults in order to better understand the nature of PTSD in later life.

1.2. Overview and History of PTSD

Trauma as a term has evolved in its meaning over the past two centuries. Etymologically, the term “trauma” was initially used to refer to physical wounds or injuries, but its contemporary meaning is typically taken as referring to a psychological equivalent. In the psychological literature, then, historical accounts of traumatic exposure and discussions relating to the effects of trauma seem to have originated in the context of warfare wherein soldiers exhibited posttraumatic reactions such as confusion and memory impairment (Andreasen, 2010, 2011). These reactions were initially ascribed to physiological effects such as exposure to explosions leading to concussion (Andreasen, 2011), or subtle molecular changes in the central nervous system leading to increased cardiovascular problems (van der Kolk, 2007), ultimately resulting in conditions such as “shellshock” and “soldier’s heart”. Although the discussions of posttraumatic reactions being the result of organic versus psychological origins of traumatic stress often related to warfare, similar cases were also noted in civilians following railroad accidents, referred to as “railroad spine” (van der Kolk, 2007). Attributing traumatic stress to organic causes among soldiers may have served an additional purpose of offering soldiers an honourable means of explaining psychological breakdowns in times of war, most notably among wars such as World War I where claims of desertion and cowardice could result in one being condemned to death (van der Kolk, 2007). Despite records of posttraumatic reactions dating as far back as 4,000 years ago (Ben-Ezra, 2004), it wasn’t until the mid-late 19th century that the concept of trauma began to include psychological trauma (Figley et al., 2017). Only after World War II were the effects of psychological trauma widely recognised, researched, and treated by psychiatrists (van der Kolk, 2007).

Psychological traumatic exposure, defined by the WHO (2018) as being an extremely threatening or horrific event or series of events, is relatively common in the general population. For example, Benjet et al. (2016) reported a lifetime prevalence rate of 70.4% across 24 countries. The long-term sequelae of being exposed to a traumatic event can have severe deleterious effects on an individual’s health, such as subsequent development of PTSD. PTSD is an often chronic and debilitating condition that can cause significant impairment in an individual's personal, professional, and social life (Bryant et al., 2016; Donahue et al., 2017; Karam et al., 2014; Scott et al., 2015).

PTSD, like many other psychiatric disorders, has undergone many revisions throughout the different iterations of the *International Classification of Diseases* (*ICD*) and *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*). These revisions have included the addition and removal of symptoms, changes to the definition of traumatic experiences, and changes to the number and composition of symptom clusters. It is important to be aware of these revisions throughout the different taxonomies in order to more accurately interpret the literature pertaining to PTSD, and to accurately interpret the variation observed in prevalence rates of PTSD (e.g. Heeke et al., 2020; Kilpatrick et al., 2013; O'Donnell et al., 2014).

1.2.1. DSM models

In the first version of the *DSM* (American Psychiatric Association [APA], 1952), the term "gross stress reaction" was used to describe a psychiatric condition which resulted from extreme emotional stress related to either combat-related trauma or catastrophic trauma (e.g. natural disasters) that occurred in civilian settings. This condition was a likely precursor to PTSD formed in later versions of the *DSM* (Andreasen, 2010). This disorder was subsequently omitted from the *DSM-II* (APA, 1968).

PTSD was then introduced into the psychiatric nomenclature in the *DSM-III* (APA, 1980) following intense pressure from Vietnam veterans' advocacy groups to include a diagnosis that reflected the psychological effects of war observed among Vietnam veterans (Andreasen, 2011). In the *DSM-III*, PTSD was categorised as an anxiety disorder that consisted of 12 symptoms reflecting the 'Re-experiencing of the traumatic event', 'Numbing of responsiveness', and 'Avoidance and Hyperarousal'. The traumatic event was also defined as a "psychologically traumatic event that is generally outside the range of usual human experience" (APA, 1980, p. 236) and had to be of such severity that it would likely result in significant symptoms of distress in almost everyone.

The codification of PTSD for the revised edition of the *DSM-III* (*DSM-III-R*; APA, 1987) was expanded to represent a broader spectrum of responses to trauma. The *DSM-III-R* model of PTSD consisted of 17 symptoms clustered into three groups that represented 'Re-experiencing', 'Avoidance and Numbing', and 'Hyperarousal'. In addition, these symptoms were also required to be present for at least one month. However, the type of traumatic event experienced no longer had to be of a severity that would likely result in distress in almost everyone.

The *DSM-IV* (APA, 1994) expanded the definition of a sufficient traumatic experience to be diagnosed with PTSD to include witnessing a traumatic event. Additionally, the number of symptoms in each symptom cluster were altered and it was now specified that these symptoms must cause clinically significant distress or functional impairment. The diagnostic algorithm remained unchanged in the revised version of the *DSM-IV* (*DSM-IV-TR*; APA, 2000).

One of the most substantial conceptual changes to the definition of PTSD came in the *DSM-5* (APA, 2013). PTSD was reclassified from an anxiety disorder to a new category entitled 'trauma and stressor-related disorders'. This diagnostic category is distinguishable from other psychiatric categories in that it requires the experience of a stressful event as a precondition for diagnosis. The *DSM-5* classification of PTSD redefined traumatic exposure in terms of directly experiencing, witnessing, or learning about a stressful event involving "exposure to actual or threatened death, serious injury, or sexual violence" (APA, 2013, p. 271).

Based on factor analytic data (Friedman et al., 2011), and item response theory analyses (see Friedman, 2013), the structure of PTSD in the *DSM-5* was then expanded to include 20 symptoms distributed across four symptom clusters reflecting 'Intrusions' (e.g. recurrent, involuntary, and intrusive memories or dreams about the event), 'Avoidance' (e.g. internal or external reminders such as thoughts or locations reminiscent of the event), 'Negative Alterations in Cognitions and Mood' (NACM; e.g. persistent negative cognitions about the self, the world, and others), and 'Hyperarousal' (e.g. sleep disturbances, aggressive or self-destructive behaviour, and hypervigilance). In order to meet the diagnostic requirements of PTSD in the *DSM-5*, an individual must meet the following criteria: experience a traumatic event as defined by the *DSM-5* (criterion A); endorse the appropriate number of symptoms in the 'Intrusion' cluster (criterion B), 'Avoidance' cluster (criterion C), 'NACM' cluster (criterion D), and 'Hyperarousal' cluster (criterion E); the symptoms must be present for more than one month (criterion F); the symptoms cause clinically significant distress or functional impairment (criterion G); and these symptoms cannot be attributable to the physiological effects of a medical condition or substance abuse (criterion H). This new diagnostic model of PTSD had a mixed reception, as it was praised for its rigorous design-making process based on empirical evidence (Weathers, 2017), but also criticised for being excessively complex and argued to be unwarranted (Hoge et al., 2016; Weathers, 2017).

1.2.2. ICD models

The *ICD* is a similar classification to that of the *DSM*, in that it provides a diagnostic structure to a vast array of psychiatric disorders. However, there are differences among certain psychiatric disorders (e.g. PTSD) whereby the symptom and diagnostic structure are quite distinct from one another. The *ICD* is the official world classification system with its intended goal, since its initial conception in 1900, to be globally applicable (Tyrer, 2014). Whereas the *DSM* was intended to be the official diagnostic classification system of the United States (U.S.) (Tyrer, 2014). However, the *DSM* is now used globally for research purposes.

PTSD was first introduced into the *ICD* classification system in the tenth version (*ICD-10*; WHO, 1993). Similar to the *DSM*, the *ICD-10* model of PTSD required that the traumatic/stressful event experienced be catastrophic or threatening in nature and likely to cause pervasive distress in almost anyone. To receive a diagnosis, an individual was also required to exhibit symptoms of re-experiencing the traumatic event, avoidance of trauma reminders, and symptoms related to either hyperarousal or the inability recall certain aspects of the traumatic event. The *ICD-10* also required that these symptoms were present within six months following the stressful event. However, the *ICD-10* did not specify a minimum duration of symptoms, nor was functional impairment a requirement for diagnosis.

For the 11th version of the *ICD* (*ICD-11*; WHO, 2018), the WHO approached revision efforts for mental and behavioural disorders with three goals in mind (Maercker et al., 2013): (1) to maximize clinical utility by simplifying assessment and diagnosis; (2) to reduce diagnostic heterogeneity; and (3) to reduce diagnostic comorbidity. To achieve these goals, the WHO instructed working groups for the various mental and behavioural disorder categories to focus diagnostic guidelines on a small set of core symptoms indicative of each disorder.

Consequently, the release of the *ICD-11* marked one of the most radical changes to the field of traumatic stress studies since the emergence of PTSD in the *DSM-III*. The *ICD-11* classified PTSD as a ‘disorder specifically associated with stress’ (code 6B40). To avoid the numerous problems associated with the *DSM*’s approach of providing a specific definition of a traumatic event (Hyland, Karatzias, Shevlin, McElroy et al., 2020), the *ICD-11* provides a broad guidance statement that a diagnosis of PTSD may be considered ‘following exposure to an extremely threatening or horrific event or series of events’. PTSD is characterised by six symptoms distributed across three core symptoms clusters including ‘Re-experiencing in the here and now’, ‘Avoidance’, and ‘Sense of Current Threat’. ‘Re-experiencing in the here and now’ refers to symptoms of vivid intrusive memories/flashbacks and distressing dreams where the person feels that they are reliving the trauma in the present. The ‘Avoidance’ cluster includes symptoms akin to those in the *DSM-5* reflecting avoidance of internal (e.g., thoughts and memories) and external (e.g., locations or activities) reminders of the event. The ‘Sense of Current Threat’ cluster includes symptoms of persistent hypervigilance and hyperarousal. To meet the diagnostic criteria for *ICD-11* PTSD, an individual must have experienced a traumatic event, must endorse at least one of two symptoms from each of the three clusters, must have experienced these symptoms for several weeks following traumatic exposure, and the symptoms must cause functional impairment.

The *ICD-11* also contains a sibling disorder to PTSD, complex PTSD (CPTSD; WHO, 2018) (code 6B41), which typically arises in response to prolonged/repeated exposure to traumatic stressors, especially those of an interpersonal nature and from which escape is difficult or impossible (e.g., childhood abuse, torture). Although previous iterations of CPTSD have been proposed (Herman, 1992) and similar diagnostic descriptions of CPTSD existed in the *DSM-IV* under ‘Disorders of Extreme Stress Not Otherwise Specified’ (DESNOS; Pelcovitz et al., 1997), this is the first official recognition of CPTSD within the psychiatric diagnostic nomenclature. In line with the *ICD-11*’s goals of improving clinical utility, reducing diagnostic heterogeneity, and reducing comorbidity, the *ICD-11* model of CPTSD focuses on a small set of core symptoms (Brewin et al., 2017). CPTSD is described in terms of 12 symptoms which is substantially shorter than the conceptually similar DESNOS which included 48 symptoms.

CPTSD includes the six core symptoms of PTSD and additional six symptoms reflecting 'Disturbances in Self-organisation' (DSO). These DSO symptoms are represented by three clusters (encompassing two symptoms per cluster): 'Affective Dysregulation' (e.g. hyper- or hypo-affective responses), 'Negative Self-concept' (e.g. feeling worthless), and 'Disturbances in Relationships' (e.g. finding it difficult to stay emotionally close to others). In order to meet the diagnostic requirements for CPTSD, an individual must meet the requirements for PTSD and also endorse at least one symptom from each DSO symptom cluster. Additionally, these symptoms must cause significant functional impairment. As per the *ICD-11* taxonomic structure, a person may only be diagnosed with PTSD or CPTSD, not both. Thus, if a person meets the diagnostic criteria for CPTSD that person does not also receive a PTSD diagnosis (i.e. the CPTSD diagnosis takes precedence).

A multitude of empirical studies which explore the patterns of symptomatology among clinical populations have found support for the *ICD-11* model of PTSD using a range of statistical approaches including factor analysis, latent class/profile analysis, and network analysis (for a comprehensive review see Brewin, 2020; Brewin et al., 2017). Moreover, prior studies using network analysis (Knefel et al., 2020), confirmatory factor analysis (Hyland, Shevlin, Elklit et al., 2017; Karatzias et al., 2016; Vallières et al., 2018), and latent class analysis (Cloitre et al., 2014; Karatzias et al., 2017) have found evidence for the construct validity of CPTSD and its discriminant validity from PTSD.

1.2.3. Alternative models of DSM-5 and ICD-11 PTSD

Prior factor analytic research has been conducted to ascertain the most appropriate latent structure of PTSD symptoms that encapsulates a sufficient representation of the psychiatric disorder. However, the precise composition of symptom clusters has been a subject of debate, with research suggesting alternative models, using the 20 symptoms outlined in the *DSM-5*, that range from four- to seven-factors (Armour et al., 2015; Elhai et al., 2011; Liu et al., 2014; Miller et al., 2013; Tsai et al., 2014; Zelazny & Simms, 2015). Determining the most accurate latent structure of PTSD is an important step in determining the most appropriate diagnostic structure of PTSD. A discordance between the diagnostic requirements and the latent structure of PTSD may result in inaccurate diagnostic estimates (Shevlin et al., 2017).

It has also been posited that the latent structure of the six *ICD-11* PTSD symptoms might be more accurately represented by a one-factor (Glück et al., 2016) or two-factor (Forbes et al., 2015) model. Evidence has generally favoured the three-factor *ICD-11* model of PTSD with the alternative one- and two-factor models exhibiting mixed findings (see Brewin et al., 2017).

1.2.4. Psychometric properties and clinical utility of DSM-5 and ICD-11 PTSD

Comparing the *DSM-5* and *ICD-11* models of PTSD within the same sample is an important aspect in determining if one model should be preferred over the other. Hansen and colleagues (2015) aimed to address this issue by comparing a number of different models of PTSD, including the *DSM-5* and *ICD-11* models among seven samples that had each been exposed to a different type of traumatic event. The findings revealed that the *ICD-11* model provided excellent statistical fit in six of the seven samples whereas the *DSM-5* model demonstrated poor fit in all samples.

Although comparing the psychometric properties of any diagnostic model is an important aspect underpinning evidence for, or against, any classification, as stated above it is also important to consider other aspects such as the clinical utility of the model. A major strength of the *ICD-11*'s use of fewer symptoms to obtain a more parsimonious representation of PTSD is that it addresses criticisms towards the *DSM* models of PTSD. These criticisms are that there are too many possible permutations of symptoms that meet the requirements for a diagnosis of PTSD, leading to heterogeneous symptom profiles (Galatzer-Levy & Bryant, 2013). More specifically, Galatzer-Levy and Bryant (2013) identified that there are 636,120 possible symptom combinations for a *DSM-5* PTSD diagnosis, whereas there are only 27 possible symptom combinations for a diagnosis following the *ICD-11* criteria (Shevlin, Hyland, Vallières et al., 2018). The high number of symptom combinations in the *DSM-5* framework can result in difficulty when developing interventions to treat PTSD. The *ICD-11*'s focus on using fewer symptoms can address this limitation and makes the development of broadly applicable interventions more likely.

Both the *DSM-IV* (Rosen et al., 2008) and *DSM-5* (Hoge et al., 2016) models of PTSD have been criticised for over-pathologizing traumatic reactions. This may be due, in part, to symptom overlap with other diagnoses such as major depression, borderline personality disorder, and generalized anxiety disorder that are misattributed to PTSD (Pai et al., 2017). For example, *DSM-5* PTSD symptoms such as intrusive memories, difficulty concentrating, negative self-concept, and sleep problems may actually reflect depressive symptomology and not PTSD. Focusing on the core symptoms that represent PTSD in the *ICD-11* model should, in theory, address this criticism and reduce misdiagnosis.

Throughout all of these iterations of the *DSM* and *ICD*, there is an implicit assumption that these models are applicable across the entire adult population. That is to say that these models assume that PTSD manifests in exactly the same way in younger and older adults. If this is the case, then much of the literature pertaining to PTSD among the general population can be extended to older adults. Additionally, when confronted with data that the occurrence of PTSD is lower in older adults than in younger adults, these models imply that such variation is most likely due to older adults being more resilient than younger adults. However, if it is the case that PTSD manifests in a unique and distinct manner among older adults, it would suggest that a different set of diagnostic requirements would be needed. Furthermore, if PTSD is qualitatively different between younger and older adults, it would suggest (1) that much of the existing literature research pertaining to PTSD is not applicable to older adults, and (2) the lower observed rates of PTSD in older adults may be due to a measurement error, not a greater resilience to traumatic distress in this cohort.

1.3. Prevalence Rate of PTSD

Section 1.2 makes it clear that there is considerable heterogeneity across classification systems meaning that interpretation of PTSD prevalence rates across the existing literature requires careful analysis. Based on findings from the World Mental Health survey project which used data from 20 countries, the average 12-month prevalence rate of PTSD was 1.1% (Karam et al., 2014). Despite this low rate of PTSD, the average number of traumatic events experienced, per person, across the different countries was 3.2 (Kessler et al., 2017). The conditional risk of PTSD following any form of trauma exposure was 4.0% (Liu, Petukhova et al., 2017).

However, the prevalence rate of PTSD can fluctuate greatly depending on the timeframe of assessment (i.e. lifetime or 12-month prevalence rates), method of assessment (self-report assessment or clinician-administered interview), classification system used (i.e. *DSM* or *ICD*), and between countries (Hoffman et al., 2011). Table 1.1 provides an overview of the PTSD prevalence rates across nations from numerous studies.

1.4. Epidemiology of PTSD in Older Adults

Empirical evidence from epidemiological studies investigating the prevalence of PTSD across different age-groups suggests that the prevalence rates of PTSD may be lower among older adults, relative to rates among those under the age of 60. The results of a nationally representative U.S. epidemiological study (Reynolds et al., 2016) found that 12-month PTSD prevalence was significantly higher for younger adults aged 20-34

Table 1.1
Prevalence rates of PTSD across countries where data are available.

Country	Prevalence rate (%)	Type	Classification	Study
Algeria	37.4	Lifetime	DSM-IV	de Jong et al., 2001
Australia	1.3	12-month	DSM-IV	Creamer et al., 2001*
Belgium	0.6	12-month	DSM-IV	Karam et al., 2014*
Brazil	1.0	12-month	DSM-IV	Karam et al., 2014*
Bulgaria	0.9	12-month	DSM-IV	Karam et al., 2014*
Cambodia	28.4	Lifetime	DSM-IV	de Jong et al., 2001*
Canada	2.4	1-month	DSM-IV	Van Ameringen et al., 2008*
Canada	9.2	Lifetime	DSM-IV	Van Ameringen et al., 2008*
Chile	4.4	Lifetime	DSM-III-R	Zlotnick et al. 2006
China	0.2	12-month	DSM-IV	Karam et al., 2014*
Colombia	0.3	12-month	DSM-IV	Karam et al., 2014*
Ethiopia	15.8	Lifetime	DSM-IV	de Jong et al., 2001
France	1.4	12-month	DSM-IV	Karam et al., 2014*
Gazza	17.8	Lifetime	DSM-IV	de Jong et al., 2001
Germany	0.5	12-month	DSM-IV	Karam et al., 2014*
Israel	0.4	12-month	DSM-IV	Karam et al., 2014*
Israel	11.6[a]	1-month	ICD-11	Ben-Ezra et al., 2018*
Italy	0.4	12-month	DSM-IV	Karam et al., 2014*
Japan	0.4	12-month	DSM-IV	Karam et al., 2014*
Lebanon	1.6	12-month	DSM-IV	Karam et al., 2014*
Mexico	0.3	12-month	DSM-IV	Karam et al., 2014*
Mexico	11.2	Lifetime	DSM-IV	Norris et al., 2003*
Netherlands	1.2	12-month	DSM-IV	Karam et al., 2014
Netherlands	7.4	Lifetime	DSM-IV	de Vries & Olff, 2009*
New Zealand	2.1	12-month	DSM-IV	Karam et al., 2014*
Northern Ireland	3.8	12-month	DSM-IV	Karam et al., 2014*
Northern Ireland	8.8	Lifetime	DSM-IV	Bunting et al., 2013*
Republic of Ireland	12.7[a]	1-month	ICD-11	Hyland, Vallières et al., 2020*
Romania	0.4	12-month	DSM-IV	Karam et al., 2014*
South Africa	0.4	12-month	DSM-IV	Karam et al., 2014*
South Korea	1.7	Lifetime	DSM-IV	Jeon et al., 2007*
South Korea	1.3	12-month	DSM-IV	Cho et al., 2007*
Spain	0.4	12-month	DSM-IV	Karam et al., 2014*
Sweden	5.6	Lifetime	DSM-IV	Frans et al., 2005*
Switzerland	5.0	Lifetime	DSM-IV	Perrin et al., 2014
Ukraine	2.0	12-month	DSM-IV	Karam et al., 2014*
United States	4.7	12-month	DSM-5	Goldstein et al., 2016*
United States	6.1	Lifetime	DSM-5	Goldstein et al., 2016*

United States	7.2[a]	1-month	ICD-11	Cloitre et al., 2019*

Note: [a] = combined rate of *ICD-11* PTSD and CPTSD (as individuals who met the diagnostic criteria for CPTSD also met the diagnostic criteria for PTSD); * = nationally representative sample.

(4.3%) and middle-aged adults aged 35-64 (5.2%) than older adults aged 65 and older (2.6%). The findings from a second epidemiological study in the U.S. (Kessler et al., 2005) found that PTSD lifetime prevalence among adults aged 60 and above (2.5%) were significantly lower than all other age groups assessed. This suggests that there may be a cohort effect, with successive cohorts being more likely to endorse lifetime PTSD. Other studies also indicate that PTSD prevalence rates significantly decrease with age (Creamer & Parslow, 2008; de Vries & Olff, 2009; Frans et al., 2005; Gum et al., 2009; Norris, 1992). However, findings from a nationally representative sample of German adults showed no difference between rates of PTSD among younger, middle-aged, and older adults (Spitzer et al., 2008). Moreover, another study found that older adults in Germany had higher levels of PTSD compared to both younger and middle-aged adults (Maercker et al., 2008). The discrepancy between Maercker and colleague's findings and previous literature might be due to the effects of World War II, with a much larger proportion of older adults reporting experiencing war-related traumas compared to the younger or middle-aged adults within their sample (Maercker et al., 2008).

A question of interest is whether the same precipitating traumatic events lead to PTSD among younger and older adult age groups. Epidemiological research among older adults found that the most frequently reported "worst" traumatic events were the unexpected death of a love one and serious illness of a loved one (Pietrzak, Goldstein et al., 2012). This finding was replicated by other researchers using an expanded dataset to that used by Pietrzak and colleagues to include all age groups aged 20 years and older who met the PTSD diagnostic criteria (Reynolds et al. 2016). These results coincide with global reports of trauma endorsement across the entire general adult population (Kessler et al., 2017).

Being kidnapped or held hostage, and physical assault, were found to be associated with the greatest odds of developing PTSD among older adults (Pietrzak, Goldstein et al., 2012). In line with the wider PTSD literature, these types of traumatic events have a high conditional risk for PTSD among the general population (Kessler et al., 2017).

Several explanations for the decreasing prevalence rates of PTSD among older adults have been offered. First, as PTSD has been associated with increased risk of early mortality (Ahmadi et al., 2011; Boscarino, 2006), it is possible that the PTSD prevalence disparity across the different age groups reflects a survivor bias where individuals with PTSD are less likely to survive into older adulthood (Cook et al., 2017; Cook & Simiola, 2018; Thomas et al., 2016). Second, older adults may be more reluctant to acknowledge mental health concerns and often convey their psychological concerns as somatic complaints due to fears of being stigmatised (Böttche et al., 2012; Cook & Simiola, 2018; Palmer et al., 1997; Pless Kaiser et al., 2019; Thorp et al., 2011). This may lead to prevalence rates being under-reported. Third, a minority of older adults may have more difficulty in accurately reporting psychological symptoms due to cognitive impairments (Thomas et al., 2016). Fourth, the diagnostic criteria for a psychiatric diagnosis may be ill-suited towards older adults (Thomas et al., 2016). For example, older adults may be less likely to attribute occupational impairment to PTSD symptomatology if they are retired, or social impairment if they are physically impaired (Bodner et al., 2018). Fifth, compared to younger adults, when faced with adverse situations and stressful events older adults are generally (1) more resilient (Gooding et al., 2012; Grossmann et al., 2010; MacLeod et al., 2016); (2) have a greater cognitive bias towards positive stimuli and memory recall (Kennedy et al., 2004; Reed &

Carstensen, 2012; Thomas et al., 2016); and (3) are better at optimising their current resources (Baltes & Baltes, 1990; Ouwehand et al., 2007). For these reasons, it is reasonable to expect a difference in current rates of PTSD between older and younger adults.

It is also possible that cohort effects may result in lower lifetime rates in older adults, compared to younger age groups. This may be due to (1) generational differences whereby older adults who experienced trauma may have sought treatment prior to the introduction of PTSD to the *DSM-III* in 1980. This may result in older adults, who exhibited symptoms of PTSD, not receiving a diagnosis and, therefore, not attributing their experiences at the time to PTSD symptomatology (Cook et al., 2017); (2) a possible contributing factor to the lower lifetime rates of PTSD nay be due to older adults having more positive biases in their memory (Kennedy et al., 2004; Reed & Carstensen, 2012; Thomas et al., 2016). As a result, older adults may not recall experiencing all symptoms to meet a diagnosis if they generally focus more on the positive aspects of their past; and (3) it is possible similar methodological concerns that lead to decreased rates of current psychiatric morbidity in older adults, such as the diagnostic systems being ill-suited to older adults (see Bodner et al., 2018; Lutz et al., 2018) and older adults reporting their psychological concerns as somatic complaints due to fears of being stigmatised (Böttche et al., 2012; Cook & Simiola, 2018; Palmer et al., 1997; Pless Kaiser et al., 2019; Thorp et al., 2011), may also lead to decreased rates of lifetime psychiatric morbidity. In other words, if there are concerns regarding the accuracy of psychiatric assessments for current psychiatric morbidity in older adults, then it is possible that these concerns also extend to cross-sectional lifetime assessments of psychiatric morbidity.

In order to better understand the reasons for the decrease in PTSD rates among older adults (such as resiliency, validity of models etc.), it is important to expand the research base pertaining to PTSD in later life. More research on the risk-factors associated with PTSD, and the comorbidity between PTSD and other disorders, among older adults is necessary to better understand if empirical findings in older adults are comparable to findings from younger adults. Furthermore, determining whether the current models of PTSD accurately represent how PTSD manifests in older adults will suggest whether there are qualitative differences regarding PTSD in older adults that ought to be recognised when making diagnostic considerations. This has important implications for the assessment of PTSD in older adults, as the removal/addition of symptoms may be required to provide a valid representation of PTSD in later life (Lutz et al., 2018). Undertaking such research among older adults is a critical step in avoiding potentially unrecognized effects of traumatic exposure that may have an adverse impact on older adults' physical and mental wellbeing (Cook & Simiola, 2018).

1.5. PTSD Symptomatology in Older Age Groups

As well as differences in prevalence rates across age groups, the symptomatology of PTSD might also differ. Exploration into the precise differences that may exist across age groups in PTSD symptomatology has yielded inconsistent findings. Goenjian et al. (1994) examined differences in the symptomatology of PTSD between younger and older adults and found that older adults, on average, exhibited fewer intrusion/re-experiencing symptoms and increased arousal symptoms relative to younger adults. Another study (Norris et al., 2002) using three samples found mixed results. Across the three samples, older adults exhibited fewer symptoms in certain symptom clusters, increased symptoms in each cluster, and no differences in symptomatology, relative to younger and middle-aged adults. The results of another study (Chung et al., 2005), which examined differences between younger and older adult responses to human made disasters (train collision and aircraft crash), found no significant difference in each symptom cluster.

The findings from another study that used an all-female sample found that older adults exhibited significantly fewer re-experiencing, hyperarousal, and avoidance symptoms compared to their younger counterparts (Acierino et al., 2002). Similarly, Konnert and Wong (2015) found that older male veterans exhibited significantly lower levels of re-experiencing, hyperarousal, and avoidance symptoms, in comparison to younger male veterans. Recently, Reynolds et al. (2016) found that older adults exhibited significantly fewer hyperarousal and avoidance symptoms compared to their younger counterparts. However, there appeared to be no significant difference between older and younger adults with regards to their symptom expression in the re-experiencing symptom cluster.

To date, the precise differences that exist between younger and older adults regarding symptom expression remains rather elusive, however, in accordance with the current literature, it would appear that the most probable relationship that exists is that older adults exhibit significantly fewer symptoms in at least one symptom cluster. Therefore, in order to understand the possible differences that exist in symptomatology, it is important that further research in this area is conducted. Furthermore, it is important to note that these studies comparing symptomology across age-groups were performed using out-dated models of PTSD, therefore, it is important to further examine differences in the structure of PTSD among older adults using more contemporary models such as the *ICD-11* model or the *DSM-5* model. Lower symptomatology and prevalence rates among older adults, relative to younger age groups, are in line with the general psychiatric literature demonstrating lower psychiatric morbidity in later life (Gum et al., 2009; Kessler et al., 2005; Thomas et al., 2016).

1.6. Sex Differences in PTSD

Understanding the most appropriate latent structure of PTSD among older adults is important because if the true latent structure of PTSD in older adults is distinct from that presented in diagnostic manuals, it can lead to inaccurate diagnostic estimates. A crucial psychometric aspect of any diagnostic construct is to ensure that the presence or absence of any symptom does not results from any variable other than the target latent variable (e.g., symptom endorsement is not more likely because of one's sex), thus allowing for an equal, unbiased, comparison across groups. This is particularly important with regards to sex differences in PTSD, given the consistent increased symptom severity and risk of developing PTSD (approximately two-fold) among females found throughout the pertinent literature (Breslau et al.,1997; DeLisi et al., 2003; Frans et al., 2005; Holbrook et al., 2002; Nemeroff et al., 2006; Olff et al., 2007; Tolin & Foa, 2006). For example, the results of a recent epidemiological study using a nationally representative sample of the U.S. population reported a PTSD prevalence rate of 8.0% among females and 3.4% among males (Lehavot et al., 2018). There appears to be a similar disparity among older adults with findings of an epidemiological study reporting PTSD prevalence rates of 5.7% in older females, compared to a prevalence rate of 3.1% in older males (Pietrzak, Goldstein et al., 2012). Although this disparity may be apparent from an epidemiological perspective, the precise mechanisms that account for this difference remain unclear.

A possibility for the observed sex differences in PTSD is methodological. Differences in the latent structure of PTSD between males and females can be empirically assessed via measurement invariance testing. Measurement invariance refers to the similarity of the factor structure across groups (Sass, 2011). If a measure is non-invariant for a particular group, then scores on that measure cannot be directly compared across groups. For example, if the factor structure of PTSD differs between males and females, then this would imply that there should be different diagnostic models for the sexes. Thus, if the latent structure of PTSD is non-invariant for the sexes, estimated prevalence rates for males and females could not be meaningfully compared.

However, there is a notable dearth of research pertaining to sex differences in PTSD among older adults, and in establishing whether the models of PTSD are invariant across sex in older adults. Sex differences in older adults across other psychiatric disorders have produced somewhat mixed findings. For example, depressive symptoms have been found to be invariant for older males and females across 24 European countries (Karim et al., 2015). However, research among Australian and U.S. older adult samples have found evidence of measurement non-invariance for depressive symptoms (Mohebbi et al., 2018). Notably, however, the magnitude of this effect was very small and unlikely to severely impact group comparisons.

Studies have also examined these differences using a different, but related, methodological strategy of differential item functioning (DIF). DIF analysis examines whether individual symptom scores vary depending on certain covariates (e.g., sex) while controlling for overall mean differences at the level of the latent variable. The presence of DIF is identified when an item exhibits different measurement properties irrespective of the overall latent mean differences (Woods, 2009). This suggests that the probability of item response, or symptom endorsement, is significantly different depending on the covariate (e.g. being male or female). Several items relating to depression among older adults have been found to exhibit DIF with one study (Broekman et al., 2008) finding that five items were biased across sex, and another (Yang et al., 2009) finding two items were biased across sex.

Studies relating to anxiety symptoms (Picconi et al., 2018) and positive/negative affectivity (Buz et al., 2015) among older adults have demonstrated that these measures were invariant across sex. Additional research (Mueller et al., 2015) has found that two anxiety symptoms were biased across sex, however, the effect size was negligible and unlikely to have an adverse impact on the comparison of anxiety among males and females in later life. Similarly, an additional study (Li et al., 2019) found that one anxiety symptom exhibited DIF across sex, however, the effect size was also negligible.

There is a greater deal of research examining sex differences in PTSD using measurement invariance and DIF in the general population. Given that there is a similar disparity between males and females in terms of PTSD prevalence rates in both older and younger cohorts, it stands to reason that if the current nosological models of PTSD are found to adequately represent PTSD among older adults, then this implies that the research among the general population can be extrapolated to older adults. However, if PTSD manifests differently in older adults depending on an individual's sex, then this will decrease the generalisability of PTSD research in the general population to older adult populations. It should also be noted that the models and symptoms of PTSD can often differ across studies. Regarding *DSM-IV* PTSD, the factorial invariance of PTSD among males and females was examined using a sample of U.S. veterans (Hall et al., 2012), indicating that there was partial invariance across sex. Wang et al. (2013) compared several models of PTSD in a sample of children/adolescents and found equivalent factor loadings across sex, despite females exhibiting more severe symptomatic manifestations of PTSD. Conversely, a study conducted by Armour et al. (2011) demonstrated factorial non-invariance between adolescent males and females. Contractor et al. (2013) also found factorial non-invariance for child/adolescent males and females, however, when more stringent criteria for comparison of model fit were applied, males and females were found to exhibit structural invariance. Chung and Breslau (2008) examined measurement invariance across males and females using latent class analysis and found evidence to suggest that the groups were invariant. Research using the *DSM-5* structure of PTSD found that this model was invariant across a sample of Australian adults (Carragher et al., 2016).

Another study (King et al., 2013) employing a different methodological strategy found that several *DSM-IV* PTSD items exhibited DIF across the sexes. However, the authors noted that, on average, these biases were quite small and unlikely to substantially effect the psychometric properties of the construct. Additionally, Rivollier and colleagues (2015) showed that one symptom ('foreshortened future') demonstrated DIF as males were more likely to endorse this symptom. However, it should be noted that this item was not included in the *DSM-5* conceptualisation of PTSD. The findings of a recent study revealed that two of the *DSM-5* PTSD items demonstrated DIF with males being more likely to endorse the 'reckless or self-destructive behaviour', despite the same latent PTSD severity, whereas females were more likely to endorse the 'emotional cue reactivity' symptom (Murphy et al., 2019). The authors also noted, however, that the magnitude of these differences was small.

Regarding the *ICD-11* model of PTSD, far less research has been conducted to determine if the latent structure is invariant across males and females. Initial studies suggest that the latent structure of *ICD-11* PTSD is invariant across the sexes (Hansen et al., 2015; La Greca et al., 2017).

There are also a number of alternative reasons for the observed sex differences in PTSD prevalence rates. Despite males more frequently experiencing traumatic events than females (Breslau & Anthony, 2007; Frans et al., 2005; Kessler et al., 1995), one mechanism that has been proposed to explain this difference in PTSD prevalence is the type of traumatic event experienced (see Olff et al., 2007). Females are more likely to experience severe interpersonal traumas such as rape and sexual abuse (Ehring & Quack, 2010; Kessler et al., 1995) which are known to have the highest conditional risk of PTSD onset (Kessler et al., 2017). However, evidence suggests that females remain at a significantly increased risk of developing PTSD even after controlling for the type of traumatic event experienced (Breslau et al., 1998; Nemeroff et al., 2006; Olff et al., 2007).

Another possible mechanism explaining the disparity between males and females is differences in their responses to traumatic exposure. Lawyer et al. (2006) found that females were more likely to report experiencing peritraumatic reactions that are associated with PTSD symptoms, including ‘dissociation’ (e.g. feeling detached), ‘emotional reactions’ (e.g. fear of dying and helplessness), and ‘panic/physiological arousal’ (e.g. shortness of breath and rapid heartbeat). Therefore, these heightened acute stress responses among females - which have also been noted elsewhere (e.g. Bryant & Harvey, 2003; Christiansen & Hansen, 2015; Fullerton et al., 2001; Irish et al., 2011) - might partially explain the disparity in risk of PTSD between sexes. Similar peritraumatic responses have been found to partially mediate the relationship between sex and PTSD (Christiansen & Hansen, 2015).

An alternative explanation for the disparity between sexes is that females and males differ in terms of their preferential coping styles (see Olff et al., 2007). The results of a meta-analysis (Tamres et al., 2002) examining sex differences in coping behaviours found that females were more likely to adopt avoidant, emotion-focused, and ruminative coping styles than their male counterparts, on average. Each of these three styles of coping are associated with increased PTSD symptom severity (Bödvarsdóttir & Elklit, 2004; Gil, 2005; Michael et al., 2007).

In conclusion, the disparity between males and females in the prevalence of PTSD extends to older adults. Several explanations have been put forth to explain the underlying mechanisms of this disparity such as factorial differences, frequency of different types of traumatic experiences, and differences in acute stress responses. Although these factors may partially explain the prevalence differences between males and females, the precise mechanisms that account for this disparity remains unclear. As such, future research in older adults is warranted.

1.7. PTSD Psychiatric Comorbidity

Another important area to consider regarding PTSD research among older adults is psychiatric comorbidity. If there are qualitative differences in how PTSD manifests, then this may have implications for understanding PTSD psychiatric comorbidity among older adults. Research has found that PTSD co-occurs with many other forms of psychopathology including mood disorders, anxiety disorders, eating disorders, personality disorders, substance abuse, suicidal ideation, and psychosis (Brewerton, 2007; Brown et al., 2001; Driessen et al., 2008; Gallagher & Brown, 2015; Krysinska & Lester, 2010; Panagioti et al., 2012; Pietrzak et al., 2011; Rytwinski et al., 2013; Seow et al., 2016). There appears to be similar trends regarding PTSD psychiatric comorbidity in older adults. For example, among a nationally representative sample of U.S. older adults, PTSD increased one’s risk of having comorbid major depressive disorder, dysthymia, bipolar disorder, generalised anxiety disorder, panic disorder, agoraphobia, specific phobias, substance use disorders, and history of suicidal attempts (Pietrzak, Goldstein et al., 2012). Additional empirical research in older adults has demonstrated a similar association between PTSD and mood, anxiety, and drug/alcohol use disorders (Averill & Beck, 2000; Chopra et al., 2014; Spitzer et al., 2008). Furthermore, there is a dearth of research relating to PTSD comorbidity in older adults, under more contemporary classifications such as the *ICD-11* and *DSM-5*. However, the results of one study (Glück et al., 2016) found that *ICD-11* PTSD symptoms, among older adults, were related to an increased risk for depressive, somatisation, and anxiety symptoms.

The high comorbidity rates between PTSD and other forms of psychopathology may be due to three overarching reasons: first, this high comorbidity may be due to the deleterious effects of trauma exposure as a shared risk factor (or aetiological factor in the case of PTSD) for numerous psychopathologies; second, self-medication may be used as a method to assuage the distressing nature of the PTSD symptoms; and third, high comorbidity may be expected due to the fact that different disorders share a latent vulnerability, as described in a dimensional mode of psychopathology. In this section, these three possibilities will be discussed in turn.

1.7.1. Trauma as a shared risk factor

Traumatic exposure - most notably childhood trauma - has been found to be a risk factor for the development of various psychiatric conditions. For example, a study examining the effects of childhood adversities on adulthood psychopathology across 21 countries found that childhood adversities predicted all types of psychopathology assessed such as mood, anxiety, behaviour, and substance use disorders (Kessler et al., 2010). In addition, meta-analytic findings indicate that individuals who have been exposed to childhood adversities are approximately three times more likely to develop psychotic symptoms (Varese et al., 2012). Similarly, trauma expose has been found to be a risk factor for developing eating disorders (Brewerton, 2007). In addition, childhood maltreatment can greatly influence the development of future substance use disorders (Najavits et al., 2017). Findings among older adult samples, although limited, corroborate these findings from general population samples, indicating that trauma exposure is a shared risk factor for multiple forms of psychopathology including mood disorders, anxiety disorders, substance use disorders, suicidal ideation, and psychosis (Burnette et al., 2017; Choi et al., 2017; Kim et al., 2019; Larkin et al., 2017; Loewy et al., 2019; Rhee et al., 2019; Van Assche et al., 2020). As traumatic exposure appears to be a commonality among PTSD and many other forms of psychopathology, this may partially explain the consistently reported high rates of PTSD psychiatric comorbidity in both older adults and the general population.

1.7.2. Self-medication hypothesis

A putative explanation for the association between PTSD and drug/alcohol use disorders is the self-medication hypothesis. This theory posits that PTSD symptom manifestation precedes the development of drug/alcohol addiction, and that individuals develop drug/alcohol abuse in an attempt to assuage the distressing psychiatric symptoms (Khantzian, 1997; Khantzian, 2003; Leeies et al., 2010). Further, the alleviation of symptom-related distress can act as a form of negative reinforcement that aids in maintaining the addictive behaviour (Baker et al., 2004). This reduction in intense negative emotional distress can often be followed by a withdrawal state whereby PTSD symptoms are exacerbated (Brady et al., 2000). This increased state of negative emotionality can lead to a pathological state of substance-dependency and acts as an additional factor sustaining the substance use disorder (Koob, 2008). In other words, the initial impulsive nature associated with substance misuse to assuage distress, can eventuality shift from impulsivity to compulsivity in an attempt to deal with the additive distress associated with withdrawal (Koob, 2008), alongside the initial distressful nature of the PTSD symptomatology. Prior support (Berenz et al., 2017; Chilcoat & Breslau, 1998; Haller & Chassin, 2014; Hawn et al., 2020; McFarlane, 1998) has been found regarding the temporal relationship between PTSD and substance misuse (i.e. PTSD is an antecedent of substance misuse). With regards to older adults, there is a lack of longitudinal research investigating self-medicating to reduce the symptoms of PTSD. However, given that there is an association between trauma and substance misuse in older adults (Choi et al., 2017; Kim et al., 2019; Larkin et al., 2017; Rhee et al., 2019) and substance use disorders and PTSD (Pietrzak, Goldstein et al., 2012), it is possible that the self-medication hypothesis explains, at least in-part, the relationship between substance use disorders and PTSD in older adults.

1.7.3. Dimensional model of psychopathology

The association between PTSD and numerous psychiatric conditions among older adults may be further explicated by assuming a dimensional paradigm of psychopathology rather than a traditional categorical model of psychiatric classification which assumes that these disorders exist as separate and unique entities. The 'Hierarchical Taxonomy of Psychopathology' (HiTOP; Kotov et al., 2017) is a dimensional framework that models the structure of psychopathology into differing spectra/dimensions (e.g. 'internalising', 'externalising', and 'thought disorder'). These spectra are further subdivided into subfactors (e.g. PTSD falls within the 'distress' subfactor of the 'internalising' spectrum) that consist of closely related psychiatric conditions. This may explain the high comorbidity between PTSD and other psychiatric disorders, with increased scores on the 'internalising' spectrum predicting increased internalising comorbidity, most notably among the disorders within the same subfactor as PTSD (i.e. major depressive disorder, dysthymia, generalised anxiety disorder, and borderline personality disorder).

The latent structure of PTSD comorbidity has been found to be represented using a three-factor structure consisting of 'fear', 'distress', and 'externalising' psychopathology (Miller et al., 2012). However, it should be noted that psychotic disorders were not assessed as part of this study. Interestingly, the latent structure of PTSD comorbidity was consistent with models of general psychopathology (e.g. HiTOP model), sharing similarities such as the 'distress' factor encompassing the same disorders as found among community samples (see Beesdo-baum et al., 2009; Eaton et al., 2011; Kotov et al., 2017). As the same underlying mechanism appears to confer vulnerability to the same constellation of disorders, both in the context of PTSD comorbidity among a trauma exposed sample and in terms of general psychopathology, this further suggests that the high comorbidity among these internalising disorders may be due to sharing the same latent factor/subfactor as PTSD.

Galatzer-Levy and colleagues (2013) examined patterns of PTSD comorbidity, using latent class analysis, across a range of internalising and substance use disorders. The results revealed three discrete classes, or patterns, of comorbidity with PTSD. The first class was found to consist of individuals with a general low risk for comorbidity, although the class contained a modest risk of suicidal ideation and major depressive episode. The second class was characterised predominately by high risk for comorbid mood and anxiety disorders, and suicidal ideation. The third class was characterised primarily by a moderate/high risk for mood and anxiety disorders, and high risk for suicidal ideation and substance use disorders. Similarly, another study (Müller et al., 2014) found that a three-class solution adequately represented the patterns of PTSD comorbidity. The first class of individuals exhibited a relatively low risk of comorbidity with a modest risk of major depressive episode. The second class was characterised predominately by an increased risk for substance use disorders, antisocial personality disorder, and suicidal ideation. The third class was characterised by increased risk for mood and anxiety disorders and suicidal ideation. The results of these studies are in line with a dimensional model of psychopathology as they show that PTSD is highly comorbid with a range of psychiatric disorders. Assuming a dimensional framework, it would be expected to see comorbidity with anxiety/depressive disorders being more probable across the latent classes as these disorders are found within the same subfactor (i.e. ‘distress’) as PTSD. As PTSD is also highly comorbid with other psychiatric disorders in later life, similar to general population samples, it is possible that these findings may extend to older adults.

Other studies have also examined PTSD comorbidity using a similar methodology; however, these studies tend to focus on fewer disorders (Anderson et al., 2018; Contractor et al., 2015; Hruska et al.,2014).

1.8. Risk Factors for Developing PTSD

Understanding the difference in prevalence rates and symptomatology of PTSD between younger and older adults also requires an understanding of potential differences in the risk factors involved at each life stage. There is a dearth of empirical research investigating the specific risk factors for developing PTSD among older adults. However, there has been extensive research conducted around examining the risk factors for developing PTSD in the general adult population, as several meta-analyses (e.g. Brewin et al., 2000; Orth & Weiland, 2006; Ozer et al., 2003) and comprehensive reviews (e.g. Bryant, 2019; DiGangi et al., 2013; Heron-Delaney et al., 2013) have been conducted around this topic. The results of these meta-analyses and reviews have suggested that there are numerous factors that play an important role in the development of PTSD, and can be classified into pre-trauma, peritraumatic, and posttraumatic risk factors (Brewin et al., 2000; DiGangi et al., 2013; Ozer et al., 2003) (see Table 1.2 for all risk factors). However, it is important to note that additional research in this area is required in order to further elucidate the etiopathogenesis of PTSD among older adults.

1.8.1. Pre-trauma factors

A multitude of pre-trauma risk factors for developing PTSD have been identified. An individual’s sex has been shown to play an important role in the development of PTSD as females are significant more likely to develop PTSD than males (Breslau, 2002; Brewin et al., 2000; Olff et al., 2007; Tolin & Foa, 2006; Xue et al., 2015), with similar differences observed in older adults (Pietrzak, Goldstein et al., 2012). Several possible explanations for the increased prevalence of PTSD among females have been proposed (for a comprehensive review see Olff et al., 2007) such as elevated physiological and dissociative acute stress responses to traumatic events, and differences in coping strategies in response to major stressors (Lawyer et al., 2006; Tamres et al., 2002).

Individuals that have experienced previous traumatic events (Brewin et al., 2000; Ozer et al., 2003; Xue et al., 2015), childhood abuse or other forms of childhood adversities (Breslau, 2002; Brewin et al., 2000) are at a significantly increased risk of developing PTSD, with cumulative traumatic exposure also predicting greater PTSD symptom severity (Follette et al., 1996; Suliman et al., 2009). This finding has also been observed in older adults (Acierno et al., 2002; Ogle et al., 2016; van Zelst et al., 2003).

Belonging to a lower socio-economic status (SES; Brewin et al., 2000), has been identified as a potential pre-truama risk factor for developing PTSD among the general adult population. Interestingly, empirical research comparing older and younger adults has found that lower income is associated with greater PTSD severity in older adults, but not younger adults (Acierno et al., 2006).

Lower education may also increase one's pre-trauma risk for developing PTSD (Brewin et al., 2000; Xue et al., 2015). The precise mechanisms explaining this relationship are not entirely clear. However, a possible reason for this association may be that higher levels of education may be associated with greater social support (Green et al., 1990) and a decreased likelihood of traumatic exposure (Breslau et al., 1991). However, research among older adults has indicated that education is not a significant predictor of PTSD (Ogle et al., 2014; 2016).

Individuals that have a pre-existing history of psychopathology, prior to trauma exposure, are at an increased risk of developing PTSD (Breslau, 2002; Brewin et al., 2000; Heron-Delaney et al., 2013). Pre-trauma psychopathology appears to be a relatively robust predictor of PTSD (DiGangi et al., 2013). Furthermore, individuals that have a family history of psychopathology have been shown to also have an increased risk of developing PTSD (Breslau, 2002; Brewin et al., 2000; Ozer et al., 2003). Research among older adults has found that pre-trauma psychopathology predicts future PTSD symptom severity, following trauma exposure (Ogle et al., 2016).

The results of a longitudinal study found that individuals who engaged in pre-existing negative appraisals of oneself, prior to traumatic exposure, were more likely exhibit increased PTSD symptoms (Bryant & Guthrie, 2007), possibly due to being predisposed to developing the dysfunctional negative cognitions that are characterised by PTSD (Bryant & Guthrie, 2007). The effects of aging may moderate this relationship between negative appraisals and PTSD, as older adults tend have a greater bias towards positive stimuli and positive memory recall (Kennedy et al., 2004; Reed & Carstensen, 2012; Thomas et al., 2016)

Increased negative affectivity (Bramsen et al., 2000; Rademaker et al., 2011; Rubin et al., 2014; Weems et al., 2007) and neuroticism (Breslau & Schultz, 2013; Cox et al., 2004; Ogle et al., 2014; Parslow et al., 2006) have also been shown to predict the development of PTSD, following trauma exposure. Maia et al. (2011) suggest that individuals with high negative affect may have a reduced capacity for extinction learning, which can lead to a vulnerability to developing PTSD, and also impaired recovery from PTSD symptoms. Additionally, neuroticism may increase an individual's vulnerability to developing symptoms such as avoidance and sleep disturbances (Breslau & Schultz, 2013; Guo et al., 2015). Research among older adults coincides with the general population studies, in that neuroticism is associated with PTSD symptoms (Ogle et al., 2014; van Zelst et al., 2003) and also predicts future PTSD symptom severity (Ogle et al., 2016).

Longitudinal research suggests that trait anger and hostility may be important pre-trauma risk factors predicting PTSD severity, following traumatic exposure (Heinrichs et al., 2005; Lommen et al., 2014; Meffert et al., 2008; Orth & Weiland, 2006; van Zuiden et al., 2011). It has been hypothesised that individuals might use anger as a potential coping mechanism to avoid trauma-related feelings of fear, induced by traumatic intrusions, which may in turn impede the emotional processing of the traumatic event (Foa, Riggs, Massie & Yarczower, 1995). The findings of a prospective study among older adults demonstrated that hostility predicted future PTSD severity (Ogle et al., 2016).

Poorer pre-trauma cognitive functioning, such as learning, memory, and verbal fluency, has also been found to be a risk factor for the development of future PTSD symptomatology in older adults (Schuitevoerder et al., 2013; Vasterling & Brailey, 2005). Additionally, greater cognitive functioning may be particularly important among older adults in reducing the deleterious impact of trauma exposure on the development of future psychiatric morbidity (Schuitevoerder et al., 2013; Vasterling & Brailey, 2005).

Empirical research among older adults has also noted that that poor health may be a risk factor for the development of increased PTSD symptoms in later life (Acierno et al., 2006; van Zelst et al., 2003). This may be particularly relevant to older adults as they are at an increased likelihood of developing health conditions, compared to younger adults (Thomas et al., 2016).

Prospective studies have indicated that sleep disturbances, prior to traumatic exposure, increase an individual's vulnerability to developing PTSD symptoms after experiencing a traumatic event (Koffel et al., 2013; van Liempt et al., 2013). Van Liempt et al. (2013) suggest that disturbances to sleep may contribute towards the development of PTSD by inhibiting the process of REM sleep on fear extinction (Spoormaker et al., 2012), following traumatic exposure. Although sleep disturbances have been found to be correlated with PTSD in older adults, this relationship appears to become non-significant when controlling for other risk factors (Ogle et al., 2016).

1.8.2. Peritraumatic factors

Literature suggests that the severity of the trauma (e.g. if the victim felt that their life was in danger), and the type of traumatic event that occurred, are crucial risk factors for developing PTSD (Brewin et al., 2000; Heron-Delaney et al., 2013; Kessler et al., 2014; Ozer et al., 2003; Xue et al., 2015). For example, interpersonal traumas such as rape and other forms of sexual assault have been found to have a high conditional risk of developing PTSD (Kessler et al., 2017). Similar findings have also been observed among older adult samples (Acierno et al., 2002, 2006; Pietrzak, Goldstein et al., 2012).

Peritraumatic dissociation during or in the immediate aftermath of a traumatic event is an important determinant of future PTSD symptom severity (Breh & Seidler, 2007; Lensvelt-Mulders et al., 2008; Ozer et al., 2003). Peritraumatic dissociation is characterised by a complex array of dissociative reactions such as emotional numbing and reduced awareness/distortions of an individual's environment and perception of reality (Bryant, 2007). Increased PTSD symptom severity may arise from the dissociative process disrupting the encoding and immediate processing of the traumatic event (Van der Kolk & Fisler, 1995). Research among older adults have found a strong association between peritraumatic dissociation and PTSD symptoms (Pietrzak, Southwick et al., 2012).

Peritraumatic tonic immobility is also an important predictor of future PTSD symptom severity. Tonic immobility is a temporary and involuntary response that can be observed during traumatic events that involve intense fear, and is characterised by motor and vocal inhibitions, parkinsonian-like tremors, and analgesia; however, the individual also remains aware of their environment (Kalaf et al., 2015; Möller et al., 2017). Tonic immobility is believed to have developed in order to increase survivability (Bracha, 2004). However, it may have pathological consequences as it has been shown to be a significant predictor of PTSD symptom severity (Kalaf et al., 2015; Möller et al., 2017; Portugal et al., 2012; Rocha-Rego et al., 2009) and is also associated with decreased response to treatment (Fiszman et al., 2008; Lima et al., 2010). These adverse effects may be the result of a sense of guilt that gives rise due to the inaction taken by the individual during the traumatic event (Bovin et al., 2014). Given that older adults are generally more resilient than younger adults (Gooding et al., 2012; Grossmann et al., 2010; MacLeod et al., 2016), it is possible that older age may potentially mitigate the effect of peritraumatic tonic immobility on PTSD development in later life.

Peritraumatic emotional reactions (e.g. helplessness) and panic-like reactions/physiological arousal (e.g. sweating, elevated heart rate and shortness of breath) significantly predict subsequent PTSD symptomatology (Lawyer et al., 2006; Marmar et al., 2006; Ozer et al., 2003). Bryant and Panasetis (2001) propose that peritraumatic panic may potentially lead to increased posttraumatic stress as a result of the panic experienced during the event, leading to a more distressing experience for the individual. These risk factors for PTSD have also been observed in older adults (Pietrzak, Southwick et al., 2012).

1.8.3. Posttraumatic factors

Several important posttraumatic risk factors that contribute towards the development and maintenance of PTSD have also been identified. In comparison to pre-trauma risk factors, the results of a meta-analysis (Brewin et al., 2000) indicate that peritraumatic and posttraumatic risk factors are stronger predictors of PTSD. There is a large body of empirical research that suggests that posttraumatic social support is an important risk factor of both the development and maintenance of PTSD symptomatology, following trauma exposure (Brewin et al., 2000; De Soir et al., 2015; Heron-Delaney et al., 2013; Ozer et al., 2003; Steine et al., 2017). Lower social support also appears to predict greater PTSD symptom severity in older adults (Acierno et al., 2006; Ogle et al., 2014).

Loneliness has been found to be a risk factor for psychopathology in later life (Wang et al., 2018), including PTSD (Macleod, 1994; Shevlin, et al., 2015; Solomon et al., 1991; 2015). Feelings of loneliness can trigger an implicit hypervigilance for threatening stimuli in the environment which can then engender the manifestation of negative cognitive biases such as the perception of the world being an unsafe place (Hawkley & Cacioppo, 2010). This can lead to poor outcomes such as feelings of hostility, anxiety, and stress, and can also contribute to the development of psychopathology (Hawkley & Cacioppo, 2010). This sense of hypervigilance and negative cognitions of the world are also common among individuals with PTSD and are also part of the *DSM-5*'s current diagnostic structure of PTSD. Alternatively, it is possible that the association between loneliness and certain PTSD symptoms may reflect, in part, a conceptual overlap between the constructs.

Individuals often display symptoms of acute stress disorder (ASD) following traumatic exposure. The symptomatology of ASD is similar to PTSD and cannot be diagnosed until three days after the traumatic event has occurred (APA, 2013). If the symptoms of ASD persist after one month, following the traumatic event, then it may progress to PTSD. Studies have indicated that ASD may be a modest predictor of PTSD (Ben-Ezra et al., 2015; Bryant, 2011; Bryant et al., 2003; Harvey & Bryant, 1998; Heron-Delaney et al., 2013; Kleim et al., 2007). Interestingly, the predictive power of ASD as a risk factor for PTSD may be conditioned on one's psychological arousal symptoms following trauma exposure (Shevlin et al., 2014).

Individuals who have been exposed to additional life stress or traumatic events (i.e. traumatic exposure that occurred after the focal traumatic event) are also at an increased risk of developing/maintaining PTSD symptoms (Adams & Boscarino, 2006; Brewin et al., 2000), and has also been observed in older adult samples (Acierno et al., 2002; Ogle et al., 2016; van Zelst et al., 2003).

Empirical research also suggests that factors related to modified personal identity such as increased event centrality may be an important posttraumatic risk factor that should be considered. Event centrality is the degree to which an individual construes their experienced trauma(s) as central to their identity, and is believed to increase PTSD symptom severity by enhancing the emotional salience and frequency of recall of the traumatic memory (Berntsen & Rubin, 2006; 2007; Ogle et al., 2014). The findings reported from numerous studies demonstrate that enhanced event centrality appears to be a robust predictor of PTSD symptom development (Berntsen & Rubin, 2007; Blix et al., 2014; Boelen, 2012; Brown et al., 2010; Ogle et al., 2014; Robinaugh & McNally, 2011; Rubin et al., 2014). Research also suggests that these findings extend to older adult populations (Ogle et al., 2014, 2016).

Table 1.2
Risk factors of PTSD in the general adult population.

Pre-trauma risk factors	Peritraumatic risk factors	Posttraumatic risk factors
Sex (female)*	Severity of trauma*	Loneliness
Previous trauma exposure*		
Lower socio-economic status	Type of trauma*	Poor social support*
Lower income*		
Lower education	Peritraumatic dissociation*	Acute stress disorder
Pre-trauma psychopathology*	Tonic immobility	Additional traumatic events*
Family history of psychopathology	Peritraumatic emotional reactions*	Event centrality*
Pre-existing negative appraisals of oneself	Peritraumatic panic*	
Negative affectivity		
Neuroticism*		
Anger and hostility*		

Pre-trauma cognitive functioning*	
Sleep disturbances	
Health problems*	

Note: * = those with evidence as risk factors in the older adult population.

1.9. Predicting PTSD in later life: Loneliness among Older Adults

As research regarding PTSD and its correlates in older adults is relatively underdeveloped, it is important to examine psychosocial variables that may predict PTSD in this age group. One such variable is that of loneliness as it tends to become more prominent as one grows older in later life (Cohen-Mansfield et al., 2016; Mund et al., 2020; Qualter et al., 2015), given that older adults are increasingly exposed to risk factors of loneliness as they age, such as retirement and the death of a loved one (Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2016; Pinquart & Sörensen, 2001; Qualter et al., 2015). Although loneliness appears to be an important predictor of psychiatric and physical wellbeing in later life (Coyle & Dugan, 2012; Hawkley & Cacioppo, 2007; Holt-Lunstad, et al., 2015; Leigh-Hunt et al., 2017; Tomstad et al., 2017; Wang et al., 2018), there is a lack of research examining the association between loneliness and posttraumatic stress responses in older adults.

The conceptual definition of loneliness varies across the academic literature (see McHugh Power et al., 2018). In psychology, one of the predominant definitions is that loneliness is the distressing experience that transpires as a result of an individual’s social relationships significantly lacking in either quality or quantity (Perlman & Peplau, 1984). Loneliness is often conceptualised as a multidimensional construct (Weiss, 1973) consisting of ‘emotional loneliness’, reflecting a perceived lack/absence of intimate relationships and close attachments, and ‘social loneliness’ which reflects a perceived lack/absence of an engaging social network that can provide a sense of belonging and companionship (de Jong Gierveld & van Tilburg, 2006). It is important to distinguish loneliness from social isolation, which is a related, but distinct, concept (i.e. feeling lonely does not always equate to being alone; Russell et al., 2012). Social isolation is an objective quantitative measure of the characteristics of an individual's social connections and is related to similar measures such as such as social network size, diversity, and frequency of contact with others (de Jong Gierveld & Havens, 2004). For example, older adults living alone would reflect social isolation in later life, but not necessarily loneliness, whereas the need for greater intimate connections would reflect loneliness, but not necessarily social isolation (Courtin & Knapp, 2017).

There have been a number of risk factors identified that are associated with feelings of loneliness in older individuals, including factors such as marital status, being female, education, availability of an intimate relationship, poor health, poorer health in older age than expected, depressive symptoms, lower life satisfaction, lower self-esteem, and poorer psychiatric functioning (Cohen-Mansfield et al., 2016; Victor & Yang, 2012; Victor et al., 2005). Additionally, age-related factors such as retirement, death of spouse or loved one, development of a chronic illness, impaired mobility, and reduced social activities (Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2016; Pinquart & Sörensen, 2001; Qualter et al., 2015) can increase one's risk for loneliness. Given that certain risk factors for loneliness increase with age, such as the development to a chronic illness or loss of a loved one, this puts older adults, particularly the older-old, at a heightened risk of loneliness (Ó'Luanaigh & Lawlor, 2008).

1.10. Loneliness in Response to Trauma

To adequately examine the theoretical relationship between loneliness and PTSD in older adults, it is first important to consider the relationship between loneliness and trauma. Empirical studies have found that increased feelings of loneliness are common among trauma exposed individuals. For example, the findings of nationally representative sample of the Netherlands population showed a significant association between stressful childhood experiences and subsequent loneliness in adulthood (Merz & Jak, 2013). Moreover, it has been found, using latent class analysis, that individuals who reported higher levels of emotional loneliness were more likely to report experiencing childhood trauma and individuals who reported higher levels of both social and emotional loneliness were more likely to have experienced childhood and adulthood trauma (Hyland, Shevlin, et al., 2019). Increased loneliness has also been observed among active-duty soldiers who reported experiencing childhood trauma (Cacioppo et al., 2016). Moreover, sexual and crime-related trauma have been found to be associated with increased loneliness among incarcerated individuals (Kao et al., 2014). Additionally, the findings of a study of female childhood abuse victims demonstrated a significant association between experiencing childhood sexual abuse and enhanced feelings of loneliness, in comparison to a control group of females that had not experienced childhood sexual abuse (Gibson & Hartshorne, 1996).

Similar findings have been observed among older adult samples. Kuwert et al. (2014) found, among a sample of older U.S. veterans aged 60 years and older, that total lifetime traumas were associated with higher levels of loneliness in later life. Similar results were also found among adults aged 50 years and older with lifetime trauma predicting greater levels of loneliness. Moreover, older adults are more likely to experience traumatic events such as the unexpected death of a loved one or suffer from a chronic illness (Pietrzak, Goldstein et al., 2012). These age-related traumas among older adults are associated with greater loneliness in later life (Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2016; Pinquart & Sorensen, 2001).

1.11. Loneliness and PTSD

In order to understand the possible contribution of loneliness to PTSD in later life, it may help to consider its contribution to psychopathology in later life more broadly. Loneliness has a deleterious effect on an individual's mental wellbeing and has been found to be associated with numerous psychiatric conditions such as depression, generalised anxiety, and suicidal ideation (Beutel et al., 2017). A prominent theory that aids in the understanding of the contribution of loneliness towards the development of psychopathology is Hawkley and Cacioppo's (2010) "loneliness loop". According to this theory, individuals with the perception that they are socially isolated can often feel that they are unsafe, which triggers an implicit hypervigilance for threatening stimuli in the environment. This hypervigilance can then cause the individual to create cognitive biases such as the world is an unsafe place, therefore causing the individual to remain socially isolated, yet in turn, blaming this social isolation on the environment. This self-reinforcing loneliness loop can elicit feelings of hostility, stress, low self-esteem, anxiety and can also activate the neurobiological and behavioural mechanisms that contribute towards negative mental health outcomes (Hawkley & Cacioppo, 2010).

It is important to note that, according to the "loneliness loop" theory, a part of the pathway from loneliness towards the development of psychopathology includes increased social isolation/withdrawal (Hawkley & Cacioppo, 2010). Social isolation has also been found to predict numerous physical and psychiatric health outcomes (Cornwell & Waite, 2009; Coyle & Dugan, 2012; Dickens et al., 2011; Matthews et al., 2016). This may possibly be due to individuals with larger social control networks, as opposed to being socially isolated, being more likely to engage in positive health behaviours (Umberson, 1987), through either direct social control such as requests to seek treatment, or indirect social control such as feelings of responsibility from others to seek treatment (Tucker, 2002). This further emphasises the importance of loneliness among older adults, as loneliness may not only predict future psychopathology, but it can also increase social isolation, which can lead to psychiatric morbidity. Longitudinal evidence for the reciprocal/self-reinforcing nature of the relationship between social isolation and loneliness has been found with loneliness being inversely associated with future social engagement, and social engagement being inversely associated with future loneliness (McHugh Power et al., 2019). Furthermore, as social isolation in turn increases future loneliness, both of these constructs may play an important, interconnected, role in the development of psychopathology.

Additional pathways between loneliness and psychopathology have also been proposed. For example, loneliness has been found to be associated with sleep problems in older adults (McHugh & Lawlor, 2013; Wang et al., 2018), which may lead to adverse effects on health and wellbeing (Leigh-Hunt et al., 2017). The relationship between loneliness and psychopathology is likely to be bidirectional. For example, loneliness has been found be both a determinant of future depressive symptoms and a consequent of past depressive symptoms in older adults (Luo et al., 2012).

The relationship between loneliness and mental wellbeing in older adults has been found to be mediated via resilience (Gerino et al., 2017), suggesting that lonely individuals have a reduced capacity to withstand stressors and adverse events which may then lead to them being more vulnerable to the onset of psychopathology. As PTSD rates tend to decline in older age (Gum et al., 2009; Kessler et al., 2005; Reynolds et al., 2016), and resiliency tends to increase (Gooding et al., 2012; Grossmann et al., 2010; MacLeod et al., 2016), this may indicate that resiliency is an important protective factor in explaining the lower rates of PTSD in later life. This may also suggest that the differences across age groups is quantitative (and not qualitative) and dependent on individual differences in resiliency. Furthermore, if the differences between PTSD across age groups are quantitative, rather than qualitative, then this suggests that the literature regarding PTSD in the general population may be generalisable to older adults. Several studies, among the general population, have demonstrated a relationship between PTSD and loneliness (Itzhaky et al., 2017; Kuwert et al., 2014; Ross et al., 2018; Shevlin et al., 2015; Solomon et al., 1991; Tsur et al., 2019) and is likely to bidirectional.

Longitudinal research (van der Velden et al., 2018) has provided evidence that posttraumatic loneliness is dependent on PTSD severity, with high levels of PTSD predicting high future loneliness whereas low levels of PTSD decreased the likelihood of having moderate/high levels of loneliness. In addition, another longitudinal study (van der Velden et al., 2019) found that pre-traumatic loneliness predicted more severe posttraumatic stress symptoms following exposure to a traumatic event. These studies were conducted using general population samples, however, given that loneliness is associated with psychopathology in later life, it is possible that these findings extend to older adults. Additionally, Macleod (1994) noted, among a sample of World War II veterans, that a substantial proportion retrospectively reported that loneliness contributed to the re-emergence of PTSD symptoms in later life.

Loneliness has also been found to be associated with CPTSD. The findings from a sample of Israeli former prisoners of war demonstrated, using latent class analysis, that membership of a CPTSD class, compared to an asymptomatic class and a PTSD class, predicted loneliness in later life (Zerach et al., 2019). Moreover, loneliness among patients with CPTSD has been noted among clinical case studies (Dagan & Yager, 2019). However, given the recency of the release of the *ICD-11*, there is a lack of research examining the relationship between CPTSD and loneliness. Similar to PTSD, it is possible that loneliness may be associated with CPTSD symptomatology among older adults, given the clinical importance of loneliness in mental wellbeing in later life.

The relationship between loneliness and PTSD/CPTSD may be explained through the association between loneliness and individual symptoms of PTSD/CPTSD. Loneliness has been found to be associated with hypervigilance for social threat (Cacioppo et al., 2017; Hawkley & Cacioppo, 2010). A similar chronic disposition is common among individuals suffering with PTSD, whereby a persistent, pathological, sense of threat/hypervigilance is observed, despite the lack of an adequate corresponding environmental stimulus (Williamson et al., 2015). Therefore, it is possible in the context of traumatic exposure, this implicit hypervigilance for social threat within an individual's environment may lead to, maintain, or exacerbate posttraumatic hypervigilance symptoms. Furthermore, coinciding with these negative evaluations of the environment, similar cognitive biases are also observed within the *DSM-5* NACM symptom cluster, whereby individuals hold persistent negative beliefs about the self, others, or the world. Moreover, lonely individuals can often feel alienated, or disconnected, from others, which can predict increased PTSD symptom severity (DePrince et al., 2011) and is similar to an additional NACM symptom of feeling detached, or estranged, from others.

Loneliness is also associated with poorer sleep quality (Cacioppo, Hawkley, Berntson et al., 2002; Cacioppo, Hawkley, Crawford et al., 2002), a symptom of *DSM-5* PTSD, and is exacerbated among victims of violent trauma and childhood maltreatment (Matthews et al., 2017). This may be due to the increased hypervigilance for social threat among lonely individuals (Matthews et al., 2017). Moreover, research suggests that perceived stress partially mediates the relationship between loneliness and poorer sleep quality in older adults (McHugh & Lawlor, 2013; Segrin & Burke, 2015). The effects of stressful life events may be further exacerbated by the persistent stressful nature of loneliness, and may, therefore, lead to, or maintain, symptoms of PTSD such as sleep problems. Furthermore, Dagan and Yager (2019) noted that feelings of loneliness and being unsafe can lead to increased hypervigilance at night, resulting in further sleep problems and increased re-experiencing/intrusion symptoms (e.g. upsetting trauma-related dreams). Therefore, given the association between sleep problems and loneliness in older adults (McHugh & Lawlor, 2013; Wang et al., 2018), it is possible that loneliness may lead to symptoms of PTSD in later life, such as sleep problems, and vice-versa.

Social withdrawal as an avoidant coping strategy has been found to predict future PTSD symptom severity (Thompson et al., 2018). Avoidance of trauma reminders is also a common symptom of both *DSM-5* and *ICD-11* PTSD. Following trauma exposure, it is possible that the increased social withdrawal within lonely individuals, compared to non-lonely individuals, may evoke additional social withdrawal/disconnection from others, leading to PTSD avoidance symptoms (DePrince et al., 2011). Social withdrawal as a coping strategy has also been found to mediate the relationship between resilience and PTSD (Thompson et al., 2018). This may be particularly relevant in older adults, as resiliency has been found to be an important variable in the relationship between loneliness and mental wellbeing in later life (Gerino et al., 2017). Moreover, social withdrawal as a maladaptive coping strategy to avoid trauma-related stressors and manage PTSD symptomatology might elicit feelings of loneliness, given the longitudinal relationship between social engagement and loneliness in older adults (McHugh Power et al., 2019).

Loneliness has also been found to be associated with a number of symptoms reflective of each CPTSD symptom clusters including poorer emotional regulation and affective processing (Hawkley et al., 2009; Wong et al., 2016), negative self-concept (Goswick & Jones, 1981; Hawkley & Cacioppo, 2010; Knoke et al., 2010), and disturbances in relationships such as poorer marital adjustment (Solomon & Dekel, 2008) and marital quality (Knoke et al., 2010). This suggests that increased loneliness may be a risk factor for increased CPTSD symptom severity.

Although a number of studies have found cross-sectional and longitudinal relationships between PTSD/CPTSD symptoms and loneliness, the precise mechanisms that explain this relationship remain unclear. Given the association between loneliness, social isolation, trauma exposure, and psychopathology in later life, it is possible that trauma exposure leads to increased loneliness, which then leads to individual symptoms of PTSD/CPTSD among older adults, such as negative cognitions, hypervigilance, sleep problems, and disturbances in relationships. Furthermore, from the 'loneliness loop' the initial increase in loneliness may cause a reciprocal effect whereby loneliness is maintained through negative cognitive biases. This, in turn, may also cause the PTSD/CPTSD symptoms associated with loneliness to persist among older adults. It is also possible that, given the association between social isolation and loneliness, older adults who use social isolation/withdrawal as a coping mechanism may again enter the 'loneliness loop' whereby this withdrawal leads to negative cognitive biases, which leads to feelings of loneliness and ultimately PTSD/CPTSD symptomatology. Furthermore, social withdrawal in response to trauma and PTSD/CPTSD symptoms may, in turn, also lead to increased loneliness. Thus, it is possible that the relationship between loneliness and PTSD/CPTSD in older adults is bi-directional.

1.12. Conclusion

In summary, although research relating to PTSD in older adults is limited, several differences appear to exist between younger, middle-aged, and older adults regarding prevalence rates and symptomatology. PTSD prevalence among older adults appears to be significantly lower than in younger and middle-aged adults. Considering that this is a robust finding throughout the PTSD literature, it is important to establish whether the current diagnostic models of PTSD are valid for older adults. Furthermore, while sex differences in PTSD are quite apparent in the general population, there is a lack of research among older adults, thus additional research in area is required.

PTSD is associated with high rates of comorbidity with other psychiatric disorders such as depression, anxiety, and substance abuse in older adults in much the same way as in the wider general population. Regarding specific risk factors for developing PTSD among older adults, few studies have directly compared differences in the effects of risk factors across younger and older adults however both groups appear to be affected by similar risk factors. In order to better understand if PTSD is similarly related to external variables in older adults, it is paramount that additional research is conducted in these areas.

The adverse effects of loneliness in older adults are apparent. The loneliness loop may be an important theoretical framework in which to understand the relationship between loneliness and PTSD/CPTSD symptoms. Social isolation appears to be associated with traumatic exposure and may be used as coping mechanisms in response to trauma. This form of coping can often be maladaptive and may partially explain the relationship between social isolation, loneliness, and psychopathology. It is possible, therefore, that there is a longitudinal relationship between loneliness and PTSD. Given the heightened risk that older adults have in experiencing feelings of loneliness, examining the longitudinal relationship between loneliness and PTSD in this cohort is advantageous.

1.13. Aims of the Thesis

The overarching goal of the thesis was to advance current understandings of the nature of posttraumatic stress responses and their correlates in people over the age of 60. To achieve this goal, several research objectives were formulated. The first objective was to test the factorial validity of the *ICD-11* and *DSM-5* models of PTSD in a nationally representative sample of older adults, and to determine if these models evidence item-bias across the sexes. The second objective was to identify if there are unique patterns of comorbidity for *ICD-11* PTSD, and to identify key risk factors associated with these different patterns of comorbidity. The third objective was to examine longitudinal changes in social and emotional loneliness and their association with changes in PTSD symptoms. The final objective was to estimate the prevalence of

ICD-11 PTSD and CPTSD in a nationally representative sample of older adults and to determine the cross-sectional association between social and emotional loneliness and CPTSD.

Related to these objectives, and with reference to the existing theoretical and empirical literature, several hypotheses were formulated.

1. Based on the assumption inherent to the *DSM-5* and *ICD-11* models of PTSD that they are valid for older adults, it was hypothesised that the four-factor *DSM-5* model of PTSD, and the three-factor *ICD-11* model of PTSD, would adequately represent the latent structure of PTSD symptoms in older adults.
2. Based on prior research (King et al., 2013; Murphy et al., 2019; Rivollier et al., 2015) it was hypothesised that several symptoms of PTSD would show signs of item-bias across sex.
3. Based on the existing data (e.g. Pietrzak, Goldstein et al., 2012; Glück et al., 2016), it was hypothesised that high rates of comorbidity would be observed among those participants who met the diagnostic requirements for *ICD-11* PTSD.
4. Based on the predictions of the HiTOP model (Kotov et al., 2017), it was hypothesised that the highest rates of comorbidity would be found for 'distress' related disorders including major depressive disorder, generalised anxiety disorder, and borderline personality disorder.
5. Based on the findings from similar research (Galatzer-Levy et al., 2013; Müller et al., 2014), it was hypothesised that multiple latent classes would be identified including classes characterised by (i) low comorbidity, (ii) comorbidity with internalising disorders, and (iii) comorbidity with externalising and/or psychotic disorders.

6. It was further hypothesised that the latent classes characterised by the highest levels of diagnostic comorbidity would be most strongly associated with having a history of suicidal behaviour.
7. Based on previous longitudinal research (van der Velden et al., 2018, 2019) it was hypothesised that changes in social and emotional loneliness would be associated with changes in posttraumatic stress symptoms over time, controlling for multiple covariates.
8. Based on previous research (Dagan & Yager, 2019; van der Velden et al., 2018, 2019; Zerach et al., 2019) it was hypothesised that social and emotional loneliness would be positively associated with CPTSD symptoms, adjusting for multiple covariates.

Chapter 2

Methodology

2.1. Chapter Overview

To achieve the research objectives of this thesis, it was necessary to use several secondary datasets with varying methodological strategies. As such, this chapter provides details of the different methodologies employed within the different datasets (e.g. sampling procedure and weighting of the data) and the differing analytical approaches taken to achieve these research objectives. The chapter beings with details of the National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III; see Grant et al., 2014) project. This project is a large-scale study in the U.S. and provides the dataset used in Chapter 3 and Chapter 4. Next, the details of the Longitudinal Aging Study Amsterdam (LASA; see Huisman et al., 2011) will be discussed. This is a large-scale and long-term project in the Netherlands. Moreover, the dataset from this project was used in Chapter 5. Following this, the details of an existing U.S. dataset that was used in the final empirical chapter (Chapter 6) will be discussed. Alongside these methodological details of each chapter, the primary statistical techniques that were used throughout the four studies will be described. Although these techniques are briefly outlined in the latter chapters, a more thorough description of the primary analytical techniques are provided below.

2.2. NESARC-III

The NESARC-III is a nationally representative sample of non-institutionalised U.S. adults aged 18 or older (*N* = 36,309). Participants included in the full sample were aged 18 years and above. Respondents also included veterans of the United States Armed Forces; however, currently active military personnel were excluded. All data were collected between April 2012 and June 2013. Protocols of the NESARC-III project received ethical approval from the institutional review boards of the National Institutes of Health and Westat. All participants provided informed consent and were remunerated $90.00 for participating in the study. The following details of the preliminary testing, sampling strategy, interviewer training, data collection, and quality control procedures employed for the NESARC-III was obtained from the NESARC-III documentation provided by Grant and colleagues (2014).

2.2.1. Field test

Before the main data collection commenced, a field test was carried out to replicate the protocol, instruments, materials, and procedures of the main study, and also as a general evaluation of the study components such as interviewer recruitment and training. This involved collecting data on 35 respondents in Washington, D.C. Moreover, quotas were set to for participants based on demographics such as sex, age, ethnicity, and education. Following evaluation of the field test, the study components were refined before commencing the main study.

2.2.2. Participant selection/sampling procedures

The NESARC-III used multistage probability sampling to randomly select potential participants from the U.S. First, primary sampling units (PSUs) were selected, consisting primarily of individual counties. However, if a county was deemed to be too small in terms of population size, they were combined with contiguous counties so that the maximum travelling distance within the PSU was ≤ 100 miles and the number of occupied housing units were ≥ 5,760, based on the recommendations of Green and colleagues (2002). This resulted in a total of 2,349 PSUs. From the total number of PSUs, 150 were selected using stratified proportional-to-size sampling, with the probability proportional to the number of housing units.

Secondary sampling units (SSUs) were defined in terms of census blocks, or a combination of contiguous blocks, within the selected PSUs, with a minimum of 60 households per block. Areas with moderate and high prevalence of minority groups were oversampled (this was an intentional design characteristic of the data collection to ensure adequate representation of minority populations).

Next, dwelling units (i.e. individual households) within the SSUs were defined as tertiary sampling units. These dwelling units were selected using the U.S. Postal Service master address files for each SSU, resulting in a total of 71,052 dwelling units. In the final stage of participant selection, one or two adults were selected from each dwelling unit. In units with four or more eligible adults, two persons were sampled from the household. When there were three or fewer eligible adults, then only one person was selected.

Of the 71,052 dwelling units identified for selection, 11,327 were considered to be out of scope (e.g. inaccessible or vacant), resulting in a total of 59,725 dwelling units. A total of 17,033 households were classified as nonresponses, resulting in a remaining 42,692 responding households (screener response rate = 71.5%). Of these sampled households, 44,931 individuals were selected to take part in the study, of which, 1,567 were later deemed ineligible for participation in the interview (e.g. active U.S. military personnel). Of the remaining 43,364 eligible persons, 36,309 agreed to participate in the study (person-level response rate = 83.7%).

2.2.3. Interviewer training

As a requirement of the NESARC-III project, all interviewers received mandatory training. Approximately 1,000 trained interviewers were involved in the data collection. The interviewers were trained in survey administration techniques in order to adequately prepare for the components of the data collection such as correctly conducting the interview, dealing with the sensitive nature of the data and questions, and effectively building a rapport with the respondent. The interviews were trained using several training techniques that included home study, demonstrations (e.g. recorded demonstration of the entire interview), interactive lectures, practice exercises, and dyad role playing with other interviewers.

2.2.4. Data collection procedures

Prior to first contact with the interviewer, a letter and brochure were sent in advance to explain details of the NESARC-III project, such as the purpose of the study. These items were sent within two weeks of the intervener's first attempt to visit the participant's address.

The reasons for the advance letter and brochure were to inform the participant and were used as a method to facilitate cooperation from the participant.

At the first in-person contact with the respondent, the interviewer explained the purpose of the study and garnered information on the eligibility of the respondent (i.e. at least 18 years of age and was member of the household) for the screener interview. To limit the likelihood of nonresponse, interviewers attempted to make first contact during prime interviewing hours (i.e. 3–9 p.m. Monday–Friday and 10 a.m.–9 p.m. on the weekend). Moreover, in the event of the potential participant not responding, the interviewer attempted to make contact up to four times before reassessing whether to continue trying to recruit the participant. Strategies were also implemented to reduce the likelihood of nonresponse such as sending postcards with additional easy-to-read information about the NESARC-III. If the respondent was eligible, then the interviewer transitioned to the screener interview. This was conducted using the 'computer-assisted personal interviewing' (CAPI) screener. The reason for this screener interview was to collect demographic information such as the respondent's sex, age, race, and ethnicity and determine the respondent's active-duty military status. This information (age and active-duty military status) was used to determine the respondent's eligibility for the main interview.

The interviewer then moved onto the 'consent module', which was used to officially document the respondent's consent to participate in the study. The interviewer provided a consent brochure to the respondent and allowed them sufficient time to read it. Once the interviewer addressed any concerns that they participant had and the participant provided their full consent, the interviewer then moved onto the next stage. The participant had the choice to take part in the main interview and provide a sample of saliva for further analyses, or just take part in the main interview.

The next stage involved providing the respondent with an incentive to participate. The incentives used were in the form of two cash payments of $45 each. The first incentive was given to the participant after they had consented to participate, and the second incentive was given after completion of the main interview.

After the first incentive was given to the participant, the interviewer then began the main interview. The NESARC-III used the *Alcohol Use Disorder and Associated Disabilities Interview Schedule–5* (AUDADIS-5; Grant et al., 2011). This is a structured, diagnostic interview, designed for use by non-clinicians, that measures psychiatric symptoms for a number of psychiatric disorders, including mood disorders, anxiety disorders, substance use disorders, and a number of phobias. The AUDADIS-5 uses the diagnostic guidelines as outlined in the *DSM-5* (APA, 2013). The main interview was also conducted using the CAPI program. As such, this controlled the flow of the interview by skipping questions wherever possible to reduce the response burden of the participant. For example, if the participant reported that they have never drank alcohol, then any substance abuse questions related to alcohol consumption would be skipped. The interviewer also used a series of flashcards to assist with conducting the interview. One reason for using such an approach was that it helped participants to report sensitive information. For example, under the ‘traumatic experiences’ section of the interview, the interviewer would show the participant a flashcard with a list of different types of traumatic events that each had a corresponding number (e.g. 5 = “natural disaster, like flood, fire, earthquake, hurricane”). The participant would then say the corresponding number(s) to the interviewer without needing to explicitly state the type of traumatic event that they had experienced.

A subsample of respondents was re-interviewed using a shortened version of AUDADIS-5 and the Psychiatric Research Interview for Substance and Mental Disorders, *DSM-5* version (PRISM-5) to assess the reliability and procedural validity of the AUDADIS-5. It was found that the concordance of *DSM-5* diagnoses between the AUDADIS-5 and PRISM-5 were fair-to-moderate (Hasin et al., 2015). Moreover, test-retest reliability of past-year, prior-to-past-year, and lifetime diagnoses were generally fair-to-good for both the diagnostic variables and their respective continuous scales (Grant et al., 2015).

2.2.5. Quality control

A subsample consisting of randomly preselected participants (10% of the full sample) was used to ensure the validity of the data assessed. Additional cases were also selected throughout the data collection process to: (1) ensure that at least 10% of cases were selected, accounting for potential nonresponse in follow-up; (2) validate cases that had any reason to suspect that there were issues with the quality of the data; and (3) validate all interviews that were conducted as part of an interviewer incentive plan (these were plans to increase the productivity of the interviewer such as collecting data during seasonal holidays). This resulted in a total of 12,400 successful follow-up interviews with respondents, either by telephone or in-person.

During these follow-up interviews, the participant was asked a series of questions relating to the various components of the NESARC-III interview. This included questions pertaining to the interviewer's decorum (e.g. whether they were polite and respectful towards the participant), verifying that the interview was conducted in-person and on the registered date, verifying that the participant provided their full informed consent and had received the correct reimbursement for participating, and verifying their responses to some of the questions within the main interview.

2.2.6. Sample weighting

The sample collected was adjusted for the complex survey design of the NESARC-III based on the stratification, clustering, and weighting of the study population to reflect the U.S. civilian population as per the 2012 American Community Survey (Bureau of the Census, 2013). The use of a complex survey design in the NESARC-III accounted for variable probabilities of selection, nonresponse, and potential shortcomings in the sampling frame (e.g., under-coverage/over-coverage of certain population groups) by poststratification of the sample on the basis of age, sex, region, and ethnicity.

The use of a complex survey design, although quite beneficial in terms of representing a population, can complicate the variance estimation of standard statistical estimates by using a nonlinear function to estimate statistics such as means, proportions, correlations, and regression coefficients (Lavrakas, 2008). Using standard formulae for calculating these statistics, which assume a simple random sample design, can result in inaccurate standard errors and therefore lead to inaccurate inferences. For example, failure to account for the stratification of a sample can lead to overestimating standard errors, thereby increasing Type II errors; whereas, failing to account for the clustering of a sample can result in underestimating standard errors, thereby increasing Type I errors (Aneshensel, 2013).

To account for this complex survey design of the NESARC-III data, it is important to employ a variance estimation procedure, such as the Taylor series linearization method. This method involves taking the linear terms of the Taylor series expansion in order to reduce the nonlinear estimate to an approximate linear estimate (Lehtonen & Pahkinen, 2004). The variance of this estimate is then based on the Taylor series approximation to this estimate, thereby yielding more accurate standard errors. All analyses for Chapter 3 and Chapter 4 took this complex survey design into account, using the Taylor series linearization method.

2.2.7. Data access

Prior to requesting access to the NESARC-III dataset, it was first necessary to obtain ethical approval from the Social Research Ethics Subcommittee (SRESC) at Maynooth University. This process involved submitting an application which detailed the various aspects of the project, such as the purpose of the data collection, consent procedures, risks and benefits of the project, how the data will be analysed, the questionnaires contained within the dataset, and supporting documentation detailing the data collection procedures, participant information leaflets, and informed consent processes of the NESARC-III dataset.

In addition, detailed information was provided regarding data security and protection. In order to ensure the dataset was secure, all data was stored and encrypted on a password protected computer terminal. The data was also backed up to Microsoft OneDrive, securely hosted by Microsoft in Europe in compliance with the General Data Protection Regulation (GDPR). The data was backed up to Microsoft OneDrive to effectively minimise any losses that may result from the damage or corruption of the data. Moreover, this enabled secure transfer of the data among the research team, rather than using transfer methods that carry increased risk of data breaches and loss, such as email transfer and transfer via USB.

Once ethical approval was granted, a signed data use agreement was submitted to the National Institute on Alcohol Abuse and Alcoholism (NIAAA) to gain access to the NESARC-III dataset. This included information such as the authorised users of the dataset, the purposes of the data request, a brief description of the project, data analysis plan, and a copy of the ethical approval letter from Maynooth University. Once the

NIAAA approved the signed data use agreement for the purposes of the current thesis, the encrypted NESARC-III dataset was securely transferred. All identifiable information, such as the participant's name and date of birth, were removed from the dataset set prior to being sent to successful applicants for secondary data analyses.

2.2.8. Data processing

The NESARC-III dataset was selected as it contained key variables of interest (i.e., PTSD and other forms of psychopathology, diverse age range, demographic variables etc.). A subset of the NESARC-III dataset was created consisting of the key variables for all participants aged 60 years and older. Variables were identified using a codebook provided by the NIAAA. For simplicity, all variables were recoded to have the same value to indicate missing data and all binary symptom variables were recoded to the same values to indicate the presence, or absence, of a symptom (0 = symptom not present, 1 = symptom present). This allowed for easy transfer to other statistical software, such as Mplus, and for the interpretation of values to remain consistent across different variables.

The individual PTSD symptom variables were extracted to create a measure of PTSD following the *DSM-5* (APA, 2013) and *ICD-11* (WHO, 2018) guidelines. Although the AUDADIS-5 assesses psychiatric symptoms following the guidelines set forth by the *DSM-5*, as the data collection began prior to the publication of the finalised *DSM-5*, additional items were included in the questionnaire pertaining to possible symptoms of PTSD; however, all symptoms that were in the finalised *DSM-5* were included in the AUDADIS-5 interview. In addition, multiple items were combined to form several of the NACM symptoms. For example, to assess the NACM symptom of "persistent negative emotional state (e.g., fear, horror, anger, guilt, or shame)" (APA, 2013, p. 272), participants who reported experiencing at least one of four items measuring fear, horror, anger, and guilt/shame in response to trauma exposure were scored as endorsing the symptom of persistent negative emotional state. Therefore, it was possible to extract sufficient items from the AUDADIS-5 to represent the symptoms of PTSD according to the *DSM-5*.

Given the additional items assessed as part of the AUDADIS-5, it was also possible to extract sufficient items to represent the symptoms of PTSD according to the *ICD-11*. The items extracted are shown in Table 2.1 with their corresponding items from the International Trauma Questionnaire (ITQ; Cloitre et al., 2018). The ITQ is the only currently available and psychometrically supported measure of *ICD-11* PTSD.

2.2.9. Criteria for Chapter 3 and Chapter 4 subsamples

The data used within Chapter 3 were drawn from the full NESARC-III dataset based on the following inclusion criteria: first, the participant was aged 60 years or older; second, they reported at least one type of traumatic experience (either directly experiencing, witnessing, or learning about); third, they responded to all items according to both the *ICD-11* and *DSM-5* classifications of PTSD. This resulted in the inclusion of 5,366 participants for Chapter 3.

Data for Chapter 4 were selected on the flowing inclusion criteria: first, the participant was aged 60 years or older; second, they reported at least one type of traumatic experience (either directly experiencing, witnessing, or learning about); third, the participant must have met the symptomatic requirements for a PTSD diagnosis based on *ICD-11* diagnostic algorithm. This resulted in a subsample of 530 participants for Chapter 4.

Table 2.1
Comparison of ICD-11 PTSD items between the AUDADIS-5 and the ITQ.

AUDADIS-5 PTSD items	ITQ (*ICD-11*) PTSD items
1. Did you have bad dreams about it?	1. Having upsetting dreams that replay part of the experience or are clearly related to the experience?
2. Did you feel you were reliving it?	2. Having powerful images or memories that sometimes come into your mind in which you feel the experience is happening again in the here and now?
3. Did you try to stop thinking about it?	3. Avoiding internal reminders of the experience (for example, thoughts, feelings, or physical sensations)?
4. Did you avoid places/people that reminded you of it?	4. Avoiding external reminders of the experience (for example, people, places, conversations, objects, activities, or situations)?
5. Did you find yourself being more watchful/alert?	5. Being “super-alert”, watchful, or on guard?
6. Were you more jumpy/easily startled than usual?	6. Feeling jumpy or easily startled?

Note: AUDADIS-5 = *Alcohol Use Disorder and Associated Disabilities Interview Schedule-5*; ITQ = the International Trauma Questionnaire.

2.2.10. Analytical plan for Chapter 3

The two primary research objectives for Chapter 3 were to (1) test the validity of the *ICD-11* and *DSM-5* models of PTSD among older adults, and (2) assess these models for item-bias across sex.

To achieve the first research objective, a series of confirmatory factor analyses (CFA) were conducted to compare competing models of *DSM-5* and *ICD-11* PTSD; the models were based on prior factor analytic research (see Chapter 3 for all models). Seven models of *DSM-5* PTSD were tested with 4-7 factors, and three models of *ICD-11* PTSD were tested with 1-3 factors. The models were estimated using the robust weighted least squares estimator (WLSMV) as this estimator performs best with categorical data (Brown, 2006).

The adequacy of each model was assessed in relation to a number of goodness-of-fit indices (Hu & Bentler, 1999). A non-significant chi-square (χ^2) test indicates excellent model fit however the use of a χ^2 test is somewhat problematic as it has increased sensitivity with large samples and tends to excessively indicate poor model fit (Brown, 2006; Tanaka, 1987), therefore suggesting that the importance of examining the alternative goodness of fit indices. Comparative Fit Index (CFI; Bentler, 1990) and Tucker-Lewis Index (TLI; Tucker & Lewis, 1973) values ≥ .95 are indicative of good model fit for CFA when the data are dichotomous, assessed using WLSMV estimation, and when the sample size is ≥ 250 (Yu, 2002). The CFI and TLI are known as incremental (or comparative) fit indices that compare the hypothesised model to a more restricted baseline model with higher values indicating better fit (Hu & Bentler, 1999). The CFI is a normed index ranging from 0-1, whereas the TLI is a non-normed index which corrects for excess model complexity (i.e. includes superfluous parameters that provide minimal contribution to the improvement of model fit; Byrne, 2012). It has also been noted that the CFI may perform better than the TLI with binary outcomes (Yu, 2002).

Additionally, Root Mean Square Error of Approximation (RMSEA; Steiger, 1990) values ≤ .05 are indicative of satisfactory model fit for CFA when the data analysed are dichotomous, using WLSMV estimation, and when the sample size is ≥ 250 (Yu, 2002). The RMSEA and χ^2 test are types of absolute fit indices which assesses the degree to which an *a priori* model fits the sample data by comparing the fit of the hypothesised model to no model at all. The RMSEA examines the discrepancy between the observed covariance matrix and the hypothesised model covariance matrix (Chen, 2007). Moreover, this discrepancy is expressed per degree of freedom, thus favouring more parsimonious models (Browne & Cudeck, 1993).

In order to compare nested models (consisting of the same number of symptoms), changes (Δ) in the fit indices were used for model assessment. ΔCFI and ΔTLI of ≥ .010 or ΔRMSEA of ≥ .015 are indicative of superior model fit (Chen, 2007; Cheung & Rensvold, 2002; Putnick & Bornstein, 2016). Moreover, to compare non-nested models, the Bayesian information criterion (BIC; Schwarz, 1978) was used. As the BIC is not produced when models are tested using the WLSMV estimators, the models were re-estimated using the robust maximum likelihood estimator (MLR) to obtain these results. Models with lower BIC values are indicative of better relative fit. The BIC is a comparative fit index that takes the complexity of the model into account (using the χ^2 value), however, the BIC also adjusts for model complexity by penalising models with a greater number of estimated parameters within the model (Byrne, 2012).

The second objective was to determine whether males and females systematically differ in their responses to *DSM-5* and *ICD-11* PTSD symptoms (in other words, whether these items were biased across sex). This was assessed via a DIF analysis. DIF examines whether individual symptom scores vary on the basis of certain covariates (e.g. sex) while controlling for overall mean differences at the level of the latent variable. The presence of DIF is identified when an item exhibits different measurement properties irrespective of the overall latent mean differences (Woods, 2009). This suggests that, when statistically controlling differences in latent means, the probability of item response is significantly different depending on the covariate, that is, an individual's probability of endorsing a specific symptom (e.g. 'distressing dreams') may be influenced by group membership (e.g. males/females), despite exhibiting the same level of the underlying latent variable (e.g. 'intrusions' latent variable).

There are several different methodological approaches available to examine DIF that each carry their own psychometric advantages and disadvantages (for reviews, see Camilli, 2006; Millsap & Everson, 1993). Although DIF is often assessed through an item response theory (IRT) framework, when the data are categorical and as such fitted to a polychoric or tetrachoric correlation matrix (e.g. as is the case when using a categorical CFA with WLSMV estimation; Muthén, 1984; Muthén & Muthén, 2018) the relationship between several IRT statistical methods (such as the standard normal ogive model of IRT; see Muthén et al., 1991) and categorical CFA are formally equivalent (Takane & De Leeuw, 1987), thereby allowing DIF assessment to be parametrised within a CFA framework. Using the structural equation modelling (SEM) framework to assess DIF allows for the estimation of the latent variables of the construct (e.g. the 'intrusions' symptom cluster). One can then control for mean differences at the latent variable level and, therefore, assess DIF. Moreover, SEM processes parse out measurement error, thus providing more accurate parameter estimates (Bollen, 1989).

For the purposes of Chapter 3, DIF was examined using latent variable modelling, through the use of a multiple indicators multiple causes (MIMIC) model. MIMIC modelling allows for the examination of the validity of a model in the presence of covariates by simultaneously conducting a CFA model while regressing the latent variables onto covariates (Jöreskog & Goldberger, 1975), thus allowing for an estimation of differences in item functioning across groups. Using a MIMIC model approach to assess DIF can be advantageous as the sample does not need to be subdivided (Gallo et al., 1994).

The MIMIC models used in Chapter 3 consisted of a measurement model and a structural model. The measurement model examines the relationship between the items (symptoms) and their respective underlying latent variables (i.e. the latent variables of PTSD). Establishing the measurement model (i.e. *ICD-11* and *DSM-5* models of PTSD at the previous CFA stage of the analytical plan) was important to ensure that the factor structure of the model being examined was valid and provided an adequate representation of the data. The structural model was comprised of the latent variables regressed onto the covariate (i.e. sex), which estimates the latent variable mean differences across groups. This allows for the direct relationship between the covariate and the individual items to be ascertained, while holding the latent variables constant. An advantage of using a SEM framework is that the full model can be estimated simultaneously.

After the measurement and structural models were established, the direct paths between the covariate (i.e. sex) and the individual items were then fixed to zero. Fixing this direct path to zero essentially assumes that there is no DIF between the covariate and the item (i.e. the degree of DIF is zero). The modification indices (MI) were then inspected to determine which items may be exhibiting DIF. MIs denote a reduction in the χ^2 value if a certain parameter was freely estimated. In this sense MIs are a form of significance testing as a χ^2 reduction of 3.84 (with 1 degree of freedom; $\alpha = .05$) denotes a significant improvement in model fit (Schermelleh-Engel et al., 2003). A significant MI suggests that the direct path between a covariate and an item should be freed and implies that DIF may be present for the respective item. In other words, the DIF of the item is not equal to zero and should therefore not be fixed to zero. This is an iterative process whereby a single parameter is freed before re-specifying the model to assess for DIF in the remaining items. Although a significant MI may suggest that DIF is present, it has been argued that viewing DIF as a dichotomous classification (i.e. DIF/no DIF) based on statistical significance is somewhat problematic as DIF exists along a continuum (Borsboom, 2006). This problem can be exacerbated when dealing with large sample sizes as viewing the presence of any DIF as indicating that the item is systematically biased may lead to identifying an excessive number of items as being biased. Therefore, it is important to determine the degree of DIF that is present, in order to make correct inferences regarding the practical significance of the DIF across groups.

It is for this reason that Chapter 3 adopted a method advanced by Saris and colleagues (2009) which aims to reduce spurious inferences that may be drawn from significant MIs. This method incorporates information from MIs, statistical power, and standardised expected parameter change (EPC). The EPC provides an estimate of the size of the misspecification for a constrained parameter which can be used to avoid trivial misspecification. This approach can be used as an indication of the magnitude of DIF present, with greater EPC values indicating greater levels of DIF. Saris et al. (2009) also demonstrated that MIs are not only affected by large sample sizes, but also other model characteristics such as large factor loadings. This can lead to identifying trivial model misspecifications as being substantively relevant as these characteristics can overestimate the size of the MIs. Therefore, it is important to calculate the power of the MI test as it may be overly sensitive to model misspecifications. Regarding the power of the MI test, a non-centrality parameter (NCP) can be calculated using the MI, EPC, and a specified deviation (δ). In Chapter 3, a deviation of $\delta = 0.1$ was used to calculate the power of the MI test, as Saris et al. (2009) recommended a deviation of $\delta \geq 0.1$ as being substantively relevant for a standardised structural parameter. As the asymptotic distribution of the MI is non-central χ^2, the power of the MI test can be determined using the NCP and a specified significance level (e.g. $\alpha = .05$; for more information and formulae etc. see Saris et al., 1987, 2009).

Saris et al. (2009) put forth guidelines to inspect model misspecification using the MIs, power, and EPC. First, if the MI is significant and the power of the test is low, then there is a misspecification in the hypothesised model, as the MI test was able to capture the misspecification despite the low power. In the second situation, the MI is non-significant, and the power of the test is high. It can therefore be concluded that the parameter is not mis-specified. In the third situation, the MI is significant, and the power of the MI test is also high. In this situation, it is recommended that the EPC is inspected in order to avoid trivial misspecifications. If the EPC is low, then there is no model misspecification, however, if the EPC is large then model re-evaluation should be considered (assuming the misspecification is substantively meaningful). As a misspecification of ≥ 0.1 is recommended to be substantively relevant for a standardised structural parameter, an EPC ≥ 0.1 was considered to be of practical concern, thus being indicative of the presence of DIF. In the fourth situation, the MI is non-significant, and the power of the MI test is also low. In this situation, the lack of information available precludes any definitive conclusions from being drawn regarding the presence or absence of a model misspecification.

To summarise the approach taken in Chapter 3, the measurement and structural models are established, with the paths from sex to the items constrained to be zero (while holding the latent means constant across groups). If a MI is significant, with either an EPC ≥ 0.1 or the power of the MI test is low, then the parameter with the largest MI or EPC is considered to be indicative of DIF and is subsequently freely estimated. As this is a sequential process, the model is then re-evaluated and assessed for evidence of DIF. An item is said to lack sufficient evidence of DIF if the MI is significant with an EPC < 0.1 and high power, or alternatively, the MI is non-significant with high power. If the MI is not significant with low power, then the result is said to be inconclusive.

2.2.11. Analytical plan for Chapter 4

The two primary research objectives for Chapter 4 were to (1) identify discernible patterns of *ICD-11* PTSD psychiatric diagnostic comorbidity, and (2) examine the association between these patterns of comorbidity and a number of covariates.

This first research objective was achieved using a latent class analysis (LCA). Employing finite mixture modelling such as LCA is a useful analytical approach for explaining unobserved (i.e. latent) population heterogeneity (Nylund-Gibson & Masyn, 2016). LCA is a flexible person-centred approach that assumes the overall population distribution of a set of categorical indicators (or manifest/observed variables) consist of multiple homogeneous subgroups (i.e. latent classes) within the population (Masyn, 2013). Moreover, this population heterogeneity is parametrised as a combination of within-class and between-class differences (Nylund-Gibson & Masyn, 2016). LCA achieves this by assuming the existence of a categorical latent variable which explains the observed associations among a set of multivariate categorical variables. Based on an individual's pattern of responses to the categorical variables, they are assigned to a latent class which consists of a subgroup of individuals who demonstrated similar response patterns. Identifying the existence of these qualitatively distinct homogeneous subgroups within the population can aid in explaining interindividual variability within the population and determine the variables that predict such variability.

As individuals can often express heterogeneity in terms of psychiatric comorbidity (e.g. Caspi et al., 2020), the use of LCA may be particularly beneficial in understanding psychopathology. For example, explaining this seemingly heterogenous population into a relatively small number of homogeneous response patterns (i.e. latent classes) may provide clinicians and researchers with a more parsimonious solution to understating psychiatric comorbidity and may therefore lead to the development of scalable interventions. Take, for example, the latent class indicators of Chapter 4. These consisted of 13 dichotomous variables which indicated either the presence, or absence, of a comorbid psychiatric disorder, such as major depressive disorder, within a sample of individuals who all met the symptom criteria for PTSD. This results in a possible 8,192 (2^{13}) different response patterns of PTSD psychiatric comorbidity. As such, simplifying these into a small number of homogeneous subgroups/latent classes, for example, three latent classes as found in prior research (Galatzer-Levy et al., 2013; Müller et al., 2014) that consist of individuals with similar response patterns may be more realistic and applicable in explaining, and therefore addressing, psychiatric comorbidity.

An important step in performing an LCA is to first establish the measurement model by determining the most appropriate number of latent classes. In order to determine the optimal number of latent classes, the fit of models consisting of one to six latent classes were compared. These models were estimated using MLR estimation, the default (Mplus) estimator for mixture models (Muthén & Muthén, 2018). The model fit of each latent class solution was determined using multiple fit indices: the Akaike information criterion (AIC; Akaike, 1987), the BIC, the sample size-adjusted BIC (ssaBIC; Sclove, 1987), entropy values, and the Lo–Mendell–Rubin adjusted likelihood ratio test (LMR-A; Lo et al., 2001). The AIC, BIC, and ssaBIC are comparative fit indices with lower values being indicative of better model fit. Entropy values range from 0–1, with higher values suggesting better model fit. This statistic reflects the accuracy of the model in correctly assigning individuals to their respective latent class

(Celeux & Soromenho, 1996). The LMR-A likelihood ratio test compares a latent class solution to a solution with one less class. A non-significant LMR-A value suggests that the solution with one less class should be accepted. Prior Monte Carlo simulation studies identified the BIC as being the best indicator for class enumeration (Nylund et al., 2007).

During the maximum likelihood estimation process, a principled search algorithm is used whereby an iterative process occurs until it reaches a convergence criterion, that is, the absolute difference between successive iterations being small enough to be considered trivial (Collins & Lanza, 2013). There are several solutions on which the algorithm can converge, referred to as local maxima, however, there is only one solution that is best, referred to as the global maximum. This is the solution with the largest loglikelihood. However, the algorithm is unable to distinguish between a local and global maximum. Therefore, it is possible that the best solution (global maximum) may be missed. To avoid this, it is recommended to use an increased number of random sets of stating values which increase the likelihood that the algorithm will converge on a global, rather than local, maximum. In Chapter 4, to avoid solutions based on local maxima, 500 random sets of starting values were used followed by 100 final stage optimizations.

To better illustrate this process, Masyn (2013) described it as being analogous to a mountain climber attempting to reach the highest peak of a mountain, however, is unable to see the other peaks of the mountain. Mountainous regions often have many peaks (local maxima) but only one true highest peak (the global maximum). Depending on where the climber begins their ascent at the base of the mountain, they climb upwards until they reach a peak. This peak may not be the highest point, however, as they are unable to see the other peaks of the mountain, they may falsely assert that they have reached the highest point. In other words, depending on the set of starting values of the algorithm (i.e. where the climber begins their ascent of the mountain), the estimation algorithm may converge on a local, rather than global, maximum. To combat this, a large team of climbers could attempt to climb the mountain, with each starting at random locations at the base of the mountain (i.e. using many random sets of starting values). If a number of climbers agree on a particular peak being the highest point, then it more likely that this is truly the highest point. In other words, if the estimation algorithm is performed many times, each with a different set of random starting values, then it is more likely that the highest point at which they converge will be the global maximum.

For every indicator (psychiatric disorder) within each latent class, there are conditional probabilities. This is the probability that a member of a latent class will endorse a specific indicator (Neely-Barnes, 2010). To determine the characteristics of each latent class (i.e. which comorbid psychiatric disorders are more likely to be endorsed), the conditional probability of endorsing a specific psychiatric disorder was used. The following criteria were used based on studies of a similar nature (Burstein et al., 2012; Galatzer-Levy et al., 2013): a probability ≥ .15 indicated a class characteristic; a probability ≥ .15 and ≤ .59 was indicative of a moderate probability of comorbid diagnosis; and a probability ≥ .60 suggested that the comorbid disorder was highly probable within the respective latent class.

To achieve the second objective of examining the association between the latent classes identified during the class enumeration process and multiple covariates, a multinomial logistic regression was used whereby the latent classes were regressed onto the covariates. This was performed using the R3STEP function in Mplus (Muthén, & Muthén, 2018; Vermunt, 2010). This is a three-step procedure which involves first establishing the most appropriate latent classes; then obtaining the most likely class memberships based on the posterior probabilities of the LCA while accounting for the classification uncertainty rate (i.e. measurement error); and finally the most likely class memberships are regressed onto the covariates, thereby accounting for at least some of the misclassification error (Asparouhov & Muthén, 2014; Vermunt, 2010). This method is advantageous as it does not result in a shift in latent classes when the covariates are included in the model.

2.3. LASA

The dataset used within Chapter 5 was drawn from the LASA project. This is an ongoing prospective study that commenced data collection in 1992/1993, with data being collected approximately every three years. The LASA project was initiated by the Ministry of Health, Welfare and Sport in the Netherlands. This project was designed to be an interdisciplinary, longitudinal study on aging that focused on the physical, cognitive, emotional, and social aspects of aging, with the purpose of developing and evaluating governmental policy in the field of aging (Huisman et al., 2011). Protocols of the LASA project were approved by the Ethical Review Board of Vrije Universiteit (VU) Medical Center, Amsterdam and all respondents provided informed consent according to prevailing law in the Netherlands.

2.3.1. Participant selection/sampling procedures

Participants were drawn from nine municipalities across three regions of the Netherlands. These regions were selected to provide an adequate representation of older adults in the Netherlands as they encompassed urban and rural areas throughout three culturally distinct regions (Huisman et al., 2011). Stratified for age and sex, individuals were randomly sampled from each of the three regions. However, the older-old (those aged 75 years and older) and older men were oversampled to account for potential attrition, ensuring that there were a representative number of individuals after many years of follow-up. The sample was selected to adequately represent that national distribution of urbanicity and population density.

The initial baseline dataset in the LASA project was drawn from the Living Arrangements and Social Networks (LSN; see Knipscheer et al., 1995) study, a previous study on older adults in the Netherlands. The LSN study consisted of older adults (*n* = 4,494) born between 1903–1937. The ‘cooperation rate’ (which was defined as the total number of completed interviews divided by the total number of eligible persons who were contacted to participate; Hoogendijk et al., 2016) for the initial wave of data collection in 1992 was 62%. However, for the purposes of the LASA project only individuals aged 55–85 (i.e. born between 1907–1937; *n* = 3,805) were selected to be contacted to take part in the LASA project. The first cycle of data collection for the LASA project commenced 11 months following the LSN study in 1992/1993 (*n* = 3,107), with a cooperation rate of 89%. For clarity, although this wave was the first of the LASA project (i.e. the baseline wave), it was termed ‘Wave B’, with ‘Wave A’ being the data collected during the LSN study. The LASA project is currently on its ninth cycle (‘Wave G’) of data collection, with the data being collected in 2018/2019.

To ensure that there was a sufficient sample size for future research, additional cohorts were collected at ten-year intervals following the initial baseline wave, alongside the original cohort that were continued to be assessed approximately every three years. The first additional cohort was collected in 2002/2003 (*n* = 1,002) consisting of older adults born between 1938–1947. The cooperation rate of this sample was 62%. The second additional cohort was collected in 2012/2013 (*n* = 1,023) consisting of older adults born between 1948–1957. The cooperation rate of this sample was 63%.

2.3.2. Interviewer training

All interviewers were recruited from the same geographic regions that participants were selected. Moreover, an effort was made during the recruitment process to make sure that interviewers had an affinity with older adults. Interviewers received approximately three-four days of training, depending on their previous history of interviewing participants. This included exercises such as delivering the interview and dyadic role-playing. Furthermore, interviewers met on a regular basis during the data collection period for evaluation.

2.3.3. Data collection procedures

Two weeks prior to the interviewer contacting the participant, an invitation letter and leaflet were sent to the participant’s home address. The interviewer then contacted the participant by phone and scheduled the time and date for conducting the interview. If the participant was unable to take part in a face-to-face interview, then they were asked to take part in a brief interview by telephone. Most participants who participated in the previous wave were eligible to participate. However, participants who were unable to participate in the previous wave, indicated that they did not want to take part in future waves, or could only take part in the brief interview by telephone were not contacted again to take part. Respondents were asked to provide written consent to participate in the study, by signing an informed consent document, as this is a legal requirement within the Netherlands. Moreover, participants were also asked to consent to having their doctors contacted for additional information, if required.

Each interview is comprised of three components: the main interview, a self-administered questionnaire, and an additional medical interview (depending on whether the participant consented to take part in the medical interview). The main/medical interviews are conducted in the respondent’s home by trained interviewers. The main interview took approximately two hours to conduct. However, the respondent was also offered the choice to take part in a shortened interview (approximately one hour) or complete the interview across two separate days. The main interview included assessments to measure different areas such as psychiatric symptoms and social, cognitive, and physical functioning. To aid with longitudinal comparisons, all measurement scales remained the same over time. However, additional measurements were included, and some measurements were removed throughout the different LASA waves. For example, Parkinson’s diseases and a perceived stress measurement were included at later cycles of data collection. All interviews for data collection (for the main interview of data collection) began in September and ended in September of the following year.

The self-administered questionnaire was completed online or using a pencil-and-paper format, depending on the respondent’s preference. This questionnaire was either collected by the interviewer at a later stage or sent by mail. The medical interview was scheduled to be conducted at a later stage and took approximately one hour to complete. The medical interview was delivered from trained interviewers that had some form of experience with treating older adults that involved physical contact (e.g. nursing or physiotherapy). The medical interview involved psychiatric diagnostic assessments for individuals who scored highly on the psychiatric components (e.g. depression) during the main interview.

With the participant’s consent, all interviews were recorded for two primary reasons. First, this helped facilitate the data cleaning process after the interviews were conducted, whereby any inconsistencies or obscurities could be rectified. Second, these recording were used to evaluate the interviewers and enhance the interviewing process.

2.3.4. Data access

In order to gain access to the LASA dataset, it was first necessary to obtain ethical approval from the SRESC at Maynooth University. An application was submitted which consisted of pertinent information such as the purpose of the data collection, consent procedures, risks and benefits of the project, how the data will be analysed, the questionnaires contained within the dataset, and supporting documentation detailing the data collection procedures, participant information leaflets, and informed consent processes of the LASA dataset. Furthermore, it was also necessary to translate the original documents from 1992/1993, regarding the LASA project, from Dutch to English. These documents were also submitted alongside the other supporting documentation during the ethical review process.

Similar procedures to the NESARC-III dataset were implemented regarding data protection and security, in that, all data was encrypted and stored on a password protected computer terminal. To protect against loss of data due to damage or corruption of the dataset, the data was also backed up to Microsoft OneDrive as the servers are hosted in Europe and are in compliance with the GDPR.

Once ethical approval was granted, contact was made with the scientific director of the LASA project regarding the use of the LASA data. The purpose of this contact was to establish interest in the proposed research ideas and to identify potential collaborators from the LASA steering group. Next, a formal proposal was submitted to the LASA steering group detaining information such as a literature review regarding the hypotheses of the project, a list of variables that were needed to complete the research project, and a detailed data analysis plan. This proposal then underwent review by the LASA steering group. Once the proposal was accepted, a signed data use agreement was sent to the LASA steering group and the dataset was subsequently securely transferred for secondary analyses.

2.3.5. Data processing

Each set of variables requested (e.g., all PTSD variables from the first time point) was securely transferred in separate files. Therefore, it was first necessary to extract all the variables to be used and merge all the files together to create a single dataset consisting of all the variables used in Chapter 5 from both waves of data that were requested. The variables were identified using a codebook on the LASA website, including those such as PTSD variables, loneliness variables, and demographic variables.

The loneliness variables were subsequently recoded following the guidelines for the 11-item De Jong Gierveld Loneliness Scale (de Jong Gierveld & Kamphuis, 1985; de Jong Gierveld & van Tilburg, 2006). This involved recoding the trichotomous response format (‘no’ = 1, ‘more-or-less’ = 2, ‘yes’ = 3) into a dichotomous format (0 = ‘absence of loneliness item’, 1 = ‘presence of loneliness item’), whereby all ‘more-or-less’ responses were merged with ‘no’ for the positive items, and ‘yes’ for the negative items. The scores on positively phrased items were then reversed so that higher scores were indicative of higher levels of loneliness. This results in all ‘more-or-less’ responses being indicative of higher loneliness.

2.3.6. Criteria for Chapter 5 subsample

The subsample for Chapter 5 analyses was drawn from two waves of the LASA dataset consisting of respondents who took part in in ‘Wave D’ (n = 2,076; collected in 1998/1999) and ‘Wave E’ (n = 1,691; collected in 2001/2002). Subsequently, these are referred to as Time 1 and Time 2, respectively. These two waves were chosen as they were the only waves in the LASA dataset to include an assessment of posttraumatic stress symptoms. Attrition between the two waves was due to mortality (n = 289), inability to take part (n = 31), refusal to take part (n = 62), and inability to make contact (n = 3). Moreover, a number of measures, including posttraumatic stress symptoms, were only assessed during the full main face-to-face interview (i.e. excluding participants who undertook shortened interviews [n = 156], discontinued their interview early [n = 6], or were interviewed via telephone [n = 253]). Therefore, the sample used in Chapter 5 (n = 1,276) was comprised of participants who completed the main interview at both Time 1 and Time 2.

2.3.7. Analytical plan for Chapter 5

The primary objective of Chapter 5 was to examine whether changes over time in loneliness (social and emotional) were associated with changes over time in posttraumatic stress symptoms.

First, in order to examine within-person change over time, it is often implicitly assumed, or is most accurate when, the metric(s) being examined is invariant across the different time points (Liu, Millsap et al., 2017). Non-invariance can result in the factor loadings and/or intercepts (or thresholds) differentially contributing to the means (Sass, 2011). This adversely impacts the measurements across time and can prevent valid and comparable estimates in the scores on each construct. Therefore, to ensure that changes observed over time are a reflection of changes in the level of the construct and not changes in what is being measured, the longitudinal measurement invariance of each latent variable (i.e. posttraumatic stress symptoms, and social and emotional loneliness) was examined.

This involves testing a sequence of increasingly constrained nested models (Meredith, 1993; Millsap & Cham, 2012) to determine whether the constructs being examined differ across time: (1) a configural model is established whereby the factorial structure is simultaneously assessed across time, and factor loadings, intercepts (or thresholds), and unique factor variances are freely estimated; (2) in the weak (metric) invariance model, factor loadings are held equal across time. If the fit of the weak invariance model does not significantly differ from the configural model, then weak invariance is established. Non-invariance at this stage suggests that the conceptual understanding of the construct differs across time, certain items are more applicable or are more appropriate at one time compared to other, or individuals at one time may have responded differently to extreme items (Chen, 2008; Sass, 2011); (3) in the strong (scalar) invariance model, factor loadings and intercepts (or thresholds) are constrained to be equal across time. If the model fit does not significantly differ from the weak invariance model, then strong invariance is established. If strong invariance is established, this implies that the means, variances, and covariances of the latent variables can be compared across time and differences across time in the means of the manifest variables are due to differences across time in the means of the latent variables (Liu, Millsap et al., 2017). Non-invariance at this stage suggests that individuals with the same score on the latent variable respond differently to certain indicators (items) of that latent variable (Sass, 2011). In other words, the items are biased across time. Similarly, with categorical data, this suggest that item thresholds are different across time, despite equal scores on the latent variable; and (4) in the strict invariance model, factor loadings, intercepts (or thresholds), and unique factor variances are held equal across time. If the model fit does not significantly differ from the strong invariance model, then strict invariance is established. If strict measurement invariance is established, this implies that differences in the means, variances, and covariances of the manifest variables across time are due to differences in the latent variables (Liu, Millsap et al., 2017). Non-invariance at this stage suggests that although the construct can still be compared at the latent variable level, this is measured with different degrees of measurement error across time (van de Schoot et al., 2012).

Longitudinal measurement invariance is similar to measurement invariance across groups; however, it also carries additional specifications such as the latent factors at Time 1 and Time 2 are allowed to covary, as well as the unique factor variances across time (Millsap & Cham, 2012). Significant Mardia's multivariate normality tests (all $p < .001$) suggested that the data for the posttraumatic stress symptoms variables was non-normal. Therefore, the posttraumatic symptoms longitudinal measurement invariance models were estimated using the MLR estimator to account for the non-normality of the data. Social and emotional loneliness longitudinal measurement invariance was estimated using the WLSMV estimator, as this estimator performs best with categorical data (Brown, 2006), with theta parametrisation in order to estimate/constrain unique factor variances over time. Furthermore, following the additional guidelines for longitudinal measurement invariance with ordered-categorical data (Liu, Millsap et al., 2017), in addition to measurement invariance using dichotomous indicators (Millsap & Yun-Tein, 2004), the threshold of each dichotomous indicator was constrained to be equal over time, for identification purposes, to establish the configural model. Thus, it was not possible to ascertain the strong invariance model with the social and emotional loneliness latent constructs.

Model fit was assessed using multiple goodness-of-fit indices (Hooper et al., 2008; Hu & Bentler, 1999). CFI and TLI values ≥ .90 indicate satisfactory model fit, with values values ≥ .95 indicating good fit. Additionally, RMSEA values ≤ .08 indicate satisfactory model fit, with values ≤ .06 indicating good fit. To compare nested models, the likelihood ratio test (Satorra, 2000; Satorra & Bentler, 2001) was used whereby a significant result suggests a change in model fit. Additionally, ΔCFI and ΔTLI ≥ .010, and ΔRMSEA ≥ .015, indicate significant change in model fit (Chen, 2007; Cheung & Rensvold, 2002).

To examine intraindividual (changes across time for posttraumatic stress symptoms, social loneliness, and emotional loneliness) and interindividual (changes in social loneliness and emotional loneliness are related to changes in posttraumatic stress symptoms) change over time, a recently developed statistical approach was employed, termed the ‘two-wave latent change score’ model (2W-LCS; see Henk & Castro-Schilo, 2016). Modelling change over time within a SEM framework is advantageous as it parses out measurement error, thereby, leading to more accurate parameter estimates (McArdle & Nesselroade, 1994). This is a strong rationale for using an LCS model, as simply calculating the difference between two observable variables can be considerably problematic. For example, as both observed variables contain a certain degree of measurement error, the difference between these two variables will reflect the true difference between scores and the difference in an unknown amount of measurement error (Henk & Castro-Schilo, 2016). Moreover, this approach can also result in attenuated variability in the difference score and therefore result in a loss of information (Henk & Castro-Schilo, 2016). Of course, this issue is of less severity depending on the reliability of the construct, in that highly reliable constructs (at each wave) are comprised of less measurement error. An LCS is conceptually akin to difference scores created by subtracting a Time 2 variable from its respective Time 1 variable but defined at the latent variable level. As this variable is defined at the latent variable level it is, at least in theory, free of measurement error.

An LCS is created by regressing the Time 2 latent factor onto both the Time 1 latent factor and the LCS latent factor (which is a second-order factor with no observed indicators), with the regressive pathways constrained to one (Henk & Castro-Schilo, 2016). Moreover, the covariance between these two factors (Time 1 and the LCS) is freely estimated. Within the 2W-LCS framework, the latent constructs are held invariant across time regarding the factor loadings, intercepts/thresholds, and unique factor variances, and the unique factor covariances are freely estimated across time. Unique factor variances represent the unique variance of each item that is not explained by its respective latent variable (i.e. measurement error). In a standard cross-sectional SEM model, unique factor covariation among items is typically assumed to be zero, as this covariation represents systematic error among items. The reason that this covariation does not represents random error is that it is, by definition, random and therefore cannot be corelated (Newsom, 2015). However, given that the reason for systematic error of a particular item at one time is likely to be the same reason for systematic error of that same item at another time, it is important that these unique factor variances are allowed to freely correlate across time (Newsom, 2015). For example, if responses to an item are partially due to a methodological artefact such as social desirability at Time 1 (e.g. respondent may under-report feelings of loneliness due to perceived stigma), it is likely that this social desirability effect will still impact responses at Time 2. Omitting these covariances from the model can overestimate the autoregressions in the model (Newsom, 2015). Moreover, estimating the unique factor covariances across time can account for some of the systematic bias that affect item responses (Newsom, 2015).

As a preliminary step to examining change-to-change relationships for posttraumatic stress symptoms, social loneliness, and emotional loneliness, it was necessary to first fit univariate LCS models for the individual constructs. This allows for identifying whether there were significant mean and variance changes in the respective LCS. A significant LCS mean suggest that individuals, on average, increased or decreased over time; whereas a significant variance in the LCS suggests that there was significant within-person heterogeneity over time. This information can be useful for assessing the variability of the construct over time. For example, although the mean of an LCS may be nonsignificant, suggesting that average scores did not change over time, there may still be significant variability among responses. As such, it is still possible to examine the variables that are associated with this variability.

Next, the multivariate 2W-LCS model was fitted where the within-person change in posttraumatic stress symptoms (denoted as Δposttraumatic stress symptoms) was regressed onto the within-person change for social loneliness (Δsocial loneliness) and emotional loneliness (Δemotional loneliness). Moreover, the LCSs were regressed onto the exogenous covariates. The 2W-LCS model allows researchers to examine change-to-change hypotheses whereby both interindividual and intraindividual change are estimated. This enables one to examine the potential predictors of this change. This a considerable strength of the 2W-LCS approach. For example, alternative approaches such as the two-wave panel model (Little et al., 2007) assess residual change (residual change being the deviation from the expected score at Time 2 following the autoregression of Time 2 on Time 1) and not true intraindividual change (Henk & Castro-Schilo, 2016). Without estimating true within-person change over time, it limits the capacity of the approach to examine change-to-change hypotheses (see Henk & Castro-Schilo, 2016). As the 2W-LCS model allows for the estimation of both within-person and between-person change, it is possible to successfully examine change-to-change hypotheses (i.e. between-person differences in intraindividual change scores on one construct will predict between-person differences in intraindividual change scores on another construct).

Due to the non-normality of the posttraumatic stress symptoms variables, the univariate posttraumatic stress symptoms model was estimated using the MLR estimator. This estimator is robust to non-normally distributed data and can account for multivariate non-normality. Whereas the emotional loneliness and social loneliness models were estimated using the WLSMV estimator, as this estimator performs best with categorical data (Brown, 2006), with theta parametrisation in order to estimate/constrain unique factor variances over time. Moreover, the multivariate 2W-LCS model was estimated using WLSMV with theta parametrisation.

It is important to note that as the 2W-LCS approach examines the change-to-change relationship of multiple constructs over a single period of time (i.e. across two waves), this limits any statistical inferences regarding the precise temporal nature of the relationship (Henk & Castro-Schilo, 2016). In order to ascertain more information regarding the temporal separation of these constructs (e.g. changes in loneliness occur prior to the changes in posttraumatic stress symptoms), it would be necessary to collect at least three occasions of data. That is, in order to determine whether changes in one construct precede changes in another (i.e. change in one construct will cause another construct to change), there would need to be at least two intervals of change (for example, across three waves, i.e. the change measured from the first and second wave; and the change measured from the second and third wave). Nonetheless, Henk and Castro-Schilo (2016) argue that researchers should not be dissuaded from using two-waves of data and found that the 2W-LCS approach still provides useful information by identifying the initial evidence of longitudinal associations among covarying constructs.

2.4. Chapter 6 Secondary Dataset

Data for Chapter 6 was drawn from an existing dataset (see Cloitre et al., 2019) that was used to examine the prevalence of *ICD-11* PTSD and CPTSD in a U.S. nationally representative sample of non-institutionalized adults aged between 18–70 years. Protocols of this study received ethical approval from the research ethics committee at the National College of Ireland, and all participants provided their full informed consent.

2.4.1. Participant selection/sampling procedures

All data was collected using a world-wide market research company called GfK. GfK use a nationally representative panel system of the U.S. population (that is comprised of 55,000 panel members) who are willing to participate in survey-based research. Registered panel members are contacted by GfK via email and asked to indicate their interest in participating in a given study. All questionnaires are then completed online using a secured GfK website.

The inclusion criteria for the study that the Chapter 6 dataset was drawn from were that respondents had to be between 18–70 years of age and had experienced at least one childhood or adulthood traumatic event in their lifetime. The participants were panel members of GfK and were randomly selected through random probability-based sampling. The resulted in, 3,953 potential participants being contacted to take part; of which, 1,839 (response rate = 46.5%) volunteered and met the inclusion criteria. The survey design also oversampled females and ethnic minorities, both at approximately a 2:1 ratio.

2.4.2. Data collection procedures

Once the potential participants were selected and indicated that they were eligible and consented to taking part in the study, they then completed the questionnaires online, using a secured GfK website. This online approach can be beneficial for the participants as it allows them to choose a time of day to complete the survey that they find to be most convenient.

The panel members were informed that they were under no obligation to complete the survey and were notified of their right to withdraw from the study at any time they wish. All matters pertaining to confidentiality, anonymity, and freedom of information are clearly articulated to panel members when they apply to become a panel member of GfK. Moreover, panel members are regularly sent reminders of their rights and ability to withdraw from the survey at any point in time. All participants were informed during the data collection process that the data they provided was intented to be used for publication purposes, both to the scientific community and the general public, and would also be shared with other researchers for secondary data analyses. Following completion of the questionnaires, particpants were debriefed by informing them of a free psyhcological support service provided by the National Center for PTSD Division of Dissemination and Training that they could contact upon experiencing any distress from the nature of the study questions.

All questionnaires were completed within March 2017. To minimise nonresponse, potential participants were sent reminders of the study throughout the month of March 2017. Panel members received financial reimbursement for their participation in the GfK panel, and potential participants were also incentivised to take in the study through entry into a raffle for prizes. The median completion time of all questionnaires was 18 minutes.

2.4.3. Sample weighting

As part of the data collection methodology that GfK employs, they aim to collect adequate numbers of participants based on a number of geodemographic benchmarks to correspond to the U.S. population, consisting of age, sex, ethnicity, education, region, household income, home ownership status, and urbanicity. To account for the oversampling of minorities and females, the data were weighted to ensure that the sample remained nationally representative. Poststratification weights were used to account for probabilities of selection, nonresponse, and potential shortcomings in the sampling frame using age, sex, ethnicity, region, education, household income, and urbanicity.

2.4.4. Data access

Ethical approval was first sought from the SRESC at Maynooth University regarding the use of the existing dataset. This involved submitting an application which detailed the different components of the data collection procedures for the existing dataset. This included information such as the methodology employed by GfK to collect the data, the questionnaires included in the dataset, the informed consent procedures, participant information leaflets, participant debriefing material, and a risk/benefit analysis.

Additionally, information pertaining to the current thesis was also included such as the research aims/hypothesis, data analysis plan, and data security and protection. Similar to the NESARC-III and LASA datasets, data security and protection measures used included encrypting and storing all data on a password protected computer terminal. Moreover, all data was backed up to Microsoft OneDrive as the servers are hosted in Europe and are in compliance with the GDPR. This was used to protect against the loss of data due to damage or corruption of the dataset.

Once ethical approval was granted, contact was made with the data controllers of the existing dataset enquiring about the use of the data for the intended research purposes of the current thesis. As the participants consented to have their data used for secondary analyses within the area of the proposed research aims (see Chapter 6), the request for the use of secondary analyses was granted by the data controllers and the dataset was subsequently securely transferred.

2.4.5. Data processing

All key variables were extracted from the dataset (i.e., PTSD/CPTSD symptoms, loneliness items, trauma exposure variables, demographic variables etc.). To estimate the number of participants who met the diagnostic criteria for PTSD/CPTSD, each PTSD and CPTSD symptom was recoded to reflect the presence, or absence, of each symptom. PTSD/CPTSD symptoms were scored using a five-point Likert scale (‘not at all’ = 0, ‘extremely’ = 4) to denote the frequency by which the participant experienced a symptom within the past month. Following the recommendations of previous research (Cloitre et al., 2018), a symptom was deemed to be endorsed if the participant scored ≥ 2 (experiencing a symptom with moderate frequency within the past month) on each respective PTSD/CPTSD symptom.

A PTSD diagnostic variable was created using the *ICD-11* guidelines whereby an individual must endorse the presence of at least one of two ‘re-experiencing in the here and now’ symptoms, one of two ‘avoidance’ symptoms, one of two ‘sense of current threat’ symptoms, and at least one functional impairment indicator. To meet the diagnostic requirements of an *ICD-11* CPTSD diagnosis, all of the PTSD criteria must be met, and at least one of two ‘affective dysregulation’ symptoms, one of two ‘negative self-concept’ symptoms, one of two ‘disturbances in relationships’ symptoms, and at least one functional impairment indicator relating to the additional DSO symptoms must be endorsed. Furthermore, a participant may only be diagnosed with PTSD or CPTSD, but not both. Therefore, if a participant met the diagnostic criteria for CPTSD, they were coded as meeting the diagnostic requirements for CPTSD, but not PTSD (i.e., the CPTSD diagnosis took precedence, following the *ICD-11* guidelines).

The loneliness variables were also recoded following the guidelines for the six-item De Jong Gierveld Loneliness Scale (de Jong Gierveld & van Tilburg, 2006). This involved recoding the trichotomous response format (‘no’ = 1, ‘more-or-less’ = 2, ‘yes’ = 3) into a dichotomous format (0 = ‘absence of loneliness item’, 1 = ‘presence of loneliness item’), whereby all ‘more-or-less’ responses were merged with ‘no’ for the positive items, and ‘yes’ for the negative items. Scores on positively phrased items were then reversed so that higher scores were indicative of higher levels of loneliness.

2.4.6. Criteria for Chapter 6 subsample

The subsample for Chapter 6 analyses that was drawn from the original study included adults aged between 60–70 years and reported experiencing at least one childhood or adulthood traumatic experience. This resulted in a subsample of 456 participants being included in the dataset for Chapter 6.

2.4.7. Analytical plan for Chapter 6

The primary aim of the Chapter 6 study was to determine the relationship between social and emotional loneliness and CPTSD symptomatology. SEM techniques were applied to examine the relationships between social and emotional loneliness, and PTSD and DSO symptoms, while controlling for a number of exogenous covariates. A major strength of using SEM is that it accounts for measurement error and therefore yields more accurate parameter estimates (Bollen, 1989). Furthermore, multiple outcomes can be measured simultaneously. As such, this reduces the likelihood of Type I errors associated with multiple comparisons. As an initial step to estimating a structural model, it is important to first establish the measurement models of the constructs measured (Anderson & Gerbing, 1988). Similar to other studies using the ITQ (e.g. Cloitre et al., 2018; Karatzias et al., 2016), the latent structure of PTSD and DSO was represented using a two factor (PTSD and DSO) second-order model where PTSD explains the variance/co-variance between the three first-order factors of 'Re-experiencing in the here and now', 'Avoidance', and 'Sense of Current Threat' and DSO explains the variance/co-variance between the three first order factors of 'Affective Dysregulation', 'Negative self-concept', and 'Disturbances in Relationships'. The structure of the loneliness model consisted of two first-order factors, namely, social and emotional loneliness.

Mardia's multivariate normality tests (all $p < .001$) indicated that the data were non-normal. Therefore, the second-order measurement model of CPTSD was estimated using the MLR estimator as this estimator is robust to non-normally distributed data and can correct for such issues of multivariate non-normality. As the items for both social and emotional loneliness were dichotomous in nature, the two-factor loneliness (social and emotional) measurement model was estimated using the WLSMV estimator (Brown, 2006). Moreover, the structural model was estimated using the WLSMV estimator.

Model fit was determined using several goodness-of-fit indices (Hu & Bentler, 1999): A non-significant χ^2 indicates excellent model fit, however, this test is sensitive to larger sample sizes. Thus, a significant result ($p < .05$) should not lead to the rejection of a model (Tanaka, 1987). In addition, CFI and TLI values $\geq .90$ indicate adequate model fit. Additionally, RMSEA values $\leq .08$ suggest adequate model fit.

Due to the limitations of the Cronbach's alpha statistic in estimating reliability among scales with a small number of items (Graham, 2006; Raykov, 1997), composite reliability was used to estimate the internal reliability of the PTSD, DSO, and emotional and social loneliness measures. Composite reliability does not carry the same strict, and often unrealistic, assumption of tau-equivalence (equal sized factor loadings) and can therefore provide more accurate estimates of reliability than Cronbach's alpha. This is most notable among scales with few items, as the impact resulting from the violation of this assumption is more pronounced in these types of scales (Graham, 2006). Composite reliability values $\geq .60$ were considered as being acceptable, following the recommendations of Bagozzi and Yi (1988).

Given the dichotomous nature of the social and emotional loneliness items, a method proposed by Raykov and colleagues (2010) was used for estimating composite reliability for measures with dichotomous items. This approach uses latent variable modelling to estimate a 2-parameter logistic (2PL) IRT model. Using the factor loadings and thresholds, one can estimate the discrimination and difficulty parameters of the 2PL model. Discrimination refers to the rate at which the probability of endorsing an item varies depending on individual's level on the latent variable. The item discrimination parameter can be calculated by dividing the factor loading of the item by a scaling constant of 1.702, with setting the factor variance to one. This constant is used to transform the logistic IRT discrimination parameter to the normal ogive discrimination parameter (Camilli, 2017). The 2-paramter normal ogive model is similar to the 2PL model, but with the relationship between the latent variable and probability of endorsing the item being described via the standard normal cumulative distribution function (Raykov et al., 2010). Item difficulty describes the relationship between an individual's given level of a latent variable and their probability of endorsing the item. Items with greater difficulty require higher levels on the latent variable for the endorsement of an item (e.g. a mean score on the latent variable corresponds to a 40% likelihood of endorsing an item), whereas, items with lower difficulty require lower levels on the latent variable for the endorsement of an item (e.g. a mean score on the latent variable corresponds to a 60% likelihood of endorsing an item). An item's difficulty parameter can be calculated by dividing the item's threshold by its respective factor loading. One can then use these parameters to calculate the true and error variance of each item, the reliability of each item, and ultimately the composite reliability of the scale (for a detailed account of the formulae required see Raykov et al., 2010).

2.5. Summary

In summary, Chapter 3 (n = 5,366) used data drawn from the NESARC-III dataset. The primary objectives of this chapter were tested through the use of CFA and DIF analyses. Chapter 4 also used a subsample (n = 530) drawn from the NEARC-III dataset. The primary objectives of this chapter were examined through the use of LCA and multinomial logistic regression. Chapter 5 used a subsample (n = 1,276) drawn from two waves of the LASA project. The primary objectives of this chapter were examined via a 2W-LCS model. Chapter 6 used a subsample (n = 456) drawn from an existing dataset consisting of U.S. adults. The primary objectives of this chapter were examined through the use of SEM.

Chapter 3

Posttraumatic stress disorder among older adults: A differential item functioning analysis of PTSD in *ICD-11* and *DSM-5*

A paper based on this chapter has been published in *Psychological Trauma: Theory, Research, Practice, and Policy*.

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Abstract

Distinct models of posttraumatic stress disorder (PTSD) are outlined in the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*) and the 11th version of the *International Classification of Diseases* (*ICD-11*). Limited data exists about the validity of these models among older adults. This study examines the probable prevalence rates of PTSD in older adults; the factorial validity of both models; and symptom-endorsement bias across sex. Using a nationally representative (United States) sample (n = 5,366) of older adults aged 60 years and older, alternative PTSD factor models were tested using confirmatory factor analysis (CFA), and item-bias was assessed using differential item functioning (DIF) analysis. PTSD was measured without the functional impairment criterion, likely resulting in inflated prevalence rates. *DSM-5* (9.5%) PTSD prevalence was significantly higher than *ICD-11* (8.7%). Women were more likely to meet criteria for *DSM-5* (OR = 1.79) and *ICD-11* (OR = 1.38) PTSD. CFA results showed that both models of PTSD had excellent fit. Four *DSM-5* symptoms demonstrated DIF with females more likely to endorse three symptoms (B1: 'unwanted memories', B4: 'feeling upset', and E6: 'sleep problems') and males more likely to endorse one symptom (E2: ‘reckless or self-destructive behaviour’). No DIF was present for the six *ICD-11* symptoms. Both PTSD models perform well among older adults, albeit there is evidence of DIF in the *DSM-5* model. A considerable proportion of older adults met diagnostic requirements for PTSD, thus highlighting the importance of trauma-related research among older adult populations.

3.1. Introduction

The global population is rapidly aging with the number of older adults (defined as those aged 60 years and older) expected to increase from 12% in 2015 to 22% in 2050. The WHO reports that 15% of older adults currently suffer from a mental disorder (WHO, 2017), however, epidemiological surveys find that while cognitive and physical illnesses increase with age, mental illnesses decrease with age (Thomas et al., 2016). This effect has also been observed specifically in relation to PTSD) (Gum et al., 2009; Reynolds et al., 2016). For example, in the National Comorbidity Survey Replication (NCS-R; Gum et al., 2009) study, in the U.S., adults aged 65 years and older had a past year PTSD prevalence rate of 0.4%, substantially lower than those aged 18-44 (3.7%), and 45-64 (5.1%).

There is no agreement about why older adults report lower rates of mental illness. Various explanations have been offered including a tendency for older adults to mis-attribute psychological symptoms to physical illness; a reluctance to report psychological symptoms due to fears of stigma; an inability to accurately report psychological symptoms due to cognitive impairments; survival effects whereby older adults who survive into older adulthood have better mental health; and, of most interest to this study, that diagnostic criteria may be inappropriate for older adults (see Palmer et al., 1997; Thomas et al., 2016). It is possible that posttraumatic symptomatology manifests differently among older adults due to the effects of the normal aging process. For example, physical impairments might reduce the frequency of individuals coming in contact with external cues that symbolise the traumatic event, or hearing loss may negate a hypervigilant or exaggerated startle response to sounds (Cook & Simiola, 2018).

In psychiatry, there are two distinct diagnostic models of PTSD. One is outlined in the *DSM-5* (APA, 2013) and the other is outlined in the *ICD-11* (WHO, 2018). *DSM-*

5 describes PTSD by 20 symptoms which are distributed across four symptom clusters (Intrusions, Avoidance, NACM, and Hyperarousal), and *ICD-11* describes PTSD by six symptoms distributed across three symptom clusters (Re-experiencing in the here and now, Avoidance, and a Sense of Current Threat). A crucial element in establishing the validity of these diagnostic criteria is to determine if the latent structure of these symptoms match the proposed diagnostic requirements (Elklit & Shevlin, 2007; Elhai & Palmieri, 2011). If the latent structure of PTSD symptoms is distinct from diagnostic requirements, this will result in inaccurate diagnostic estimates (Shevlin et al., 2017).

Factor analytic studies of *DSM-5* PTSD symptoms provide tentative support for the *DSM-5*'s four-factor model. This model has been shown to reasonably approximate observed sample data, however, alternative models have been shown to provide superior model fit including a four-factor 'Dysphoria' model (Miller et al., 2013), a five-factor 'Dysphoric Arousal' model (Elhai et al., 2011), distinct six-factor 'Anhedonia' (Liu et al., 2014), 'External Behaviours' (Tsai et al., 2014), and 'Alternative Dysphoria' (Zelazny & Simms, 2015) models, and a seven-factor 'Hybrid' model (Armour et al., 2015) (see Table 3.1). While typically providing superior fit than the *DSM-5*'s four-factor model, the clinical utility of these alternative models has been challenged because none have been aligned to a workable diagnostic algorithm (Shevlin et al., 2017). Regarding *ICD-11* PTSD, the vast majority of factor analytic studies have supported the *ICD-11*'s three-factor model and have found it to be superior to alternative one- and two-factor models (see Brewin et al., 2017; Glück et al., 2016; Hansen et al., 2017; Hyland, Brewin et al., 2017) (see Table 3.2).

The majority of the *DSM-5* and *ICD-11* PTSD factor analytic studies are based on samples of young and middle-aged adults. Only one study has evaluated the factorial validity of *ICD-11* PTSD on an exclusively older adult sample (Glück et al., 2016), and

Table 3.1
Items and factor structure of alternative models using the 20 symptoms outlined in the DSM-5.

Symptoms	DSM-5 4 Factors	Dysphoria 4 Factors	Dysphoric Arousal 5 Factors	Anhedonia 6 Factors	External Behaviours 6 Factors	Alternative Dysphoria 6 Factors	Hybrid 7 Factors
Unwanted memories	Int	Int	Int	Int	Int	Int	Int
Distressing dreams	Int	Int	Int	Int	Int	Int	Int
Feelings of recurrence	Int	Int	Int	Int	Int	Int	Int
Feeling Upset	Int	Int	Int	Int	Int	Int	Int
Physical Reactions	Int	Int	Int	Int	Int	Int	Int
Internal Avoidance	Av	Av	Av	Av	Av	Av	Av
External Avoidance	Av	Av	Av	Av	Av	Av	Av
Amnesia	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Negative self-beliefs	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Self-blame	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Negative feelings	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Loss of interest	NACM	Dys	NACM	Anh	NACM	Anh	Anh
Distant	NACM	Dys	NACM	Anh	NACM	Anh	Anh
No positive feelings	NACM	Dys	NACM	Anh	NACM	Anh	Anh
Aggression	Hyp	Dys	Dys-Ar	Dys-Ar	EB	EB	EB
Risky behaviour	Hyp	Dys	Dys-Ar	Dys-Ar	EB	EB	EB
On guard	Hyp	Hyp	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar
Easily startled	Hyp	Hyp	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar
Concentration	Hyp	Dys	Dys-Ar	Dys-Ar	Dys-Ar	Dys	Dys-Ar
Sleep problems	Hyp	Dys	Dys-Ar	Dys-Ar	Dys-Ar	Dys	Dys-Ar

Note: Int = intrusions; Av = avoidance; NACM = negative alterations in cognitions and mood; Hyp = hyperarousal; Dys = dysphoria; Dys-Ar = dysphoric arousal; Anx-Ar = anxious arousal; Anh = anhedonia; EB = externalised behaviour.

Table 3.2
Items and factor structure of alternative models using the symptoms outlined in the ICD-11.

	ICD-11 Model	2 Factor Model	1 Factor Model
Distressing dreams	Re	Re-Av	PTSD
Reliving the event	Re	Re-Av	PTSD
Internal avoidance	Av	Re-Av	PTSD
External avoidance	Av	Re-Av	PTSD
On guard	Th	Th	PTSD
Easily startled	Th	Th	PTSD

Note: Re = re-experiencing in the present; Av = avoidance; Th = sense of current threat.

currently there are no studies evaluating the *DSM-5* model of PTSD exclusively among older adults. Consequently, it is currently not established if the *ICD-11* and *DSM-5* models of PTSD are valid representations of the latent structure of PTSD symptoms among older adults.

The current study used a nationally representative sample of older adults (60 years and older) from the U.S. to address three objectives. First, to estimate the probable prevalence rates, and sex differences, of *DSM-5* and *ICD-11* PTSD among older adults. Second, to test the factorial validity of the *DSM-5* and *ICD-11* models of PTSD using CFA. Finally, based on evidence from non-older adult samples that males and females systematically differ in their responses to several *DSM-5* PTSD symptoms (e.g., Murphy et al., 2019), a DIF analysis was performed on the *DSM-5* and *ICD-11* PTSD symptoms to determine if there are sex differences in symptom endorsements among older adults.

3.2. Methods

3.2.1. Participants and recruitment strategy

Participants in this study were drawn from the NESARC-III study which is a nationally representative sample of non-institutionalised adults from the U.S. aged 18 years and older (*N* = 36,309). Information on the NESARC-III data is available elsewhere (Grant et al., 2014). Protocols of the NESARC-III project received ethical approval from the institutional review boards of the National Institutes of Health and Westat, and all participants provided their informed consent. Approval for secondary analysis was granted by the ethical review board at Maynooth University.

Participants in this study (*n* = 5,366) were selected from the full NESARC-III dataset if they (a) were aged 60 years or older, (b) reported experiencing or witnessing at least one traumatic event in their lifetime, and (c) responded to all PTSD symptom questions corresponding to the *DSM-5* and *ICD-11* descriptions. Data were adjusted for oversampling (of ethnic/racial minorities) and non-responses and were weighted to reflect the U.S. civilian population as per the 2012 American Community Survey (Bureau of the Census, 2013). All parameter estimates were adjusted for the complex survey design of the NESARC-III based on the stratification, clustering, and weighting of the study population, whereas sample size is based on the unweighted data. Consequently, reported proportions may not correspond to the reported sample/subsample sizes. The sample included a similar proportion of females (52.5%, *n* = 3,026) and males (47.5%, *n* = 2,340), and the average age was 62.92 years (*SD* = 9.73) (see Table 3.3 for other sample characteristics).

3.2.2. Measures

All data were gathered using the AUDADIS-5 (Grant et al., 2011). The AUDADIS-5 is a structured, diagnostic interview which assesses participants for symptoms associated with an array of psychiatric disorders including PTSD. Previous research has examined the procedural validity of the AUDADIS-5 (compared to the semi-structured, clinician-administered PRISM-5, and indicated that the concordance of *DSM-5* PTSD diagnosis between the AUDADIS-5 and PRISM-5 was fair-to-moderate, whereas the concordance between dimensional measures was good (Hasin et al., 2015). Furthermore, test-retest reliability of past-year, prior-to-past-year, and lifetime PTSD diagnosis was fair-to-moderate, and the test-retest reliability of the dimensional measure was good (Grant et al., 2015).

Table 3.3
Other sample characteristics of the current study.

Sample characteristic	%[a] (n)[b]
Residency	
Urban	72.5 (4,097)
Rural	27.5 (1,269)
Marital status	
Married/cohabiting	61.9 (2,470)
Not married/cohabiting (windowed/divorced etc.)	38.1 (2,896)
Education	
Less than high school	13.1 (822)
High school or equivalent	25.9 (1,453)
Some college-level education or higher	61.0 (3,091)
Employment status	
Currently employed	27.3 (1,401)
Retired	61.1 (3,255)
Unemployed/home-making etc.	11.6 (710)

Note: [a] = Percentages are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population; [b] = sample size is based on the unweighted data.

Traumatic exposure

Participants were first asked if they had personally experienced any of 19 traumatic events or witnessed/learned about any of 13 traumatic events (event types are listed in Table 3.4). Respondents could report experiencing a maximum of four different types of traumatic events and were instructed to specify their most stressful traumatic event. All PTSD items were responded to in relation to this most distressing event. Witnessing/learning about someone with a serious or life-threatening illness was the most commonly reported traumatic experience (30.2%, n = 1,548) and the event most frequently endorsed as being 'most stressful' (17.7%, n = 909).

PTSD symptoms

Items were extracted from the AUDADIS-5 that corresponded to the 20 *DSM-5* symptoms (Cronbach's alpha = .90) (see Table 3.1) and the six *ICD-11* symptoms (Cronbach's alpha = .77) (see Table 3.2). Symptoms were answered using a dichotomous response format ('yes' = 1, 'no' = 0). A *DSM-5* PTSD diagnosis requires the presence of at least one of five 'Intrusion' symptoms, one of two 'Avoidance' symptoms, two of seven NACM symptoms, and two of six 'Hyperarousal' symptoms. An *ICD-11* PTSD diagnosis requires the presence of at least one of two 'Re-experiencing' symptoms, one of two 'Avoidance' symptoms, and one of two 'Sense of Current Threat' symptoms. The *DSM-5* and *ICD-11* also require that these symptoms cause functional impairment, however, the AUDADIS-5 does not screen for this criterion with all participants. As such, diagnostic rates are calculated based on the traumatic exposure and symptom requirements only. As a result, PTSD prevalence rates are likely to be inflated.

Table 3.4

Frequency of exposure to each type of traumatic event, and proportion endorsed as most stressful.

Traumatic event	Exposure %[a] (n)[b]	Most stressful %[a] (n)[b]
Personally experienced		
Serious or life-threatening injury	18.1 (972)	7.9 (437)
Serious or life-threatening illness	27.9 (1,440)	14.5 (719)
Saw a dead body or body parts	27.4 (1,464)	9.7 (555)
Injured in a terrorist attack	0.5 (33)	0.1 (11)
Natural disaster (e.g. flood, fire)	14.5 (744)	4.6 (243)
Sexually abused before age 18	6.5 (374)	3.4 (200)
Sexually assaulted as an adult	2.0 (139)	0.9 (64)
Physically abused before age 18	3.1 (175)	0.9 (60)
Beaten up by spouse/romantic partner	6.4 (434)	3.1 (213)
Beaten up by someone else	3.9 (210)	1.1 (56)
Kidnapped/held hostage	0.5 (27)	0.1 (8)
Stalked	2.0 (111)	0.7 (34)
Mugged, or threatened with a weapon	6.7 (383)	3.1 (171)
Active military combat	7.1 (345)	3.8 (191)
Peacekeeper/relief worker	0.6 (33)	0.2 (11)
Civilian in war zone/place of terror	1.1 (55)	0.6 (27)
Refugee	0.6 (30)	0.2 (8)
Prisoner of war	0.5 (27)	0.2 (10)
Juvenile detention or jail	1.8 (116)	0.6 (37)
Other	2.8 (151)	1.7 (94)

Witnessed/learned about		
Serious or life-threatening injury	19.1 (948)	8.3 (390)
Serious or life-threatening illness	30.2 (1,548)	17.7 (909)
Injured in a terrorist attack	7.7 (413)	2.7 (145)
Natural disaster (e.g. flood, fire)	1.8 (100)	0.5 (25)
Sexual abuse as a child under age 18	7.5 (385)	1.9 (95)
Sexual assault as an adult	6.5 (338)	3.2 (168)
Physical abuse as a child under age 18	2.1 (113)	0.7 (36)
Beaten up by spouse/romantic partner	6.8 (207)	1.4 (70)
Being beaten up by someone else	5.7 (345)	2.0 (115)
Kidnapped/held hostage	4.4 (239)	1.2 (63)
Stalked	0.7 (41)	0.2 (11)
Mugged, or threatened with a weapon	1.3 (75)	0.3 (15)
Seeing a dead body or body parts	4.0 (226)	1.3 (74)
Other	2.6 (128)	1.5 (78)

Note: [a] = Percentages are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population; [b] = sample size is based on the unweighted data.

3.2.3. Analytical plan

First, probable PTSD rates were computed based on the diagnostic requirements of the *DSM-5* and *ICD-11*, and these were compared using the exact McNemar binomial test. Diagnostic agreement between these algorithms was examined using Cohen's Kappa where values from .61–.80 indicate substantial agreement and values > .80 indicate almost perfect agreement (Landis & Koch, 1977). Sex differences in diagnostic rates (and symptom endorsement) were compared using the design-adjusted, second-order Rao-Scott χ^2 test of independence (reported as an F statistic). This version of the

χ^2 test accounts for the complex survey design used in the NESARC-III (i.e. weighting, stratification, and clustering) and involves a correction to the conventional Pearson χ^2 statistic thereby providing better control of Type I errors (Rao & Scott, 1984; Thomas & Decady, 2004). Odds ratios (OR) with 95% confidence intervals were used to determine the magnitude of difference between sexes.

Second, seven alternative *DSM-5* PTSD models (Table 3.1) and three alternative *ICD-11* PTSD models (Table 3.2) were tested using CFA. All models were estimated using the WLSMV as this estimator performs best with categorical data (Brown, 2006). Model adequacy was assessed in relation to a number of goodness-of-fit indices for dichotomous data (Hu & Bentler, 1999; Yu, 2002). A non-significant χ^2 indicates excellent model fit, however, this test is positively related to sample size therefore a significant result ($p < .05$) should not lead to the rejection of a model (Tanaka, 1987). CFI (Bentler, 1990) and TLI (Tucker & Lewis, 1973) values $\geq .95$ indicate good model fit. Additionally, RMSEA (Steiger, 1990) values $\leq .05$ indicate good model fit. In order to compare model fit among nested models, changes in the CFI, TLI, and RMSEA were used as criteria to determine improvement in model fit. ΔCFI and ΔTLI $\geq .010$, and ΔRMSEA $\geq .015$ indicate significant improvement in model fit (Chen, 2007; Cheung & Rensvold, 2002; Putnick & Bornstein, 2016). Non-nested models were compared using the BIC (Schwarz, 1978) produced using the MLR estimator, and lower values on the BIC indicate better fit.

Finally, DIF analysis was performed to determine if any *ICD-11* or *DSM-5* PTSD symptoms evidenced bias for sex. DIF was assessed using a MIMIC model which is advantageous because it allows covariates (categorical or continuous) to be entered into the model simultaneously without needing to subdivide the sample (Gallo et al., 1994). MIMIC models include a measurement model (identified in the CFA analyses) and a structural model (i.e., the latent variables of PTSD regressed onto sex).

This tests for sex differences on the latent variables of PTSD. The direct paths between sex and the PTSD symptom indicators are fixed to zero and the MIs are inspected to determine which items may be exhibiting DIF. MIs denote a reduction in the χ^2 value if a certain parameter was freely estimated and a reduction of 3.84 (with one degree of freedom; $\alpha = .05$) denotes a significant improvement in model fit. It has been argued that viewing DIF as a dichotomous classification (i.e. DIF/no DIF) based on statistical significance is problematic as DIF exists along a continuum (Borsboom, 2006) and Type I errors are likely to occur with large sample sizes. It is important to determine the degree of DIF that is present in order to make correct inferences regarding the practical significance of the DIF across groups. Therefore, the method advanced by Saris and colleagues (2009) for model evaluation was followed and DIF was determined to be present if an MI was > 3.84 with a corresponding standardised EPC value ≥ 0.10. Assessing for DIF is an iterative process where the symptom/parameter with the largest DIF effect size (i.e. standardised EPC ≥ 0.10) is freely estimated and the model is reassessed for further evidence of DIF. The process continues until no there is no further evidence of DIF.

All analyses were performed using Mplus 7.4 (Muthén & Muthén, 2012) and the survey package (Lumley, 2004; Lumley, 2019) in R 3.4.4 (R Development Core Team, 2018). These statistical programmes can account for the complex survey design elements of the NESARC-III, and thus provide accurate parameter estimates, standard errors, and model fit results.

3.3. Results

3.3.1. DSM-5 and ICD-11 diagnostic rates

The probable *DSM-5* PTSD diagnostic rate was 9.5% (95% CI = 8.6%, 10.5%), significantly higher than the probable *ICD-11* PTSD diagnostic rate of 8.7% (95% CI = 7.7%, 9.8%), McNemar binomial test, $p = .012$. There was substantial agreement between the two diagnostic systems (Cohen's Kappa = .68 [95% CI .65,.72], $p < .001$), with 6.5% ($n = 393$) meeting both diagnostic criteria, 3.0% ($n = 189$) meeting *DSM-5* diagnostic criteria but not *ICD-11* criteria, and 2.2% ($n = 109$) meeting *ICD-11* criteria but not *DSM-5* criteria.

Females were significantly more likely than males to meet requirements for *DSM-5* PTSD (F [1, 113] = 26.59, OR = 1.79 [95% CI 1.43, 2.25], $p < .001$) and *ICD-11* PTSD (F [1, 113] = 7.19, OR = 1.38 [95% CI 1.09, 1.74], $p = .008$). Sex differences for the individual PTSD symptoms are reported in Tables 3.5 (*DSM-5*) and 3.6 (*ICD-11*). Females were significantly more likely than males to endorse 16 (of 20) *DSM-5* PTSD symptoms (ORs ranging from 1.19 to 2.00), and males were significantly more likely to endorse one symptom ('risky behaviours'; F [1, 113] = 4.09, OR = 0.69 [95% CI 0.48, 0.99], $p = .045$). Females were significantly more likely to endorse five (of six) *ICD-11* PTSD symptom (ORs ranging from 1.20 to 1.60).

3.3.2. CFA results

Table 3.7 presents the fit statistics for the alternative models of the *DSM-5* PTSD symptoms. Based on the CFI, TLI, and RMSEA results, all models fit the data extremely well. The seven-factor Hybrid model had the lowest BIC value suggesting its statistical superiority. However, the ΔCFI, ΔTLI, ΔRMSEA values indicated that the Hybrid model was not significantly different for the *DSM-5* model. Given the similar model fit results for all models, the fact that the *DSM-5* model is the most parsimonious, and it is the only model with a clear diagnostic algorithm (Shevlin et al., 2017), it was concluded that the original four-factor *DSM-5* model was the optimal representation of the symptom structure of PTSD. Inter-factor correlations ranged from .82 to .96, and standardised factor loadings ranged from .66 to .92 (see Table 3.8).

Table 3.5

Descriptive statistics and odds ratios for sex differences in individual DSM-5 PTSD symptoms.

Symptom	Total %[a] (n)[b]	Male %[a] (n)[b]	Female %[a] (n)[b]	OR[c, d] (95% CI)
Unwanted memories	52.2 (2,869)	45.8 (1,091)	58.0 (1,778)	1.64*** (1.42 / 1.88)
Disturbing dreams	19.7 (1,117)	19.1 (479)	20.3 (638)	1.08 (0.91 / 1.28)
Feelings of recurrence	13.1 (748)	12.1 (295)	14.1 (453)	1.19* (1.00 / 1.42)
Feeling Upset	25.0 (1,393)	18.5 (460)	30.9 (933)	1.97*** (1.67 / 2.31)
Physical Reactions	13.8 (789)	11.6 (288)	15.8 (501)	1.43*** (1.20 / 1.71)
Internal Avoidance	22.5 (1,301)	18.3 (473)	26.4 (828)	1.60*** (1.35 / 1.90)
External Avoidance	11.7 (701)	10.1 (263)	13.1 (438)	1.33* (1.06 / 1.68)
Amnesia	11.1 (650)	10.0 (249)	12.1 (401)	1.23 (1.00 / 1.52)
Negative self-beliefs	28.3 (1,579)	25.7 (621)	30.6 (958)	1.27** (1.08 / 1.50)
Self-blame	6.6 (380)	5.7 (138)	7.5 (242)	1.35* (1.03 / 1.76)
Negative feelings	26.2 (1,482)	21.4 (524)	30.5 (958)	1.61*** (1.36 / 1.91)
Loss of interest	11.6 (671)	9.1 (227)	13.8 (444)	1.60*** (1.29 / 1.99)

Distant	11.3 (678)	9.2 (238)	13.2 (440)	1.49*** (1.19 / 1.86)
No positive feelings	6.7 (423)	5.4 (149)	7.9 (274)	1.51** (1.17 / 1.95)
Aggression	6.4 (377)	5.6 (147)	7.1 (230)	1.29 (0.99 / 1.66)
Risky behaviour	3.0 (177)	3.6 (92)	2.5 (85)	0.69* (0.48 / 0.99)
On guard	20.0 (1,113)	18.5 (450)	21.4 (663)	1.20* (1.03 / 1.40)
Easily startled	10.4 (621)	9.0 (225)	11.6 (396)	1.34** (1.11 / 1.62)
Concentration	13.0 (767)	10.2 (251)	15.5 (516)	1.62*** (1.30 / 2.00)
Sleep problems	16.8 (968)	11.9 (294)	21.2 (674)	2.00*** (1.67 / 2.39)

Note: n = 5,366; OR = unadjusted odds ratio; 95% CI = 95% Confidence Intervals; [a] = Percentages are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population; [b] = sample size is based on the unweighted data; [c] = sex coded as 0 = male, 1 = female; [d] = design degrees of freedom = 113.
Statistical significance: *$p < .05$; **$p < .01$; ***$p < .001$.

Table 3.6

Descriptive statistics and odds ratios for sex differences in individual ICD-11 PTSD symptoms.

Symptom	Total %[a] (n)[b]	Male %[a] (n)[b]	Female %[a] (n)[b]	OR[c, d] (95% CI)
Disturbing dreams	19.7 (1,117)	19.1 (479)	20.3 (638)	1.08 (0.91 / 1.28)
Reliving the event	17.9 (1,019)	16.1 (390)	19.6 (629)	1.27** (1.10 / 1.46)
Internal avoidance	22.5 (1,301)	18.3 (473)	26.4 (828)	1.60*** (1.35 / 1.90)
External avoidance	11.7 (701)	10.1 (263)	13.1 (438)	1.33* (1.06 / 1.68)
On guard	20.0 (1,113)	18.5 (450)	21.4 (663)	1.20* (1.03 / 1.40)
Easily startled	10.4 (621)	9.0 (225)	11.6 (396)	1.34** (1.11 / 1.62)

Note: n = 5,366; OR = unadjusted odds ratio; 95% CI = 95% Confidence Intervals; [a] = Percentages are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population; [b] = sample size is based on the unweighted data; [c] = sex coded as 0 = male, 1 = female; [d] = design degrees of freedom = 113.

Statistical significance: *p < .05; **p < .01; ***p < .001.

Table 3.7
Model fit statistics and inter-factor correlations for the different models of PTSD.

	χ^2	df	CFI	TLI	RMSEA (90% CI)	BIC	Inter-factor correlations Mean (range)
DSM-5 symptoms							
DSM-5 model	608.782***	164	.989	.987	.022 (.021-.024)	38,266	.86 (.82–.96)
Dysphoria model	603.889***	164	.989	.987	.022 (.020-.024)	38,198	.84 (.79–.89)
Dysphoric arousal model	561.674***	160	.990	.988	.022 (.020-.024)	38,047	.84 (.79–.94)
Anhedonia model	470.244***	155	.992	.990	.019 (.017-.021)	37,452	.84 (.77–.94)
External Behaviours model	519.098***	155	.991	.989	.021 (.019-.023)	37,639	.83 (.75–.95)
Alternative dysphoria model	551.822***	155	.990	.988	.022 (.020-.024)	37,667	.84 (.75–.94)
Hybrid model	424.449***	149	.993	.991	.019 (.017-.021)	37,030	.84 (.75–.94)
ICD-11 symptoms							
ICD-11 model	9.267	6	1.000	.999	.010 (.000-.022)	19,584	.76 (.71–.80)
Two-factor model	211.150***	8	.978	.959	.069 (.061-.077)	20,069	.79
One-factor model	336.476***	9	.965	.941	.082 (.075-.090)	20,372	-

Note: n = 5,366; Estimator = WLSMV; χ^2 = Chi-square Goodness of Fit statistic; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA (90% CI) = Root-Mean-Square Error of Approximation with 90% confidence intervals; BIC = Bayesian information criterion.
*p < .05; **p < .01; ***p < .001.

Table 3.8

Standardised factor loadings and inter-factor correlations of DSM-5 model of PTSD.

	Intrusions	Avoidance	NACM	Hyperarousal
Factor Loadings				
Unwanted memories	.80			
Distressing dreams	.80			
Feelings of recurrence	.86			
Feeling Upset	.86			
Physical Reactions	.85			
Internal Avoidance		.82		
External Avoidance		.91		
Amnesia			.66	
Negative self-beliefs			.71	
Self-blame			.66	
Negative feelings			.86	
Loss of interest			.84	
Distant			.88	
No positive feelings			.86	
Aggression				.84
Risky behaviour				.79
On guard				.76
Easily startled				.86
Concentration				.92
Sleep problems				.87

Inter-factor correlations				
Intrusions	1			
Avoidance	.88	1		
NACM	.82	.86	1	
Hyperarousal	.83	.82	.96	1

Note: NACM = negative alterations in cognitions and mood.
All factor loadings and correlations are statistically significant ($p < .05$).

Table 3.7 also presents the fit statistics for the alternative models of the *ICD-11* PTSD symptoms. The three-factor *ICD-11* model demonstrated excellent fit according to the CFI, TLI, and RMSEA. The *ICD-11* model was statistically superior (ΔCFI and ΔTLI values > .010, ΔRMSEA > .015, lowest BIC value) to the competing models. Inter-factor correlations ranged from .71 to .80, and standardised factor loadings ranged from .79 to .94 (see Table 3.9).

3.3.3. DIF results

Females had significantly higher mean scores than males on the four *DSM-5* PTSD latent variables (Table 3.10). Controlling for these latent variable mean differences, evidence of DIF was identified for four symptoms. The largest effect was for the ‘risky behaviour’ (E2) symptom with males being more likely to endorse the symptom (MI = 16.65, EPC = -.18). This was followed by 'feeling upset' (B4) (MI = 16.16, EPC = .11), 'sleep problems' (E6) (MI = 13.91, EPC = .11), and 'unwanted memories' (B1) (MI = 13.47, EPC = .10) which were all more likely to be endorsed by females. Technical details are presented in Tables 3.11-3.15, and item characteristic curves (ICC) illustrating DIF are presented in Figures 3.1-3.4.

Females also had significantly higher mean scores than males on the three *ICD-11* PTSD latent variables (Table 3.10), however, there was no evidence of DIF for any *ICD-11* symptom (see Table 3.16).

Table 3.9

Standardised factor loadings and inter-factor correlations of ICD-11 model of PTSD.

	Re-experiencing	Avoidance	Sense of Current Threat
Factor Loadings			
Distressing dreams	.89		
Reliving the event	.92		
Internal avoidance		.82	
External avoidance		.91	
On guard			.79
Easily startled			.94
Inter-factor correlations			
Re-experiencing	1		
Avoidance	.78	1	
Sense of Current Threat	.71	.80	1

Note: All factor loadings and correlations are statistically significant ($p < .05$).

Table 3.10
Effects of sex on PTSD latent factors.

	Baseline MIMIC model		DIF corrected model	
	B (SE)	β (SE)	B (SE)	β (SE)
DSM-5 Model of PTSD				
Intrusions	.20*** (.04)	.13 (.02)	.11** (.04)	.07 (.02)
Avoidance	.21*** (.04)	.13 (.03)	.21*** (.04)	.13 (.03)
NACM	.16*** (.03)	.12 (.03)	.16*** (.03)	.12 (.03)
Hyperarousal	.18*** (.04)	.11 (.02)	.15*** (.04)	.09 (.02)
ICD-11 Model of PTSD				
Re-experiencing	.10* (.04)	.05 (.02)	-	-
Avoidance	.21*** (.04)	.13 (.03)	-	-
Sense of Current Threat	.12** (.03)	.07 (.02)	-	-

Note: Sex coded as 0 = male, 1 = female; MIMIC = multiple indicators multiple causes; DIF = differential item functioning; B = unstandardised estimates; β = standardised estimates; SE = standard error; NACM = negative alterations in cognitions and mood. Statistical significance: *$p < .05$; **$p < .01$; ***$p < .001$.

Table 3.11

DSM-5 PTSD - Statistical information for parameters demonstrating DIF (model 1).

Parameter	MI	NCP	Power	EPC	Decision
Int1 on Sex	6.213	14.263	0.965	0.066	No DIF
Int2 on Sex	11.527	12.251	0.938	-0.097	No DIF
Int3 on Sex	8.024	12.857	0.948	-0.079	No DIF
Int4 on Sex	16.120	12.624	0.944	0.113	DIF
Int5 on Sex	0.251	12.806	0.947	-0.014	No DIF
Av1 on Sex	3.123	6.560	0.726	0.069	No DIF
Av2 on Sex	3.124	5.409	0.643	-0.076	No DIF
NACM1 on Sex	0.975	10.146	0.890	-0.031	No DIF
NACM2 on Sex	0.457	12.659	0.945	-0.019	No DIF
NACM3 on Sex	0.109	7.569	0.786	-0.012	No DIF
NACM4 on Sex	1.956	11.088	0.915	0.042	No DIF
NACM5 on Sex	0.485	9.168	0.857	0.023	No DIF
NACM6 on Sex	0.055	8.594	0.834	-0.008	No DIF
NACM7 on Sex	0.087	8.700	0.839	-0.010	No DIF
Hyp1 on Sex	0.851	8.311	0.822	-0.032	No DIF
Hyp2 on Sex	**16.654**	**5.376**	**0.640**	**-0.176**	**DIF**
Hyp3 on Sex	1.933	14.120	0.964	-0.037	No DIF
Hyp4 on Sex	0.421	11.662	0.927	-0.019	No DIF
Hyp5 on Sex	1.294	8.961	0.849	0.038	No DIF
Hyp6 on Sex	18.410	11.596	0.926	0.126	DIF

Note: MI = Modification Index; NCP = non-centrality parameter; EPC = expected parameter change (standardised); DIF = evidence of differential item functioning; No DIF; not sufficient evidence of differential item functioning; Int = Intrusions item; Av = avoidance item; NACM = negative alterations in cognitions and mood item; Hyp = hyperarousal. Largest EPC ≥ 0.10 (i.e. the next parameter to be freely estimated) is highlighted in bold.

Table 3.12

DSM-5 PTSD - Statistical information for parameters demonstrating DIF (model 2).

Parameter	MI	NCP	Power	EPC	Decision
Int1 on Sex	6.229	14.300	0.966	0.066	No DIF
Int2 on Sex	11.560	12.286	0.939	-0.097	No DIF
Int3 on Sex	8.047	12.894	0.949	-0.079	No DIF
Int4 on Sex	**16.163**	**12.658**	**0.945**	**0.113**	**DIF**
Int5 on Sex	0.251	12.806	0.947	-0.014	No DIF
Av1 on Sex	3.138	6.591	0.728	0.069	No DIF
Av2 on Sex	3.128	5.416	0.643	-0.076	No DIF
NACM1 on Sex	0.977	10.167	0.890	-0.031	No DIF
NACM2 on Sex	0.458	12.687	0.945	-0.019	No DIF
NACM3 on Sex	0.109	7.569	0.786	-0.012	No DIF
NACM4 on Sex	1.962	11.122	0.915	0.042	No DIF
NACM5 on Sex	0.487	9.206	0.859	0.023	No DIF
NACM6 on Sex	0.055	8.594	0.834	-0.008	No DIF
NACM7 on Sex	0.087	8.700	0.839	-0.010	No DIF
Hyp1 on Sex	1.881	8.164	0.815	-0.048	No DIF
Hyp2 on Sex	-	-	-	-	-
Hyp3 on Sex	4.007	14.265	0.965	-0.053	No DIF
Hyp4 on Sex	1.555	11.359	0.921	-0.037	No DIF
Hyp5 on Sex	0.375	8.503	0.831	0.021	No DIF
Hyp6 on Sex	13.918	11.296	0.919	0.111	DIF

Note: MI = Modification Index; NCP = non-centrality parameter; EPC = expected parameter change (standardised); DIF = evidence of differential item functioning; No DIF; not sufficient evidence of differential item functioning; Int = Intrusions item; Av = avoidance item; NACM = negative alterations in cognitions and mood item; Hyp = hyperarousal. Largest EPC ≥ 0.10 (i.e. the next parameter to be freely estimated) is highlighted in bold.

Table 3.13
DSM-5 PTSD - Statistical information for parameters demonstrating DIF (model 3).

Parameter	MI	NCP	Power	EPC	Decision
Int1 on Sex	13.473	13.473	0.956	0.100	DIF
Int2 on Sex	6.450	11.467	0.923	-0.075	No DIF
Int3 on Sex	3.349	11.922	0.932	-0.053	No DIF
Int4 on Sex	-	-	-	-	-
Int5 on Sex	0.306	11.953	0.933	0.016	No DIF
Av1 on Sex	3.138	6.591	0.728	0.069	No DIF
Av2 on Sex	3.124	5.409	0.643	-0.076	No DIF
NACM1 on Sex	0.977	10.167	0.890	-0.031	No DIF
NACM2 on Sex	0.458	12.687	0.945	-0.019	No DIF
NACM3 on Sex	0.109	7.569	0.786	-0.012	No DIF
NACM4 on Sex	1.960	11.111	0.915	0.042	No DIF
NACM5 on Sex	0.486	9.187	0.858	0.023	No DIF
NACM6 on Sex	0.056	8.750	0.841	-0.008	No DIF
NACM7 on Sex	0.087	8.700	0.839	-0.010	No DIF
Hyp1 on Sex	1.880	8.16	0.815	-0.048	No DIF
Hyp2 on Sex	-	-	-	-	-
Hyp3 on Sex	4.006	14.261	0.965	-0.053	No DIF
Hyp4 on Sex	1.555	11.359	0.921	-0.037	No DIF
Hyp5 on Sex	0.374	8.481	0.830	0.021	No DIF
Hyp6 on Sex	**13.907**	**11.287**	**0.919**	**0.111**	**DIF**

Note: MI = Modification Index; NCP = non-centrality parameter; EPC = expected parameter change (standardised); DIF = evidence of differential item functioning; No DIF; not sufficient evidence of differential item functioning; Int = Intrusions item; Av = avoidance item; NACM = negative alterations in cognitions and mood item; Hyp = hyperarousal. Largest EPC ≥ 0.10 (i.e. the next parameter to be freely estimated) is highlighted in bold.

Table 3.14

DSM-5 PTSD - Statistical information for parameters demonstrating DIF (model 4).

Parameter	MI	NCP	Power	EPC	Decision
Int1 on Sex	**13.473**	**13.473**	**0.956**	**0.100**	**DIF**
Int2 on Sex	6.453	11.472	0.923	-0.075	No DIF
Int3 on Sex	3.351	11.930	0.932	-0.053	No DIF
Int4 on Sex	-	-	-	-	-
Int5 on Sex	0.306	11.953	0.933	0.016	No DIF
Av1 on Sex	3.142	6.600	0.729	0.069	No DIF
Av2 on Sex	3.121	5.403	0.642	-0.076	No DIF
NACM1 on Sex	0.977	10.167	0.890	-0.031	No DIF
NACM2 on Sex	0.458	12.687	0.945	-0.019	No DIF
NACM3 on Sex	0.109	7.569	0.786	-0.012	No DIF
NACM4 on Sex	1.961	11.117	0.915	0.042	No DIF
NACM5 on Sex	0.486	9.187	0.858	0.023	No DIF
NACM6 on Sex	0.055	8.594	0.834	-0.008	No DIF
NACM7 on Sex	0.087	8.700	0.839	-0.010	No DIF
Hyp1 on Sex	0.319	7.975	0.806	-0.02	No DIF
Hyp2 on Sex	-	-	-	-	-
Hyp3 on Sex	0.883	13.062	0.951	-0.026	No DIF
Hyp4 on Sex	0.025	10.000	0.885	-0.005	No DIF
Hyp5 on Sex	2.776	8.252	0.819	0.058	No DIF
Hyp6 on Sex	-	-	-	-	-

Note: MI = Modification Index; NCP = non-centrality parameter; EPC = expected parameter change (standardised); DIF = evidence of differential item functioning; No DIF; not sufficient evidence of differential item functioning; Int = Intrusions item; Av = avoidance item; NACM = negative alterations in cognitions and mood item; Hyp = hyperarousal. Largest EPC ≥ 0.10 (i.e. the next parameter to be freely estimated) is highlighted in bold.

Table 3.15

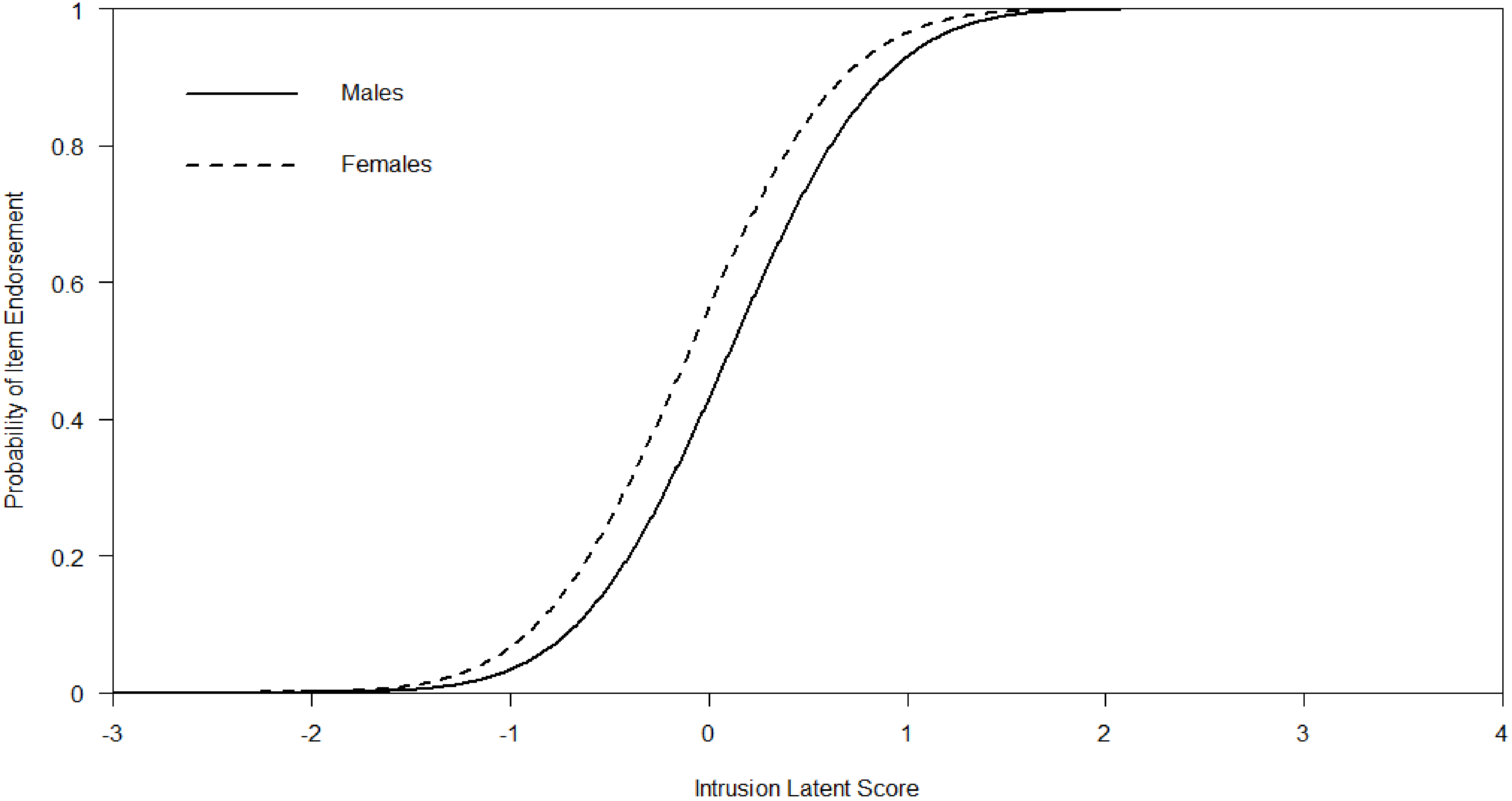
DSM-5 PTSD - Statistical information for parameters demonstrating DIF (model 5).

Parameter	MI	NCP	Power	EPC	Decision
Int1 on Sex	-	-	-	-	-
Int2 on Sex	2.176	10.284	0.894	-0.046	No DIF
Int3 on Sex	0.290	10.035	0.886	-0.017	No DIF
Int4 on Sex	-	-	-	-	-
Int5 on Sex	3.825	10.280	0.894	0.061	No DIF
Av1 on Sex	3.126	6.760	0.739	0.068	No DIF
Av2 on Sex	3.141	5.438	0.645	-0.076	No DIF
NACM1 on Sex	0.978	10.177	0.891	-0.031	No DIF
NACM2 on Sex	0.459	12.715	0.946	-0.019	No DIF
NACM3 on Sex	0.109	7.569	0.786	-0.012	No DIF
NACM4 on Sex	1.963	11.128	0.916	0.042	No DIF
NACM5 on Sex	0.487	9.206	0.859	0.023	No DIF
NACM6 on Sex	0.056	8.750	0.841	-0.008	No DIF
NACM7 on Sex	0.087	8.700	0.839	-0.010	No DIF
Hyp1 on Sex	0.322	8.05	0.810	-0.020	No DIF
Hyp2 on Sex	-	-	-	-	-
Hyp3 on Sex	0.892	13.195	0.953	-0.026	No DIF
Hyp4 on Sex	0.026	10.400	0.897	-0.005	No DIF
Hyp5 on Sex	2.769	8.231	0.818	0.058	No DIF
Hyp6 on Sex	-	-	-	-	-

Note: MI = Modification Index; NCP = non-centrality parameter; EPC = expected parameter change (standardised); DIF = evidence of differential item functioning; No DIF; not sufficient evidence of differential item functioning; Int = Intrusions item; Av = avoidance item; NACM = negative alterations in cognitions and mood item; Hyp = hyperarousal.

Figure 3.1

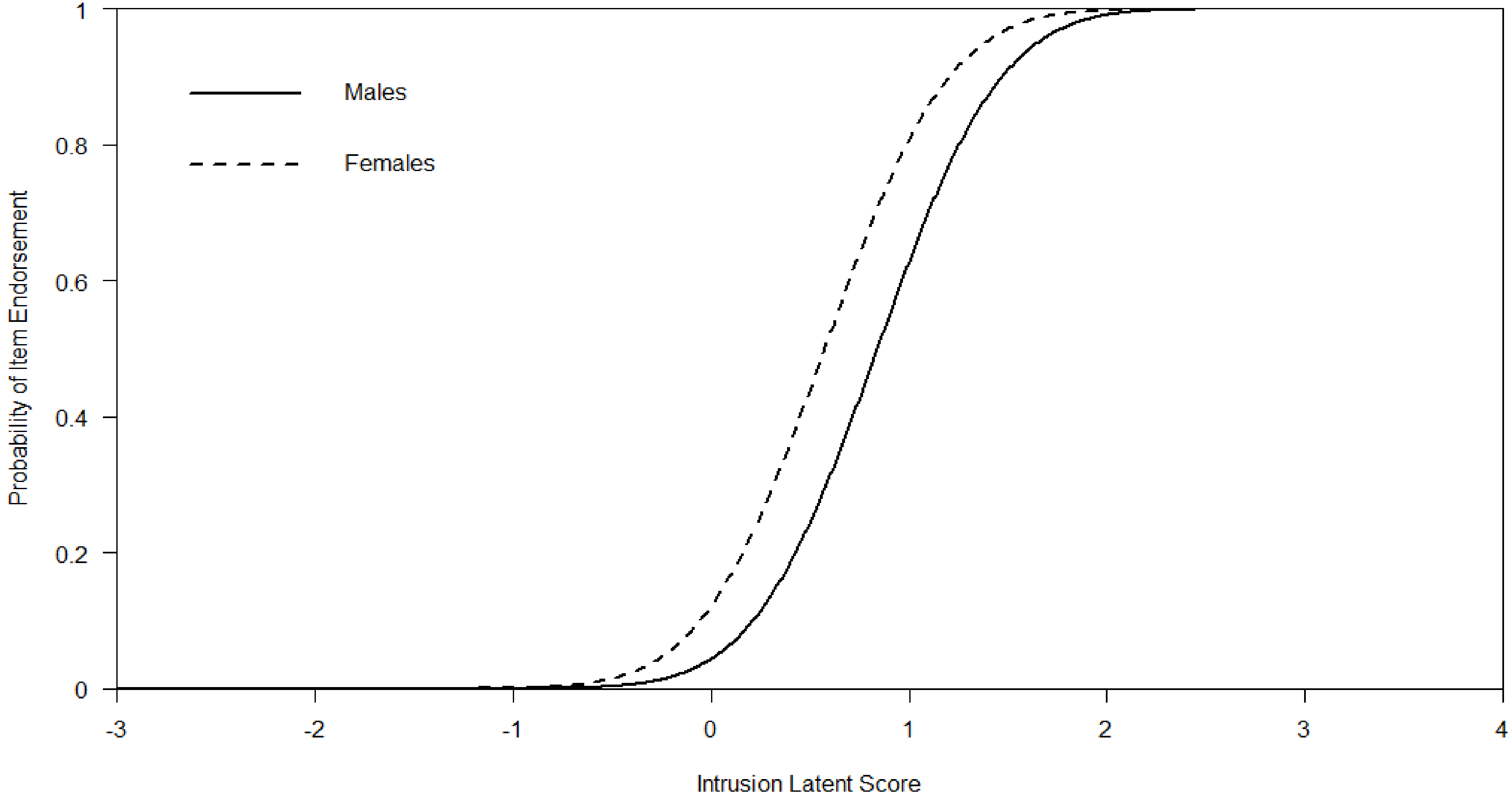
Item characteristic curve (ICC) illustrating the DIF of the B1: 'unwanted memories' symptom across males and females.



Note: The x-axis represents a standardised latent score for intrusions, with a mean of zero and a standard deviation of one. The y-axis represents the probability of endorsing the item.

Figure 3.2

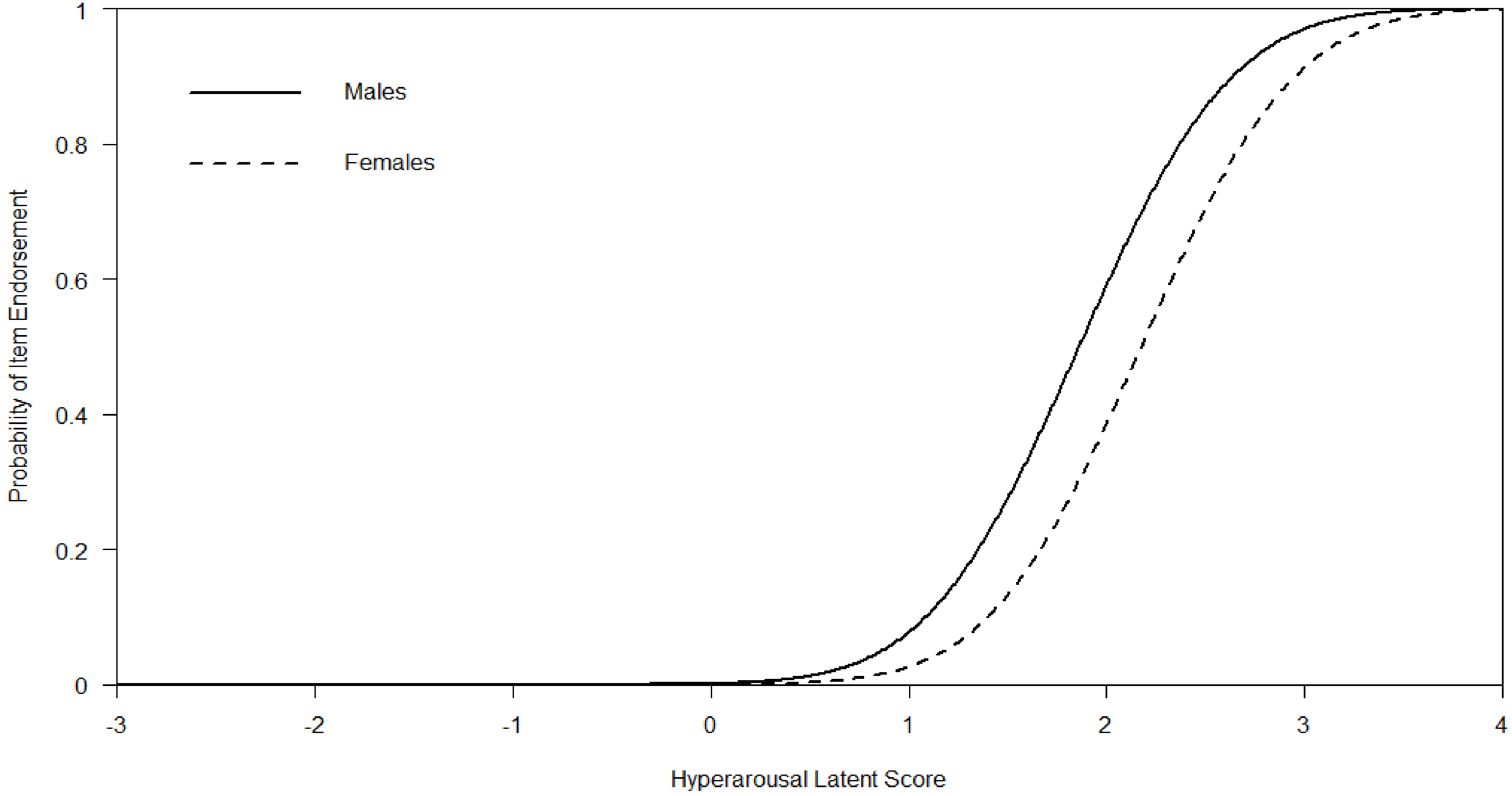
Item characteristic curve (ICC) illustrating the DIF of the B4: 'feeling upset' symptom across males and females.



Note: The x-axis represents a standardised latent score for intrusions, with a mean of zero and a standard deviation of one. The y-axis represents the probability of endorsing the item.

Figure 3.3

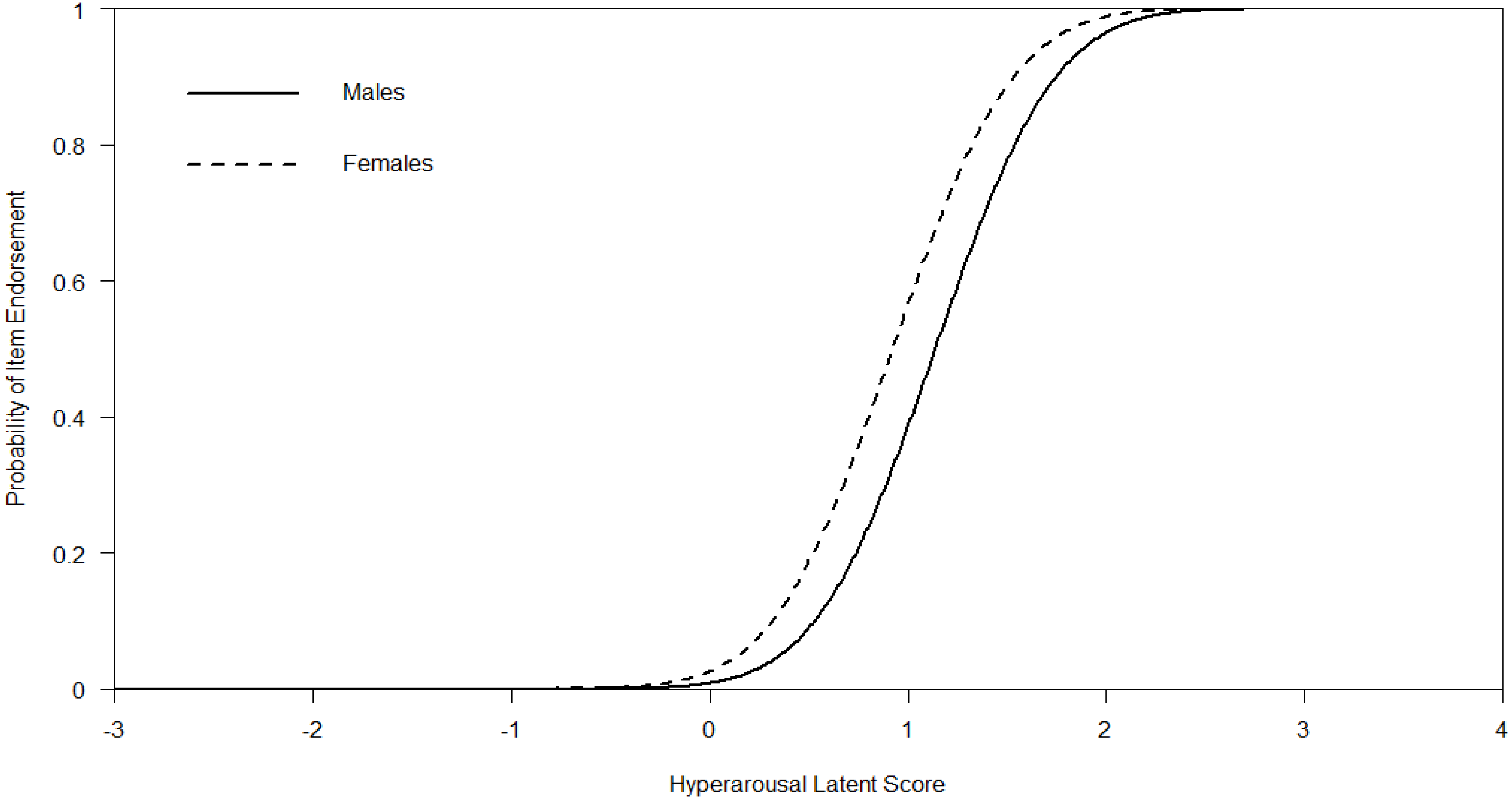
Item characteristic curve (ICC) illustrating the DIF of the E2: 'risky behaviour' symptom across males and females.



Note: The x-axis represents a standardised latent score for hyperarousal, with a mean of zero and a standard deviation of one. The y-axis represents the probability of endorsing the item.

Figure 3.4

Item characteristic curve (ICC) illustrating the DIF of the E6: 'sleep problems' symptom across males and females.



Note: The x-axis represents a standardised latent score for hyperarousal, with a mean of zero and a standard deviation of one. The y-axis represents the probability of endorsing the item.

Table 3.16

ICD-11 PTSD - Statistical information for parameters demonstrating DIF.

Parameter	MI	NCP	Power	EPC	Decision
Re1 on Sex	3.383	18.296	0.990	-0.043	No DIF
Re2 on Sex	3.374	16.662	0.983	0.045	No DIF
Av1 on Sex	6.087	13.164	0.952	0.068	No DIF
Av2 on Sex	6.053	10.761	0.907	-0.075	No DIF
Th1 on Sex	0.255	17.708	0.988	-0.012	No DIF
Th2 on Sex	0.251	12.806	0.947	0.014	No DIF

Note: MI = Modification Index; NCP = non-centrality parameter; EPC = expected parameter change (standardised); DIF = evidence of differential item functioning; No DIF; not sufficient evidence of differential item functioning; Re = re-experiencing item; Av = avoidance item; Th = sense of current threat item.

3.4. Discussion

Little data exists regarding the validity of the *DSM-5* and *ICD-11* models of PTSD in older adults. The CFA results obtained in this study support the factorial validity of the *DSM-5* and *ICD-11* models of PTSD among older adults. This is important as it suggests that the diagnostic algorithms for PTSD derived from these models are meaningful and valid for adults aged 60 years and older in the general population. Clinicians working with people in this age cohort can therefore use these systems with confidence.

Witnessing/learning about someone with a serious or life-threatening illness was the most commonly reported traumatic event and most frequently endorsed as being the most stressful event experienced. This finding is in line with previous research noting that this type of traumatic event is common among older adults (Pietrzak, Goldstein et al., 2012). It is likely that the frequent occurrence of this type of traumatic event is reflective of normative age-related events of the current sample (e.g. illness of spouse; Cook et al., 2017). It was also noteworthy that 8.7% and 9.5% of this sample met symptom criteria for a probable diagnosis of *ICD-11* and *DSM-5* PTSD, respectively. These findings are similar to other estimates of PTSD in the U.S. general population. For example, in a household sample of U.S. adults aged 18-70 years, Cloitre et al. (2019) reported a rate of 7.2%. The current result calls into question the assumption that PTSD is substantially lower among those over 60 years of age. Of course, probable PTSD rates in this study were estimated without a measure of functional impairment among a trauma exposed sample and are therefore likely to be somewhat overestimated.

This finding is inconsistent with those of the NCS-R (Gum et al., 2009) which showed a very minor proportion of adults over the age of 65 exhibit clinically meaningful levels of PTSD. Interestingly, Gum and colleagues (2009) found that those aged between 45-64 years presented with the highest rates of PTSD and noted that without sufficient training and consideration for geriatric populations, it is likely that we will be faced with a crisis within the psychiatric healthcare system for older adults. Similarly, this higher rate of PTSD among middle-aged adults has been found in the previous NESARC-II study (Reynolds et al., 2016). Therefore, this noticeable increase in PTSD prevalence rates among adults aged 60 years and older in the current study, compared to the NCS-R and NESARC-II, may reflect this predicted crisis within the healthcare system. However, this increase may be attributable to other factors such as a greater propensity for older adults to display higher levels of subsyndromal PTSD than full PTSD (Pietrzak, Goldstein et al., 2012). It is possible that due to the absence of the functional impairment criterion, the reported prevalence rates are closer to the general U.S. population as the result of this criterion being somewhat ill-suited to psychiatric diagnostic assessments among older adults (Bodner et al., 2018), and may therefore underestimate the true prevalence. For example, older adults may be less likely to attribute occupational impairment to PTSD symptomatology if they are retired, or social impairment if they are physically impaired. Additionally, varying prevalence estimates across the literature may also be due to differences in methodologies such as the use of different PTSD diagnostic classifications in the current study, and different cut-off scores for age.

Consistent with data from non-older adult community and clinical samples (see Brewin et al., 2017), a significantly greater number of older U.S. adults met diagnostic requirements for PTSD based on the *DSM-5* guidelines compared to the *ICD-11* guidelines. However, while statistically significant, the actual difference in probable diagnostic rates between the two systems was very small and there was substantial agreement across the systems in who met criteria for PTSD. As such, it is reasonable to conclude that the *DSM-5* and *ICD-11* capture roughly equal numbers of older adults meeting criteria for a diagnosis of PTSD.

In line with the wider trauma literature (Cloitre et al., 2019; Tolin & Foa, 2006), females were more likely to meet diagnostic criteria for PTSD according to the *DSM-5* and *ICD-11* in this sample. A similar trend was observed for sex effects at the symptom and latent variable levels. The DIF analysis for the *DSM-5* symptoms revealed that several symptoms were systematically affected by a respondent’s sex. Responses to one symptom (E2: ‘risky behaviours’) were systematically biased towards males. In other words, despite equal levels on the underlying latent trait, males were more likely to endorse this symptom than females. Furthermore, three symptoms were found to be systematically biased towards females: namely 'unwanted memories', 'feeling upset', and 'sleep problems'. Similar effects for the 'feeling upset' and ‘risky behaviours’ symptoms were previously reported in a sample of Malaysian adolescents (Murphy et al., 2019). Discovering the same DIF effects in two culturally distinctive samples – and two samples of varying age profiles - is strong evidence that these symptom indicators are systematically biased for sex. As such, it may be advisable to reconceptualize, or remove, these symptoms in the next version of the *DSM*.

These findings have several clinically relevant implications. First, the *ICD-11* and *DSM-5* models of PTSD appear to provide valid representations of the latent structure of PTSD symptoms among older adults and identify similar numbers of people meeting criteria for PTSD. Clinicians should therefore feel confident that the *ICD-11* and *DSM-5* models provide an accurate description of PTSD in older adults. Second, as the *ICD-11* provides a more parsimonious account of PTSD than the *DSM-5* - there are 27 possible symptom combinations for an *ICD-11* PTSD diagnosis, and 636,120 possible symptom combinations for a *DSM-5* PTSD diagnosis (Galatzer-Levy & Bryant, 2013; Shevlin, Hyland, Vallières et al., 2018) - and there is no evidence of DIF, it can be argued that it offers clinicians a more parsimonious and statistically superior model of PTSD for use with older adults.

There are several important limitations associated with these results. First, as this study was based on a nationally representative household sample of U.S. older adults, the findings may not generalise to older adults in other nations, or to adults seen in clinical services. Second, the probable PTSD rates did not take into account the functional impairment criterion meaning they are likely to be overestimated. Third, although DIF was assessed based on sex, other sources of bias such as ethnicity may be important to examine in future studies. Finally, PTSD symptoms were estimated using items from the AUDADIS-5. It will be important to replicate this study using measures specifically designed to capture the *DSM-5* and *ICD-11* PTSD symptoms.

In conclusion, in this study the *DSM-5* and *ICD-11* models provided valid representations of PTSD symptom expression among members of the general population in later life. Moreover, a substantial proportion of people over the age of 60 may be suffering from PTSD, or at the very least, considerable posttraumatic symptomatology. Thus, researchers, clinicians, and policy-makers should not discount older adults when considering how to understand, identify, prevent, and treat trauma-based mental health problems.

Chapter 4

Patterns of comorbidity associated with *ICD-11* PTSD among older adults in the United States

A paper based on this chapter has been published in *Psychiatry Research*.

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Abstract

Little research has been conducted on posttraumatic stress disorder (PTSD) comorbidity among older adults regarding the description of PTSD in the 11th version of the *International Classification of Diseases* (*ICD-11*). This study sought to provide evidence of a dimensional model of psychopathology using the 'Hierarchical Taxonomy of Psychopathology' (HiTOP) model as a theoretical framework to explain patterns of *ICD-11* PTSD comorbidity. Distinct patterns of *ICD-11* PTSD comorbidity among a nationally representative sample (n = 530) of adults aged 60 years and older from the United States were examined using latent class analysis (LCA). Covariates associated with comorbidity classes were assessed through multinomial logistic regression. *ICD-11* PTSD was highly comorbid with other psychopathologies. LCA results favoured a two-class solution. Class 1 (71.7%) was characterised by moderate probabilities for major depressive disorder and alcohol use disorder; Class 2 (28.3%) was characterised by a moderate-high probability of general psychopathology and was associated with lower social support, spousal/partner physical abuse, and history of attempted suicide. PTSD was highly comorbid with other disorders among older adults. Distinct patterns of PTSD comorbidity exist among this cohort and these findings can aid clinicians and researchers in understanding and predicting maladaptive responses to trauma and associated psychopathology.

4.1. Introduction

PTSD frequently co-occurs with other psychiatric disorders including major depressive disorder (MDD; Rytwinski et al., 2013), generalised anxiety disorder (GAD; Gallagher & Brown, 2015), eating disorders (Brewerton, 2007), substance use disorders (SUD; Driessen et al., 2008; Pietrzak et al., 2011), psychotic disorders (Seow et al., 2016), borderline personality disorder (BPD; Frías & Palma, 2015), and also with suicidal ideation (Panagioti et al., 2012). High rates of comorbidity are unsurprising given that trauma exposure is a common risk factor for PTSD as well as all other forms of psychopathology (Bendall et al, 2008; Brewerton, 2007; Copeland et al., 2018; Gilbert et al., 2009; Kessler et al., 2010; Najavits et al., 2017; Varese et al., 2012). One goal of the new model of PTSD presented in the recently published *ICD-11* (WHO, 2018) was to reduce diagnostic comorbidity by including only a small number of core symptoms (Maercker et al., 2013). Retaining core symptoms – and excluding transdiagnostic ones – should reduce diagnostic comorbidity if psychiatric disorders are orthogonal (although orthogonality in this context is not without enduring controversy; see Marshall, 2020). However, recent findings indicate that psychopathological/ psychiatric comorbidity rates remain extremely high for *ICD-11* PTSD (Hyland et al., 2018; Karatzias, Hyland et al., 2019; Shevlin, Hyland, Vallières et al., 2018). The *ICD-11* also contains a sibling disorder to PTSD, CPTSD (WHO, 2018). In order to meet the diagnostic requirements for CPTSD, an individual must meet the requirements for PTSD and additional symptoms reflecting 'disturbances in self-organization'. Akin to PTSD, CPTSD has been found to be highly comorbid with other forms of psychopathology (Karatzias, Hyland et al., 2019).

A wealth of data shows that diagnostic comorbidity is extremely common (Caspi & Moffitt, 2018; Kotov et al., 2017). Diagnostic comorbidity can be explained and understood within a dimensional model of psychopathology. The HiTOP (Kotov et al.,

2017) is a prominent dimensional model of psychopathology which proposes that variation and covariation in psychopathology is explainable in terms of a small number of superordinate correlated latent dimensions (e.g. ‘internalising’, ‘externalising’, and ‘thought disorder’). These dimensions are divided into ‘subfactors’ that explain covariation between specific clusters of mental health problems that cut across traditional psychiatric diagnoses. In the HiTOP model, PTSD (symptoms) sits within the ‘distress’ subfactor of the ‘internalising’ dimension. Thus, the HiTOP model predicts that PTSD should be most strongly correlated with disorders within the same subfactor such as MDD, GAD, and BPD. Moreover, because the internalising dimension is correlated with all other dimensions, PTSD would also be expected to correlate with disorders in other dimensions, albeit to a lesser extent. Thus, HiTOP states that comorbidity is unavoidable because psychiatric disorders are manifestations of the same, or related, latent variable(s). Furthermore, focusing on the core symptoms of PTSD should reduce measurement error, thereby increasing covariation with other psychiatric disorders. As such, the parameters of the HiTOP model predict that reducing PTSD to its core symptoms will not only not lead to a reduced rate of diagnostic comorbidity, but it may in fact lead to an increased rate of comorbidity.

Miller and colleagues (2012) examined the latent structure of PTSD comorbidity in a sample of military veterans with high rates of PTSD and found that three latent factors (‘fear’, ‘distress’, and ‘externalising’) adequately represented the structure of PTSD comorbidity. Consistent with the HiTOP model, these factors shared similarities such as the ‘distress’ factor encompassing the same disorders (MDD, GAD, dysthymia, and BPD) that has been observed as a common factor found among community samples (see Beesdo-baum et al., 2009; Kotov et al., 2017). Identifying discernible patterns of comorbidity, along with the risk factors for these different patterns of comorbidity, is important as this information may aid clinicians in preventing individuals from progressing to highly dysfunctional multimorbid trajectories associated with adverse outcomes such as increased social and occupational impairment, suicidal ideation, and physical morbidity (Calabrese et al., 2011; Hefner & Rosenheck, 2019; Momartin et al., 2004).

Variable-oriented approaches to modelling comorbidity, such as those used by Miller et al. (2012), presuppose, and function optimally with, sample homogeneity. When examining a potentially heterogenous population where distinct subgroups may exist, such as individual responses to trauma, person-oriented approaches such as LCA - which can account for sample heterogeneity - may be more appropriate (von Eye & Bogat, 2006). Prior studies examining patterns of PTSD comorbidity using LCA across a range of internalising and externalising disorders have revealed three discrete classes (Galatzer-Levy et al., 2013; Müller et al., 2014). One class reflected individuals with a low probability of comorbidity across all disorders (except for a moderate probability of major depression); another was characterised by a high probability of comorbid mood and anxiety disorders; and the third was characterised by a high probability for SUDs, mood disorders, and anxiety disorders. Suicidal ideation was found to be a characteristic of all high comorbidity classes. This finding is in line with research suggesting that psychiatric comorbidity is a risk factor for suicidal behaviour in relation to both PTSD comorbidity and general psychopathology (Calabrese et al., 2011; Gili et al., 2019; Kavalidou et al., 2019; Kavalidou et al., 2017; Norman et al., 2018; Turecki & Brent, 2016).

The literature pertaining to PTSD comorbidity specifically among older adults is relatively underdeveloped; the available data suggests that PTSD in older adults is highly comorbid with a range of internalising and externalising disorders (Averill & Beck, 2000; Chopra et al., 2014; Glück et al., 2016; Pietrzak, Goldstein et al., 2012; Pless Kaiser et al., 2019; Spitzer et al., 2008). However, epidemiological evidence indicates that psychiatric morbidity (including PTSD) and comorbidity is significantly lower among older adults in comparison to their younger counterparts (Gum et al., 2009; Kessler et al., 2005; Thomas et al., 2016). For example, Kessler and colleagues (2005) found that 11.6% of adults aged 60 years and older reported having two or more psychiatric disorders, which was substantially lower than those aged 18-29 (33.9%), 30-44 (34.0%), and 45-59 (27.0%). Furthermore, it has been found that older age is associated with decreased odds of psychiatric comorbidity among individuals who met the criteria for a past-year diagnosis of PTSD (Reynolds et al., 2016). Therefore, as rates of diagnostic psychiatric comorbidity may be substantially lower among older adults, it is important to determine if patterns of covariation among psychiatric disorders observed from previous studies in the general population are generalisable to this population.

In this study, patterns of comorbidity for *ICD-11* PTSD were investigated among a nationally representative sample of older adults (60 years and above) from the U.S. Based on the predictions of the HiTOP model, four hypotheses were formulated. First, it was hypothesised that rates of diagnostic psychiatric comorbidity involving *ICD-11* PTSD and a range of other psychiatric disorders would be high. Second, that the highest comorbidity rates would be found for 'distress' related disorders including MDD, GAD, and BPD. Third, based on prior findings regarding the latent structure of PTSD comorbidity, it was hypothesised that multiple latent classes would be identified, including classes characterised by (i) low comorbidity, (ii) comorbidity with internalising disorders, and (iii) comorbidity with externalising and/or psychotic disorders. Finally, it was hypothesised that the latent classes characterised by the highest levels of diagnostic comorbidity would be associated with a history of suicidal behaviour. Moreover, additional covariates were included that have been found to play an important role in predicting positive/negative mental health outcomes, such as social support (Wang et al., 2018).

4.2. Methods

4.2.1. Participants and recruitment strategy

Participants in this study were drawn from the NESARC-III study which is a nationally representative sample of non-institutionalised adults from the U.S. aged 18 years and older (N = 36,309). Information on the NESARC-III data is available elsewhere (Grant et al., 2014). Protocols of the NESARC-III project received ethical approval from the institutional review boards of the National Institutes of Health and Westat, and all participants provided their informed consent. Approval for secondary analysis was granted by the ethical review board at Maynooth University.

The current sample (n = 530) was selected from the full NESARC-III dataset based on several inclusion criteria: (a) were aged 60 years or older, (b) reported experiencing or witnessing at least one traumatic event in their lifetime, and (c) met the symptomatic requirements for an *ICD-11* PTSD diagnosis. Data were adjusted for oversampling (of ethnic/racial minorities) and non-responses and were weighted to reflect the U.S. civilian population as per the 2012 American Community Survey (Bureau of the Census, 2013). All parameter estimates were adjusted for the complex survey design of the NESARC-III based on the stratification, clustering, and weighting of the study population, whereas sample size is based on the unweighted data. The sample included a higher proportion of females (59.9%, n = 330) than males (40.1%, n = 200), and the average age was 67.65 years (SD = 6.67) (see Table 4.1 for other sample characteristics).

Table 4.1
Sample characteristics and descriptive statistics of the current study.

Sample characteristic	%[a] (n)[b]	Mean[a] (95% CI)	Median	SD	Range
Social support		40.39 (39.67 / 41.11)	42.00	7.00	13–48
Marital status					
Married/cohabiting	57.3 (220)				
Not married/cohabiting (windowed/divorced etc.)	42.7 (310)				
Residency					
Urban	71.7 (404)				
Rural	28.3 (126)				
Education					
Less than high school	21.7 (126)				
High school or equivalent	25.9 (148)				
Some college-level education or higher	52.5 (256)				
Household income					
$0–$24,999	37.1 (253)				
$25,000–$49,999	29.6 (143)				
$49,999–$79,999	15.3 (67)				
$80,000 and above	18.1 (67)				
Attempted suicide	10.1 (60)				
Trauma exposure					
Sexually abused before age 18	20.4 (102)				
Sexually assaulted as an adult	7.4 (46)				

Physically abused before the age 18	9.0 (48)
Beaten up by spouse/romantic partner	15.4 (101)
Beaten up by someone else	5.9 (32)
Other interpersonal trauma	15.2 (83)
Non-interpersonal trauma	63.5 (330)
War-related trauma	18.7 (90)

Note: 95% CI = 95% confidence intervals; SD = standard deviation; [a] = Percentages and descriptive statistics are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population; [b] = sample size is based on the unweighted data.

4.2.2. Measures

All data were gathered using the AUDADIS-5 (Grant et al., 2011). The AUDADIS-5 is a structured, diagnostic interview which assesses participants for symptoms associated with an array of psychiatric disorders.

Traumatic exposure

Participants were presented with two lists of different traumatic events that they may have experienced. One list consisted of 19 traumatic events that they may have personally experienced (e.g. childhood sexual abuse). The second list consisted of 13 traumatic events that they may have witnessed/learned about (e.g., witnessing/learning about another person's childhood sexual abuse). Participants were then asked to select, from these lists, the traumatic event(s) that they have personally experienced or witnessed/learned about. Participants could also select "other" as an additional option if the type of traumatic event that they experienced was not specified on either list. However, in order to reduce response burden, respondents could only report experiencing a maximum of four different types of traumatic events from these two lists and were instructed to specify their most stressful traumatic event. If the respondent had experienced more than four traumatic events, only the four most severe events were recorded. All PTSD items were responded to in relation to their most distressing event.

For the purposes of the current study, several of the direct traumatic events were used as covariates of latent class membership. These included being sexually abused before age of 18 years, being sexually assaulted as an adult, being physically abused before age of 18 years, being beaten up by a spouse/romantic partner, being beaten up by someone else, experiencing other forms of interpersonal trauma (kidnapped, stalked, or mugged), experiencing a non-interpersonal trauma (serious or life-threatening injury/illness, saw a dead body or body parts, being admitted to a juvenile detention/jail, or experiencing a natural disaster), and experiencing a war-related trauma (being injured in a terrorist attack, experiencing active military combat, being a peacekeeper/relief worker, being a civilian in war zone/place of terror, being a refugee, being a prisoner of war).

ICD-11 PTSD symptoms

Items were extracted from the AUDADIS-5 that corresponded to the six *ICD-11* PTSD symptoms. See Table 2.1 for a comparison between the items extracted from the AUDADIS-5 and their corresponding items from the ITQ (Cloitre et al., 2018), the only available and psychometrically supported measure of *ICD-11* PTSD and CPTSD. Symptoms were answered using a dichotomous response format (‘yes’ = 1, ‘no’ = 0). The internal consistency among the sample of older adults was satisfactory (Cronbach’s alpha = .77). In addition, the *ICD-11* model of PTSD, using the same items as the current study, has previously been found to provide excellent statistical fit among adults aged 60 years and above (Fox et al., 2020a).

An *ICD-11* PTSD diagnosis requires the presence of at least one of two ‘Re-experiencing’ symptoms, one of two ‘Avoidance’ symptoms, and one of two ‘Sense of

Current Threat' symptoms. Diagnosis also requires that these symptoms cause functional impairment, however, this criterion was not screened for with all participants. As such, participants screened positive for a probable PTSD diagnosis based on the traumatic exposure and symptom requirements only. 530 respondents met the symptom criteria for lifetime *ICD-11* PTSD, corresponding to 6.1% of the full sample of older adults aged 60 years and above (n = 8,367), and 8.8% of older adults who endorsed at least one traumatic event (n = 5,625).

Comorbid psychiatric disorders

A range of lifetime psychiatric diagnoses, based on the criteria set forth in the *DSM-5* (APA, 2013), were extracted from the AUDADIS-5. This included mood and anxiety disorders (MDD, dysthymia, GAD, social phobia, specific phobia, agoraphobia, and panic disorder), eating disorders (anorexia nervosa, bulimia nervosa, and binge-eating disorder), alcohol use disorder (AUD), other drug use disorders (cannabis, opioid, cocaine, sedative, club drug, inhalant/solvent, hallucinogen, stimulant, and heroin use disorders), and personality disorders (antisocial personality disorder [ASPD], BPD, and schizotypal personality disorder [SPD]). Eating disorders (ED) and drug use disorders (DUD) were subsequently grouped to create dichotomous variables that indicates the presence (or absence) of any ED, or any DUD. A total comorbidity count variable was also created that corresponded to the (unweighted) total number of the above psychiatric disorders. These psychiatric comorbid disorders were measured according to the *DSM-5* guidelines.

Previous research has examined the procedural validity of the AUDADIS-5 (compared to the semi-structured, clinician-administered PRISM-5), and indicated that the concordance of *DSM-5* diagnoses between the AUDADIS-5 and PRISM-5 were fair-to-moderate (Hasin et al., 2015). Furthermore, test-retest reliability of past-year, prior-to-past-year, and lifetime diagnoses were generally fair-to-good (Grant et al., 2015), with Kappa statistics ranging from .35 – .87 for the diagnostic variables, and intraclass correlation coefficients ranging from .45 – .85 for their respective continuous scales.

Attempted suicide

To assess history of suicidal attempts, participants were asked “in your entire life did you ever attempt suicide?”. Responses were scored using a dichotomous response format (‘yes’ = 1, ‘no’ = 0). This item has been used in previous versions of the NESARC and was found to have a moderate test-retest reliability across NESARC Wave 1 and Wave 2 (Palmetto & Link, 2010).

Social support

Social support was measured using the general population version of the 12-item Interpersonal Support Evaluation List (ISEL-12; Cohen et al., 1985). Half of the items are positive statements (e.g. “if I wanted to have lunch with someone, I could easily find someone to join me”), and the other half are negatively phrased (e.g. “if I were sick, I know I would find someone to help me with my daily chore”). The items are measured on a four-point Likert-scale (‘definitely false’ = 1, ‘definitely true’ = 4). Higher scores indicate greater perceived social support. Responses were summed to create a composite social support score ranging from 12–48. A unidimensional model has previously been found to be both valid and reliable (Merz et al., 2014). The internal consistency among the current sample was satisfactory (Cronbach’s alpha = .85).

Sociodemographic variables

Several sociodemographic variables were assessed including age, sex, marital status, residency (urban/rural), education, and past-year household income. Education was measured using 14 categories ranging from “no formal schooling” to “professional or doctorate degree”. Household income was measured using 21 categories that ranged from “less than $5,000” to “$200,000 or more”.

4.2.3. Analytical plan

The analytical plan was three-fold. First, prevalence rates of various psychiatric disorders were estimated among the older adult sample that met the symptom criteria for *ICD-11* PTSD. Second, latent classes of PTSD comorbidity were examined through LCA (conducted using Mplus 7.4; Muthén & Muthén, 2012), using MLR estimation. To determine the optimal number of latent classes, models with one to six classes were examined. 500 random sets of starting values were used followed by 100 final stage optimizations in order to avoid solutions based on local maxima. The fit of each latent class model was determined using several fit indices: the AIC (Akaike, 1987), the BIC (Schwarz, 1978), the ssaBIC (Sclove, 1987), entropy values, and the LMR-A likelihood ratio test (Lo et al., 2001). Lower AIC, BIC, and ssaBIC values, and higher entropy values, indicate better model fit. A non-significant LMR-A value indicates that the model with one less class should be accepted. Previous Monte Carlo simulation studies indicated that the BIC is the best indicator for class enumeration (Nylund et al., 2007). Regarding the individual psychiatric disorders, and akin to studies of a similar nature (Burstein et al., 2012; Galatzer-Levy et al., 2013), a probability ≥ .15 indicated a class characteristic; a probability ≥ .15 and ≤ .59 was indicative of a moderate probability of comorbid diagnosis; and a probability ≥ .60 suggested that the disorder was highly probable within the respective class.

Third, a multinomial logistic regression was performed by regressing the latent classes (identified during the class enumeration process) onto several covariates (age, sex, marital status, residency, education, household income, social support, attempted suicide, and multiple forms of traumatic exposure). This was conducted using the R3STEP function in Mplus (Muthén & Muthén, 2012; Vermunt, 2010). This three-step procedure involves first identifying the most appropriate latent classes; then obtaining the most likely class memberships based on the posterior probabilities of the LCA, while accounting for the classification uncertainty rate (i.e. measurement error); and finally the most likely class memberships are analysed with the covariates, thus accounting for at least some of the misclassification error (Asparouhov & Muthén, 2014; Vermunt, 2010). This method is also preferable as it does not result in a shift in latent classes when the covariates are included.

4.3. Results

4.3.1. ICD-11 PTSD comorbidity

The sample characteristics and descriptive statistics of the variables used in the current study are reported in Table 4.1. Among the older adults who met symptom criteria for *ICD-11* PTSD, the most common co-occurring disorder was MDD (40.5%), followed by AUD (30.1%), BPD (28.0%), and GAD (21.9%) (Table 4.2 for full details). Moreover, 21.5% reported experiencing no comorbid disorder, 25.9% reported one additional comorbid disorder, 19.1% reported two additional comorbid disorders, 12.2% reported three additional comorbid disorders, and 21.2% reported experiencing four or more additional comorbid disorders.

4.3.2. Latent class analysis

Table 4.3 presents the LCA results for the different class solutions. Two diagnostics indicate that a two-class solution fit the data best: the BIC value and the LMR-A test finding. However, a single further diagnostic favoured the three-class solution (the ssaBIC). The two-class solution (see Figure 4.1) was determined to be the most appropriate model on the grounds of statistical fit and parsimony. However, for the purposes of transparency, the three-class solution is also included (see Figure 4.2).

Class 1 (71.7%) was characterised by moderate probabilities of comorbid MDD (.30) and AUD (.23). This class was labelled 'PTSD with moderate probabilities of depressive/alcohol use disorders'. Class 2 (28.3%) was characterised by a high probability for comorbid MDD (.66) and BPD (.74), and moderate probabilities for dysthymia (.38), GAD (.48), social phobia (.23), specific phobia (.25), agoraphobia (.15), panic disorder (.28), DUD (.22), AUD (.47), and SPD (.48). This class was labelled ‘PTSD with general psychopathology’.

4.3.3. ICD-11 PTSD patterns of comorbidity covariates

The results of the multinomial logistic regression are reported in Table 3, and Class 1 (‘PTSD with moderate probabilities of depressive/alcohol use disorders’) was treated as the reference class for all comparisons. Lower levels of social support (OR = 0.94 [95% CI 0.89, 1.00], p = .035), a history of attempted suicide (OR = 2.96 [95% CI 1.17, 7.44], p = .021), and physical abuse from a spouse/romantic partner (OR = 2.79 [95% CI 1.20, 6.46], p = .017) were associated with an increased likelihood of membership of Class 2 (‘PTSD with general psychopathology’).

Table 4.2

Prevalence rates of ICD-11 PTSD lifetime comorbid psychiatric disorders.

Comorbid disorder	%[a] (n)[b]
Major depressive disorder (MDD)	40.5 (222)
Dysthymia	16.4 (90)
Generalised anxiety disorder (GAD)	21.9 (126)
Social phobia	9.4 (52)
Specific phobia	12.0 (75)
Agoraphobia	5.0 (30)
Panic disorder	11.3 (58)
Alcohol use disorder (AUD)	30.1 (160)
Any drug use disorder (DUD)	10.4 (55)
Any eating disorder (ED)	2.8 (15)
Antisocial personality disorder (ASPD)	4.0 (20)
Borderline personality disorder (BPD)	28.0 (166)
Schizotypal personality disorder (SPD)	18.4 (100)
Number of comorbid disorders	
0	21.5 (108)
1	25.9 (138)
2	19.1 (89)
3	12.2 (74)
4+	21.2 (121)

Note: n = 530; [a] = Percentages are adjusted for the complex survey design of the NESARC-III, based on the stratification, clustering, and weighting of the study population; [b] = sample size is based on the unweighted data.

Table 4.3
Model fit statistics for LCA demonstrating patterns of ICD-11 PTSD comorbidity among older adults.

Number of classes	Log likelihood	AIC	BIC	ssaBIC	LMR-A (*p*)	Entropy
1	-2749.045	5524.090	5579.637	5538.371	-	-
2	-2586.928	5227.855	5343.223	5257.517	320.584 (.025)	.73
3	-2543.710	5169.420	5344.608	5214.462	85.462 (.576)	.80
4	-2519.699	5149.397	5384.405	5209.820	47.482 (.553)	.86
5	-2498.372	5134.744	5429.573	5210.547	42.172 (.402)	.87
6	-2482.050	5130.101	5484.749	5221.284	32.276 (.719)	.88

Note: n = 530; Estimator = MLR; AIC = Akaike information criterion; BIC = Bayesian information criterion; ssaBIC = sample size-adjusted Bayesian information criterion; LMR-A = Lo–Mendell–Rubin adjusted likelihood ratio test.

Figure 4.1

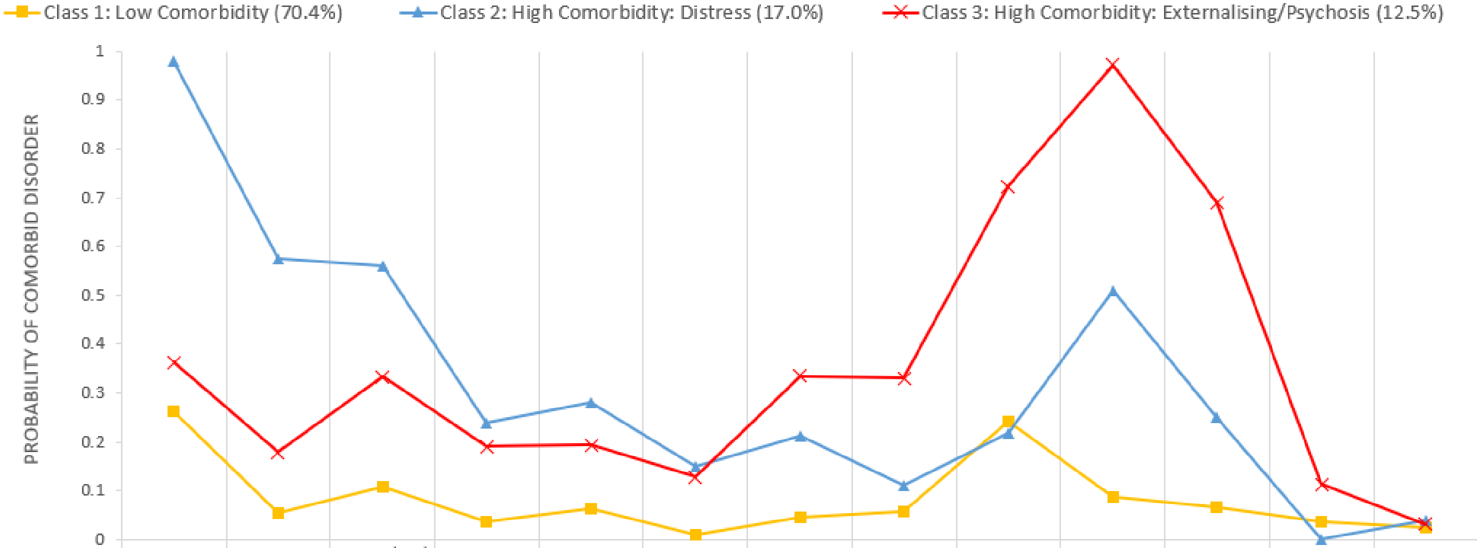
Latent classes of ICD-11 PTSD comorbidity.

	Major Depressive Disorder	Dysthymia	Generalised Anxiety Disorder	Social Phobia	Specific Phobia	Agoraphobia	Panic Disorder	Drug Use Disorder	Alcohol Use Disorder	Borderline PD	Schizotypal PD	Antisocial PD	Eating Disorder
Class 1: PTSD with Moderate Probabilities of Depressive/Alcohol Use Disorders (71.7%)	.301	.076	.113	.037	.069	.010	.044	.055	.234	.092	.065	.036	.024
Class 2: PTSD with General Psychopathology (28.3%)	.660	.382	.479	.233	.246	.150	.281	.223	.465	.744	.475	.052	.038

Note: The x-axis represents the varying lifetime psychiatric disorders; the y-axis represents the probability of endorsing the respective comorbid psychiatric disorder; PD = personality disorder.

Figure 4.2

Alternative three-class solution: Latent classes of ICD-11 PTSD comorbidity.



	Major Depressive Disorder	Dysthymia	Generalised Anxiety Disorder	Social Phobia	Specific Phobia	Agoraphobia	Panic Disorder	Drug Use Disorder	Alcohol Use Disorder	Borderline PD	Schizotypal PD	Antisocial PD	Eating Disorder
Class 1: Low Comorbidity (70.4%)	.264	.055	.108	.037	.065	.010	.045	.058	.241	.088	.068	.037	.024
Class 2: High Comorbidity: Distress (17.0%)	.979	.575	.561	.240	.280	.150	.211	.112	.219	.509	.252	.000	.041
Class 3: High Comorbidity: Externalising/Psychosis (12.5%)	.364	.179	.334	.191	.194	.128	.335	.331	.724	.972	.691	.114	.032

Note: The x-axis represents the varying lifetime psychiatric disorders; the y-axis represents the probability of endorsing the respective comorbid psychiatric disorder; PD = personality disorder.

Table 4.4
Multinomial logistic regression for covariates of latent class membership.

Covariate	Class 2 vs. Class 1
	OR (95% CI)
Age	0.96 (0.91 / 1.01)
Sex[a]	0.72 (0.32 / 1.63)
Marital status[b]	0.50 (0.23 / 1.06)
Residency[c]	1.26 (0.69 / 2.29)
Education	1.05 (0.91 / 1.21)
Household income	0.98 (0.91 / 1.06)
Social support	**0.94* (0.89 / 1.00)**
Attempted suicide	**2.96* (1.17 / 7.44)**
Sexually abused before age 18	1.29 (0.62 / 2.68)
Sexually assaulted as an adult	1.15 (0.33 / 3.97)
Physically abused before age 18	0.64 (0.24 / 1.68)
Beaten up by spouse/romantic partner	**2.79* (1.20 / 6.46)**
Beaten up by someone else	0.69 (0.24 / 1.98)
Other interpersonal trauma	0.47 (0.19 / 1.14)
Non-interpersonal trauma	1.39 (0.77 / 2.50)
War-related trauma	0.50 (0.19 / 1.34)

Note: Class 1 = PTSD with moderate probabilities of depressive/alcohol use disorders; Class 2 = PTSD with general psychopathology; OR = odds ratio; 95% CI = 95% Confidence Intervals; [a] = sex coded as 0 = male, 1 = female; [b] = marital status coded as 0 = not married/cohabiting, 1 = married/cohabiting; [c] = residency coded as 0 = urban, 1 = rural.
Statistical significance: *$p < .05$.

4.4. Discussion

There is limited research regarding *ICD-11* PTSD comorbidity, especially with older adults. In line with emerging evidence from general population and clinical samples (Hyland et al., 2018; Karatzias, Hyland et al., 2019; Shevlin, Hyland, Vallières et al., 2018), *ICD-11* PTSD was found to be highly comorbid with a range of lifetime psychiatric disorders. Moreover, despite an overall decline in psychiatric morbidity among older adults (Gum et al., 2009; Kessler et al., 2005; Thomas et al., 2016) and comorbidity with PTSD (Reynolds et al., 2016), nearly four fifths of the sample met the diagnostic criteria for at least one other psychiatric disorder. This suggests that although there is a general downward trend in the prevalence of psychiatric disorders among older adults, psychiatric comorbidity remains high for those with PTSD.

Consistent with the second hypothesis, the highest rates of comorbidity were identified for other 'distress' disorders including MDD, BPD, and GAD. The notable exception to this pattern was the association with AUD which, according to the HiTOP model, sits within the 'externalising' dimension of psychopathology. A putative explanation for the increased probability of comorbid AUD is the self-medication hypothesis, which proposes that PTSD symptom manifestation precedes the development of drug/alcohol addiction and that individuals misuse drugs/alcohol in an attempt to assuage the distressing nature of their psychiatric symptoms (Khantzian, 1997; Leeies et al., 2010). However, given the cross-sectional nature of the data, and that a lifetime traumatic exposure assessment was used, it is not possible to garner the precise temporal ordering to test the self-medication hypothesis. In other words, it is unclear whether trauma exposure and/or PTSD symptoms preceded the onset of substance abuse.

Among the different psychiatric disorders that were comorbid with PTSD, similar prevalence rates were found compared to the general population (Pagura et al., 2010). However, among the current sample of older adults, PTSD comorbidity was substantially lower among several of the internalising ‘fear’ disorders (consisting of social phobia, specific phobia, agoraphobia, and panic disorder), compared to the general population. Most notably, panic disorder and specific phobia. It is also important to note that a subset of the current sample is likely to have also met the requirements of CPTSD, the sibling disorder to PTSD in the *ICD-11*. However, given the available items in the AUDADIS-5 it was not possible to extract sufficient items to represent this sibling disorder. A diagnosis of CPTSD may partially explain the observed comorbidity rates, most notably among MDD, GAD, and BPD (Frost et al., 2020; Karatzias, Hyland et al., 2019). However, previous research has found similar comorbidity rates between PTSD and CPTSD regarding AUD and suicidality (Karatzias, Hyland et al., 2019).

It is also possible that the PTSD symptoms are covered by diagnostic overshadowing, whereby symptoms are falsely attributed to PTSD but are in reality manifestations of another disorder (Hryvniak & Rosse, 1989). However, a strength of the *ICD-11* model of PTSD focusing on the ‘core PTSD’ symptoms should, in theory, reduce the likelihood of diagnostic overshadowing. For example, the *ICD-11* model does not include symptoms pertaining to difficulty concentrating, or the inability to recall certain aspects of a traumatic event. Therefore, diagnostic overshadowing with other psychiatric disorder, or age-related conditions (e.g. dementia) are unlikely to be an issue within the context of the current study.

Given the heterogenous nature of trauma response, a person-centred approach was taken to examine patterns of PTSD comorbidity. Somewhat inconsistent with previous findings from the general population (Galatzer-Levy et al., 2013; Müller et al., 2014) and the third hypothesis, a two-class solution was found to be the most appropriate representation of latent patterns of PTSD comorbidity. This suggests that psychiatric comorbidity among older adults with PTSD may manifest in somewhat different ways than in the general population. These previous studies reported a moderate probability of MDD within the lower comorbidity class, however, it was found that this class ('PTSD with moderate probabilities of depressive/alcohol use disorders') was characterised by an increased probability of AUD and MDD. This suggests that PTSD may carry an inherent risk for comorbid depressive/alcohol use disorders among older adults, even in the more resilient class.

The second class ('PTSD with general psychopathology') was characterised by increased likelihood of nearly all other disorders with the exception of ASPD and EDs. Individuals in this class had moderate or high probabilities of meeting requirements for diagnoses that cut across the internalising, externalising, and thought-disorder spectra of the HiTOP model. Thus, diagnostic comorbidity in this sample did not follow a simple dimensional-specific pattern; this finding is consistent with the HiTOP's description of correlated superordinate dimensions of psychopathology which ultimately reflect a general vulnerability to all forms of psychopathology (Kotov et al., 2017). This description could be evaluated in future analyses taking advantage of superordinate analytic approaches within LCA.

Although there is no consensus regarding the precise reason for the observed psychiatric morbidity and comorbidity differences among older adults compared to their younger and middle-aged counterparts, possible explanations include: (1) generational differences in one's willingness to disclose psychiatric symptoms due to fear of stigma (Cook & Simiola, 2018; Pless Kaiser et al., 2019); (2) that older adults are more likely to report psychological symptoms as somatic complaints (Cook & Simiola, 2018; Palmer et al., 1997; Pless Kaiser et al., 2019); (3) the inability to accurately report psychological symptoms due to cognitive impairments (Thomas et al., 2016); and (4) due to the distressing nature and concomitant health-risks of PTSD, and most notably

PTSD and comorbid psychiatric diagnoses, it may be possible that age-related differences reflect a form of survivor bias whereby individuals with PTSD are less likely to survive into older adulthood (Cook & Simiola, 2018; Thomas et al., 2016). These explanations may, in-part, account for the differences in comorbidity patterns among the current sample compared to the general population studies.

The higher rates of SPD in the second class may be explained through a number of different reasons. First, this high comorbidity may be due to the deleterious effects of trauma exposure as a shared risk factor of psychosis and PTSD (Bendall et al., 2008; Varese et al., 2012). Second, there may be an overlap in the clinical manifestation of PTSD symptoms and psychotic indicators (Seow et al., 2016). For example, re-experiencing the traumatic event (e.g. flashbacks) may be misconstrued as hallucinations, and hypervigilance may be misconstrued as paranoia (O'Conghaile, & DeLisi, 2015). Third, high comorbidity rates between PTSD and psychosis may be mediated through numerous other psychiatric comorbidities such as substance abuse and depressive symptoms (Sareen et al., 2005).

Consistent with the fourth hypothesis, those with a history of suicidal attempts were nearly three times more likely to belong to the class characterised by high rates of comorbidity. This is consistent with previous findings (Galatzer-Levy et al., 2013; Müller et al., 2014), and provides additional evidence that an increased burden of psychopathology is a risk factor of suicidality. Membership of the highly comorbid class was also associated with lower levels of social support. This predictor being associated with high comorbidity levels aligns with results found among general (non-PTSD) populations. For instance, there is a wealth of existing data demonstrating the important role that social support and social connection plays in maintaining good mental health (Wang et al., 2018). Moreover, spousal/partner physical abuse was the only type of traumatic experience to predict membership of the higher comorbidity class. This finding is similar to Galatzer-Levy and colleagues (2013) who found that partner physical abuse was the only trauma-specific variable that predicted class membership for the two higher-comorbidity classes, compared to the low comorbidity class.

The findings of this study have important clinical and research implications. First, it was found that *ICD-11* PTSD was a highly comorbid disorder among older adults. Clinicians working with geriatric populations should be aware of this high comorbidity among patients exhibiting symptoms of PTSD, as psychiatric diagnostic assessments in later life can carry difficulties such as older adults being less likely to endorse social or occupational impairment that may lead to psychiatric disorders being under-, or mis-diagnosed (see Bodner et al., 2018). Second, results provide evidence that there are distinct patterns of PTSD comorbidity among older adults. Clinicians working with older adults should be cognizant that increased rates of disorder comorbidity are associated with less social support, spousal/partner physical abuse, and history of suicide attempts. Older adults with multiple mental health problems require urgent and substantial clinical interventions. Third, the current findings provide additional evidence in support of the HiTOP model and demonstrate that this framework may be useful for clinicians in understanding which disorders are most likely to exist comorbidly.

The findings of this study should be interpreted in light of several limitations. First, the current study used a nationally representative household sample of U.S. older adults, therefore, the generalisability to older adults in other nations, or in in-patient clinical settings, cannot be assumed. Second, the measure of *ICD-11* PTSD did not consider the functional impairment criterion, and as such comorbidity rates may be overestimated. However, it has been argued that a limitation of current psychiatric diagnostic assessments, specifically related to the functional impairment criteria, may be inaccurate among older adults (Bodner et al., 2018). For example, older adults may be less likely to attribute social impairment to PTSD symptomatology if they are physically impaired, or occupational impairment if they are retired. Third, it will also be important to replicate this study using measures specifically designed to capture the *ICD-11* PTSD diagnostic criteria (such as the ITQ; Cloitre et al., 2018), including items that explicitly refer to the “here-and-now” quality of the re-experiencing symptoms. Moreover, future research should aim to include an assessment of *ICD-11* CPTSD. Fourth, as LCA is an exploratory and data-driven approach, future studies should aim to examine latent classes of PTSD within varying contexts to ensure that these findings are robust. Fifth, it should be noted that the measure of suicidal attempt history does not take into account factors such as the intensity or outcome of the attempted suicide (e.g. serious life-threatening injuries/hospitalisation). Moreover, due to the sensitive nature of this question, it is possible that the prevalence rate was under-estimated. Sixth, the measure of comorbidity used was a count variable denoting the presence/absence of a disorder and was not weighted to reflect differences in the functional impairment of the disorder. The limitation of such a counting approach is that all comorbid psychiatric disorders are incorrectly assumed to be equal in terms of distress/functional impairment. Seventh, as the measures of psychiatric comorbidity used were lifetime assessments, it was not possible to precisely infer temporal ordering among the disorders. For example, whether PTSD symptoms had abated before the onset of the other forms of psychopathology. As such, future research should aim to address this limitation by employing longitudinal methods of psychiatric assessment.

In summary, previous research has found that diagnostic psychiatric comorbidity reduces among older adults. Despite this reduction among older adults, it was found that *ICD-11* PTSD appears to remain a highly comorbid disorder in later life. Diagnostic psychiatric comorbidity was most notably observed among other internalising ‘distress’ disorders (MDD, BPD, and GAD) and AUD. Similar to studies among the general population, the latent class with higher diagnostic psychiatric comorbidity was associated with a greater likelihood of having a history of suicidal attempts. Moreover, these findings provide a useful addition to the literature pertaining to both the structure of general psychopathology and the structure of *ICD-11* PTSD comorbidity. These findings demonstrate the importance of identifying early signs of maladaptive posttraumatic responses and can inform clinicians and researchers of potential comorbid subtypes that may manifest as a response to trauma.

Chapter 5

Posttraumatic stress disorder and loneliness are associated over time: A longitudinal study on PTSD symptoms and loneliness, among older adults

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Abstract

Loneliness has a pernicious effect on mental health in later life and is likely to have a bidirectional relationship with psychopathology. However, longitudinal research examining loneliness and posttraumatic stress symptoms among older adults is scarce. This study aimed to examine the longitudinal relationship between subtypes of loneliness (social and emotional) and posttraumatic stress symptoms. Using two waves of data from an older adult sample (n = 1,276), the Longitudinal Aging Study Amsterdam (LASA), longitudinal relationships among subtypes of loneliness and posttraumatic stress symptoms were examined using a multivariate two wave-latent change score (2W-LCS) model. Both social (time 1: rho = .22; time 2: rho = .22) and emotional (time 1: rho = 41; time 2: rho = .38) loneliness were cross-sectionally associated with posttraumatic stress symptoms. There were significant, however, very small increases in both posttraumatic stress symptoms (Cohen's d = -0.16, $p < .001$) and emotional loneliness over time (Wilcoxon r = -.05, p = .006), whereas social loneliness scores did not significantly change over time (Wilcoxon r = .00, p = .857). Changes in both social (β = .16) and emotional loneliness (β = .15) were associated with small changes in posttraumatic stress symptoms, consistent with the existence of a longitudinal association between the constructs, net of covariate effects. Results provide evidence of the existence of a longitudinal association between subtypes of loneliness and posttraumatic stress symptoms, among older adults. Results have implications for clinicians who should identify individuals at risk of developing posttraumatic stress symptoms, and for the theory of both posttraumatic stress disorder and loneliness.

5.1. Introduction

Loneliness is a distressing psychological experience that occurs when an individual feels their social connectedness to be insufficient (Peplau & Perlman, 1982). It has been conceptualised as a unidimensional, and as a multidimensional construct that is characterised by 'emotional loneliness' (emotional loneliness; lack, or absence, of intimate relationships and close attachments) and 'social loneliness' (social loneliness; desire to have a wider engaging social network that can provide a sense of belonging and companionship) (de Jong Gierveld & van Tilburg, 2006; Weiss, 1973). Loneliness is common among older adults (Ong et al., 2016) and while it is not unique to the ageing population (Qualter et al., 2015), can often arise in later life (Cohen-Mansfield et al., 2016). This increase can be due to older adults being more likely to experience risk factors such as the death of a loved one, a chronic illness, impaired mobility, and retirement (Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2016; Pinquart & Sorensen, 2001).

Longitudinal research suggests that loneliness may be associated with PTSD symptomatology (e.g. van der Velden et al., 2018; 2019). However, longitudinal research among these constructs is relatively scarce, with very little research examining this longitudinal relationship among older adults. It is valuable to assess the longitudinal relationship between loneliness and PTSD among older adults because the trajectory of these constructs may be quite different in this cohort of the population. While loneliness is often reported at higher levels among older adults relative to younger counterparts, numerous epidemiological studies have found that the incidence of PTSD is lowest among the oldest adults in the population (e.g. Gum et al., 2009). It is possible that these opposing trends (i.e. PTSD symptoms tend to decline in later life, whereas loneliness tends to increase in later life) may impact the stationarity of the association between these constructs; that is, the effect may not persist into later life. Therefore, it is worthwhile to examine the relationship between PTSD and loneliness among older adults.

Loneliness can be maintained through negative cognitive biases such as hypervigilance for social threats (Hawkley & Cacioppo, 2010). A similar psychological disposition is found among individuals suffering from PTSD where a persistent sense of threat occurs despite the lack of a corresponding environmental stimulus (Williamson et al., 2015). Moreover, loneliness is associated with numerous other experiences that are common among trauma exposed persons including re-experiencing/intrusion symptoms (Dagan & Yager, 2019), avoidance symptoms (DePrince et al., 2011), negative evaluations of the world (Cacioppo & Hawkley, 2009), and poor sleep quality (Matthews et al., 2017; McHugh & Lawlor, 2013). Loneliness may also be associated with symptoms such as feelings of alienation, detachment, and estrangement from others (DePrince et al., 2011); however, it is important to note that this association may reflect a conceptual overlap between these constructs.

Longitudinal research in the general population has shown that loneliness does not predict PTSD symptoms among those who have experienced a recent traumatic event (i.e., within the last two months), but it does predict PTSD symptoms among individuals who have experienced a trauma in the more distant past (i.e. in the last 5–12 months) (van der Velden et al., 2019). Given that PTSD symptoms naturally remit for many exposed persons in the first months following their traumatic event (Steinert et al., 2015), these findings suggest that loneliness may interfere with the natural adjustment and recovery process for some trauma-exposed persons. There is only one study that has examined the relationship between loneliness and PTSD in an older adult sample. In this study, O’Connor (2010) found that social and emotional loneliness measured two months after the death of a spouse were associated with PTSD symptoms 18 months post-bereavement. Similar to the findings of van der Velden and colleagues (2019), it is possible that loneliness may be a marker of a more complicated bereavement process, whereby intense feelings of loneliness may interfere with the natural recovery process following bereavement. While there is evidence that loneliness predicts future PTSD symptoms, it is also plausible that PTSD symptoms could predict future feelings of loneliness. For example, social withdrawal and relational difficulties are common experiences among people suffering from PTSD (Solomon & Dekel, 2008; Solomon et al., 2015; Thompson et al., 2018), and it is possible that these behaviours might result in feelings of loneliness. Thus, the association between loneliness and PTSD over time may be reciprocal.

Although symptoms of PTSD are chronic and stable for some individuals; they have been found to fluctuate over time for others in later life (Chopra et al., 2014). Symptoms of PTSD have also been found to re-emerge in later life, possibly due to age-related normative events such as retirement, bereavements, and worsening physical health (Pless Kaiser et al., 2019). For example, veterans who begin to suffer from impaired mobility may re-experience the sense of vulnerability they felt when injured in combat (Pless Kaiser et al., 2019). However, the cause of these fluctuations in later life is not clear. Given the importance of loneliness in later life, and its association with PTSD symptomatology, it may of clinical benefit to examine the longitudinal association between these constructs. As such, determining whether there is a longitudinal association may aid clinicians and researchers in identifying possible variables that precede/predict these fluctuations in PTSD symptoms in later life.

There is limited research examining the longitudinal associations between PTSD and loneliness. Additionally, there is very limited research regarding this relationship among older adults which appears to be a critical period for the experience of loneliness. In this study, the relationship between emotional and social loneliness and posttraumatic stress symptoms was examined across two time points within a sample of older adults. It was hypothesised that changes in social and emotional loneliness would be associated with changes in posttraumatic stress symptoms over time.

5.2. Methods

5.2.1. Design, participants, and recruitment strategy

Participants were drawn from two waves of the LASA study. This is an ongoing prospective study that began in 1992/1993, with data being collected approximately every three years. Random samples, stratified for age and sex, of older adults (between the ages of 55-85) were recruited from population registers in nine municipalities across three regions of the Netherlands, with an oversampling of the older-old (aged 75 years and above) and older men to ensure that there were sufficient numbers of older participants after years of follow-up. Participants were interviewed either in their homes by trained persons or took part in a brief interview by telephone instead of the main, in-person, interview. Protocols of the LASA study were approved by the Ethical Review Board of the VU Medical Center, Amsterdam and all respondents provided informed consent according to prevailing law in the Netherlands. Approval for secondary analysis was granted by the ethical review board at Maynooth University. Further information on the LASA project is detailed elsewhere (Huisman et al., 2011).

The current sample consisted of data drawn from participants who took part in 'Wave D' (n = 2,076; collected in 1998/1999) and 'Wave E' (n = 1,691; collected in 2001/2002), henceforth referred to as Time 1 and Time 2, respectively (Figure 5.1 presents reasons for attrition between waves). These two waves were selected as they were the only assessment periods to include a measure of posttraumatic stress symptoms. Moreover, a number of measures, including posttraumatic stress symptoms, were only assessed during the full main interview. Therefore, as part of the eligibility criteria for the current study, only participants who completed the main interview at both waves (n = 1,276) were included in the current sample (see Figure 5.1). The sample included an almost similar proportion of females (54%, n = 689) and males (46%, n = 587), and the average age was 72.24 years (SD = 7.34), with all adults aged 60 years and older (see Table 5.1 for other sample characteristics).

Figure 5.1

Flowchart presenting breakdown of participants included in the current study.

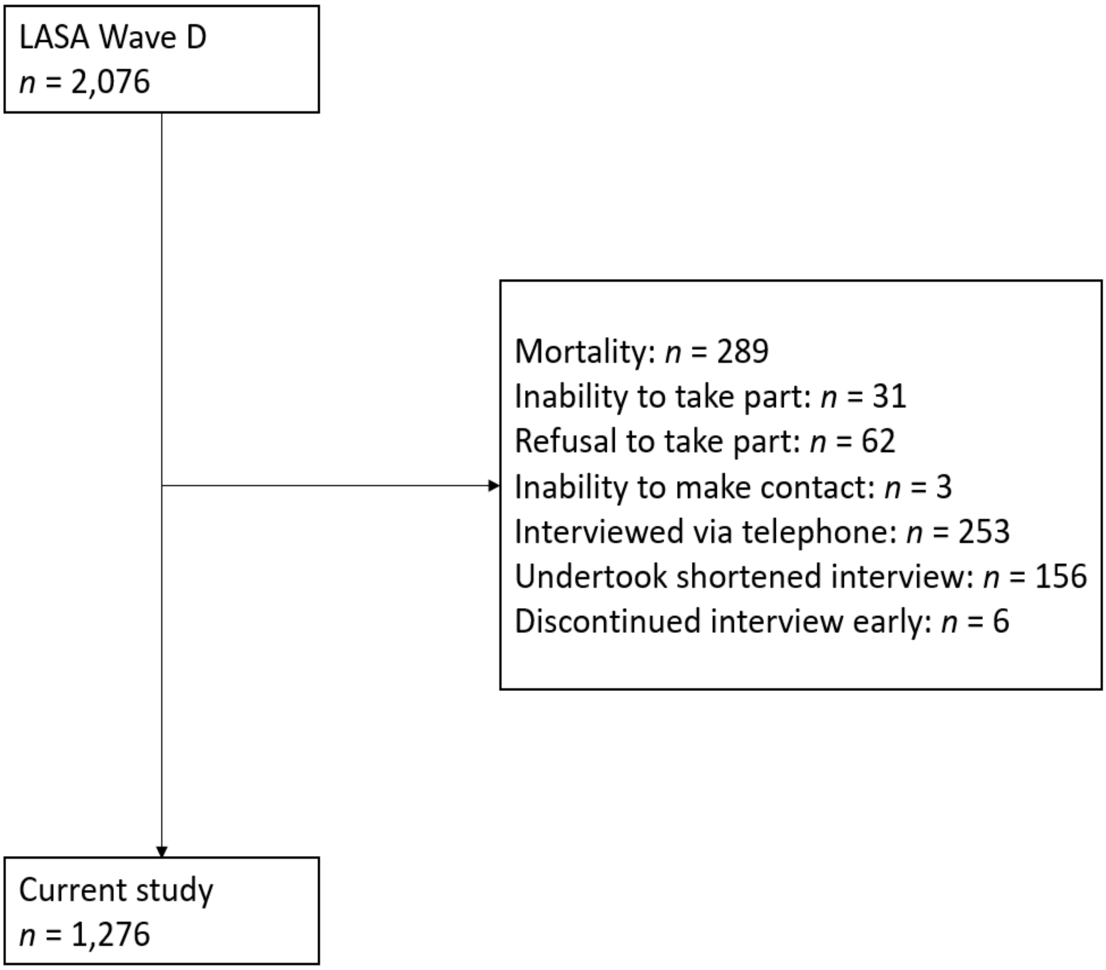


Table 5.1
Sample characteristics and descriptive statistics of the current study.

Sample characteristic	% (n)	Mean (95% CI)	Median	SD	Range
PTSS (T1)		31.75 (31.31 / 32.18)	30.00	7.89	22–75
PTSS (T2)		32.75 (32.32 / 33.18)	31.00	7.83	22–69
Emotional loneliness (T1)		1.15 (1.05 / 1.24)	0.00	1.67	0–6
Emotional loneliness (T2)		1.23 (1.14 / 1.33)	0.00	1.70	0–6
Social loneliness (T1)		.97 (0.90 / 1.05)	0.00	1.37	0–5
Social loneliness (T2)		1.00 (0.92 / 1.07)	0.00	1.40	0–5
Personal network size		15.23 (14.74 / 15.73)	13.00	9.04	0–62
Partner status					
Partner	64.9 (828)				
No partner	35.1 (448)				
Urbanity[a]					
< 500	23.6 (301)				
500–1000	19.2 (245)				
1001–1500	18.8 (240)				
1501–2000	19.6 (250)				
≥ 2500	18.7 (239)				
Education					
Elementary education or less	36.1 (460)				
Lower vocational–general intermediate	32.2 (411)				
Intermediate vocational–university education	31.7 (405)				

Recent negative life events	
0	31.6 (403)
1	40.8 (521)
2	21.6 (276)
3+	5.9 (75)

Note: T1 = Time 1; T2 = Time 2; PTSS = posttraumatic stress symptoms; 95% CI = 95% confidence intervals; SD = standard deviation; [a] = mean number of addresses per squared kilometre within a circle with a radius of one kilometre.

5.2.2. Measures

Posttraumatic stress symptoms

Posttraumatic stress symptoms were measured using the Self-Rating Inventory for Posttraumatic Stress Disorder (SRIP; Hovens et al., 1994). The SRIP is a 22-item Dutch questionnaire designed to assess the presence (within the last four weeks) of the 17 PTSD symptoms that were outlined in the *DSM-IV* (APA, 1994). As such, these items can be clustered into three groups representing ‘Re-experiencing’ symptoms (six items; e.g. “I had the feeling that past events were happening again”), ‘Avoidance and Numbing’ symptoms (nine items; e.g. “I tried to avoid situations that would recall past events”), and ‘Hyperarousal’ symptoms (seven items; e.g. “I was easily frightened”). All items are rated on a four-point Likert-scale (‘not at all’ = 1, ‘extremely’ = 4). Higher scores indicate greater posttraumatic stress symptoms with total scores ranging from 22–88. These symptoms are in reference to unspecified traumatic events (referred to simply as “past events”). The use of non-specific traumatic events may be beneficial among older samples that are less likely to disclose potentially sensitive information due to fears of stigma (Thomas et al., 2016). Previous research utilising data drawn from the LASA project found support for the reliability and validity of this instrument among community-dwelling older adults (Van Zelst et al., 2003). Moreover, the SRIP has demonstrated good concurrent validity with PTSD measures such as the Clinician Administered PTSD Scale (CAPS) (Hovens et al., 1994; Kok et al., 2013). The internal consistency (Cronbach's alpha) of the SRIP scale scores in the current sample at Time 1 ($\alpha = .87$) and Time 2 ($\alpha = .86$) were satisfactory. In order to reduce model complexity, the items representing each symptom cluster were parcelled to create three variables (Re-experiencing, Avoidance and Numbing, and Hyperarousal) that loaded onto a single unidimensional posttraumatic stress symptoms latent variable.

Loneliness

The 11-item De Jong Gierveld Loneliness Scale (de Jong Gierveld & Kamphuis, 1985; de Jong Gierveld & van Tilburg, 2006) was used to assess social and emotional loneliness. This is a multidimensional scale consisting of five positively phrased items measuring social loneliness (e.g. "I can call on my friends whenever I need them") and six negatively phrased items measuring emotional loneliness (e.g. "I often feel rejected"), assessed on a three-point Likert scale ('no' = 1, 'more-or-less' = 2, 'yes' = 3). The items are then dichotomised (0 = 'absence of loneliness item', 1 = 'presence of loneliness item') whereby 'more-or-less' is merged with 'no' for the positive items, and 'yes' for the negative items (i.e. responding 'more-or-less' indicates loneliness), and the scores on positively phrased items are reversed so that higher scores are indicative of greater levels of loneliness (de Jong Gierveld & Kamphuis, 1985). Possible scores on the social loneliness dimension range from 0-5, and emotional loneliness scores range from 0–6. Prior research has found support for the reliability and validity of this measure (van Tilburg & De Leeuw, 1991). Within the current sample, the internal consistencies were satisfactory for the full loneliness scale at both Time 1 ($\alpha = .81$) and Time 2 ($\alpha = .82$), the social loneliness dimension at Time 1 ($\alpha = .73$) and Time 2 ($\alpha = .75$), and the emotional loneliness dimension at Time 1 ($\alpha = .81$) and Time 2 ($\alpha = .80$).

Covariates

A number of covariates were assessed at Time 1 including age (using date of birth), sex (official status as registered with the participant's respective municipal registry office; coded as 0 = male, 1 = female), urbanity, partner status (0 = ‘no partner’, 1 = ‘partner cohabiting/non-cohabiting’), and education. Urbanity was measured as the mean number of addresses per squared kilometre within a circle with a radius of one kilometre, using the participant’s postal code for reference (categorised into five categories ranging from < 500 to ≥ 2500). Education data was collected using nine categories ranging from “elementary not completed” to “university education”. In addition to partner status, personal network size (the number of people that the participant is in contact with regularly and who they also consider to be important to them) was included as a potential confounding variable to control for the effects of social connectedness/isolation. A count of recent negative life events (categorised as 0, 1, 2, 3+ recent negative life events), within the last three years, was also measured (this included the death of a family member, illness of a partner/relative, victim of a crime, serious conflict with others, and serious financial troubles). These covariates were selected to control for any confounding effect (see VanderWeele, 2019) that they may have on the relationships among the primary variables of interest (i.e. associated with PTSD symptoms, emotional loneliness and/or social loneliness) (e.g. such as those relationships previously reported by Drennan et al., 2008; Gum et al., 2009; Hyland, Shevlin et al., 2019; McHugh Power et al., 2019; Tolin & Foa, 2006; Tomaka et al., 2006; Ventimiglia & Seedat, 2019). Additional analyses excluding partner status and personal network size were included for transparency, as these variables may arguably be overadjusting the model.

5.2.3. Analytical plan

First, zero-order correlations were calculated to determine the bivariate associations among all study variables. Spearman’s rho (ρ) was used for bivariate associations involving at least one categorical variable of more than two levels (i.e. urbanity, education, recent negative life events, social loneliness, and emotional loneliness), whereas, Pearson's *r* coefficient was used for the remaining bivariate associations. Moreover, change over time for posttraumatic stress symptoms was measured using a paired samples *t*-test (and Cohen's *d* as a measure of effect size; 0.2 is a small, 0.5 a medium, and 0.8 a large effect); whereas, emotional and social loneliness change over time was assessed using a Wilcoxon signed-rank tests (and *r* as a measure of effect size; .1 is a small, .3 a medium, and .5 a large effect), given the ordinal nature of the data.

Second, in order to examine intraindividual change over time, it is often implicitly assumed, or is most accurate when, the metric(s) being examined is invariant across the different time points (Liu, Millsap et al., 2017). Therefore, to ensure that individual changes observed over time are a reflection of changes in the level of the construct and not changes in what is being measured, it was necessary to examine the longitudinal measurement invariance (see Liu, Millsap et al., 2017; Millsap & Yun-Tein, 2004) of each latent variable (i.e. posttraumatic stress symptoms, and social and emotional loneliness).

Third, to examine intraindividual (changes across time for posttraumatic stress symptoms, social loneliness, and emotional loneliness) and interindividual (changes in social loneliness and emotional loneliness are related to changes in posttraumatic stress symptoms) change over time, a recently developed statistical approach was employed, termed the 2W-LCS model (see Henk & Castro-Schilo, 2016). This approach examines relationships between changes in multiple constructs across time. As a preliminary step to examining change-to-change relationships for posttraumatic stress symptoms, social loneliness, and emotional loneliness, it was necessary to first fit univariate LCS models for the individual constructs. This determines whether there were significant mean and variance changes in the respective LCS. Next, the multivariate 2W-LCS model was fitted where the within-person change in posttraumatic stress symptoms (denoted as

Δposttraumatic stress symptoms) was regressed onto the within-person change for social loneliness (Δsocial loneliness) and emotional loneliness (Δemotional loneliness). Moreover, the LCSs were regressed onto the exogenous covariates (age, sex, urbanity, partner status, education, personal network size, and recent negative life events). Due to the nonnormality of the posttraumatic stress symptoms variables, as indicated by significant Mardia's multivariate normality tests (all $p < .001$), the univariate posttraumatic stress symptoms model was estimated using the MLR estimator. This estimator is robust to nonnormally distributed data and can correct for such issues of multivariate nonnormality. Whereas the emotional loneliness and social loneliness models were estimated using the WLSMV estimator, as this estimator performs best with categorical data (Brown, 2006), with theta parametrisation in order to estimate/constrain unique factor variances over time. Moreover, the multivariate 2W-LCS model was estimated using WLSMV with theta parametrisation.

It is important to note that as the 2W-LCS approach examines the change-to-change relationship of multiple constructs over a single period of time (i.e. across two waves), this precludes any statistical inferences regarding the precise temporal ordering of the relationship (Henk & Castro-Schilo, 2016). In order to ascertain the precise temporal relationship (e.g. changes in loneliness precede changes in posttraumatic stress symptoms), it would be necessary to collect at least three waves of data. That is, in order to determine whether changes in one construct precede changes in another (i.e. change in one construct will cause another construct to change), there would need to be at least two intervals of change (for example, across three waves). Nonetheless, the 2W-LCS approach still provides useful information by identifying longitudinal associations among covarying constructs.

Model fit was assessed using multiple goodness-of-fit indices (Hooper et al., 2008; Hu & Bentler, 1999). CFI (Bentler, 1990) and TLI (Tucker & Lewis, 1973) values ≥ .90 indicate adequate model fit, with stricter criteria of ≥ .95 to indicate good fit. Additionally, RMSEA (Steiger, 1990) values ≤ .08 indicate adequate model fit, with stricter criteria of ≤ .06 as being indicative of good model fit. Analyses were conducted using the lavaan package (Rosseel, 2012) in R 3.6.3 (R Development Core Team, 2020). Missing data for the multivariate 2W-LCS were minimal (3.0% of all cases had any missing data) and were handled using the default (lavaan) listwise deletion.

5.3. Results

5.3.1. Zero-order correlations and change over time

Table 5.2 displays the zero-order correlations among all observed study variables. Posttraumatic stress symptoms, emotional loneliness, and social loneliness were associated with the majority of study variables. The strongest associations were the autocorrelations between posttraumatic stress symptoms (r = .66 p < .001), emotional loneliness (ρ = .64, p < .001), and social loneliness (ρ = .56, p < .001). Among the observable variables, there was a very small increase in posttraumatic stress symptoms (t[1,246] = -5.79, p < .001, d = -0.16) from Time 1 (M = 31.68, *Mdn* = 30.00, SD = 7.83) to Time 2 (M = 31.74, *Mdn* = 31.00, SD = 7.83). Although this increase was statistically significant, it is unlikely to be a substantively meaningful increase given that the effect size was less than ‘small’. Similarly, there was a very small increase in emotional loneliness (Z = -2.73, p = .006, r = -.05) from Time 1 (M = 1.14, *Mdn* = 0.00, SD = 1.67) to Time 2 (M = 1.23, *Mdn* = 0.00, SD = 1.70), whereas, there was no significant change in social loneliness scores (Z = -0.18, p = .857, r = .00) from Time 1 (M = 0.97, *Mdn* = 0.00, SD = 1.37) to Time 2 (M = 0.99, *Mdn* = 0.00, SD = 1.39). The effect sizes were also less than ‘small’ suggesting that these were not substantively meaningful changes.

Table 5.2

Zero-order correlations between all observed study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. PTSS (T1)	–												
2. PTSS (T2)	.66***	–											
3. EL (T1)	.41***	.35***	–										
4. EL (T2)	.36***	.38***	.64***	–									
5. SL (T1)	.22***	.19***	.37***	.31***	–								
6. SL (T2)	.21***	.22***	.33***	.39***	.56***	–							
7. Age	.15***	.20***	.21***	.22***	.12***	.15***	–						
8. Sex[a]	.13***	.10***	.17***	.15***	-.03	-.06*	.06*	–					
9. Partner status[b]	-.13***	-.12***	-.35***	-.27***	-.06*	-.10***	-.33***	-.38***	–				
10. Urbanity	.09**	.07*	.03	.05	.10***	.09**	.06*	.02	-.06*	–			
11. Education	-.10**	-.11***	-.11***	-.09**	.00	-.01	-.12***	-.26***	.21***	.17***	–		
12. Network size	-.14***	-.13***	-.16***	-.14***	-.26***	-.25***	-.17***	-.03	.15***	.00	.09**	–	
13. Recent NLE	.10***	.06*	.08**	.07**	.01	-.02	.00	.07*	.00	-.04	-.03	.07*	–

Note: T1 = Time 1; T2 = Time 2; PTSS = posttraumatic stress symptoms; EL = emotional loneliness; SL = social loneliness; Network size = personal network size; Recent NLE = recent negative life events; [a] = sex coded as 0 = male, 1 = female; [b] = partner status coded as 0 = no partner, 1 = partner. Statistical significance: *p < .05; **p < .01; ***p < .001.

5.3.2. Longitudinal measurement invariance

Table 5.3 presents the fit statistics and nested model comparisons for the unidimensional model of posttraumatic stress symptoms, and the multidimensional model of loneliness (i.e. social and emotional loneliness). Both posttraumatic stress symptoms and loneliness achieved strict invariance (i.e. factor loadings, intercepts/thresholds, and unique factor variances constrained equal across time) as indicated by the non-significant likelihood ratio test (LRT), ΔCFI and ΔTLI < .010, and ΔRMSEA < .015 (Chen, 2007; Cheung & Rensvold, 2002). Therefore, these constructs could be examined across time using LCS.

5.3.3. Univariate LCS

Univariate LCS models were specified for posttraumatic stress symptoms, emotional loneliness, and social loneliness. The posttraumatic stress symptoms univariate LCS model provided excellent fit to the data (χ^2[12] = 12.17, p = .433; CFI = 1.000; TLI = 1.000; RMSEA = .003 [90% CI .000, .026]). The mean of the posttraumatic stress symptoms LCS was significant ($\mu_{\Delta\text{posttraumatic stress symptoms}}$ = 0.145, p < .001) indicating that, on average, individuals increased from Time 1 to Time 2, however, there was also significant within-person heterogeneity suggesting that not all participants followed this trajectory, as indicated by the significant variance ($\sigma^2_{\Delta\text{posttraumatic stress symptoms}}$ = 0.520, p < .001). Similarly, the emotional loneliness univariate LCS model provided excellent fit to the data (χ^2[57] = 102.21, p < .001; CFI = .996; TLI = .995; RMSEA = .025 [90% CI .017, .033]). The mean ($\mu_{\Delta\text{emotional loneliness}}$ = 0.081, p = .046) and variance ($\sigma^2_{\Delta\text{emotional loneliness}}$ = 0.338, p < .001) of the emotional loneliness LCS was also significant, indicating that scores increased over time. The social loneliness univariate LCS model also provided excellent fit to the data (χ^2[37] = 45.05, p = .171; CFI = .999; TLI = .998; RMSEA = .013 [90% CI .000, .025]). The mean of the social loneliness LCS was non-significant ($\mu_{\Delta\text{social loneliness}}$ = -0.012, p =

Table 5.3

Longitudinal measurement invariance tests of posttraumatic stress symptoms and loneliness (social and emotional) models.

	χ^2	df	CFI	TLI	RMSEA (90% CI)	ΔCFI	ΔTLI	ΔRMSEA	LRT $\Delta\chi^2$ (p)[a]
Posttraumatic stress symptoms									
Configural	3.130	5	1.000	1.000	.000 (.000-.024)	–	–	–	–
Weak[a]	4.384	7	1.000	1.000	.000 (.000-.020)	.000	.000	.000	1.253 (.534)
Strong[b]	5.026	9	1.000	1.000	.000 (.000-.022)	.000	.000	.000	0.452 (.798)
Strictc[c]	12.165	12	1.000	1.000	.003 (.000-.026)	.000	.000	.003	6.755 (.082)
Loneliness									
Configural[d]	709.210***	192	.965	.958	.046 (.042-.050)	–	–	–	–
Weak[e]	709.007***	201	.966	.961	.045 (.041-.048)	.001	.003	.001	3.931 (.916)
Strict[f]	673.667***	231	.969	.966	.042 (.038-.045)	.003	.005	.003	11.285 (.257)

Note: Loneliness = multidimensional model consisting of social and emotional loneliness; χ^2 = Chi-square Goodness of Fit statistic; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA (90% CI) = Root-Mean-Square Error of Approximation with 90% confidence intervals; Δ = change/difference in value; LRT = likelihood ratio test; [a] = LRT $\Delta\chi^2$ is based on the standard χ^2, whereas model fit is based on the robust χ^2; [a] = factor loadings constrained equal; [b] = factor loadings and intercepts constrained equal; [c] = factor loadings, intercepts, and unique factor variances constrained equal; [d] = thresholds constrained equal with dichotomous indicators, for model identification; [e] = factor loadings and thresholds constrained equal; [f] = factor loadings, thresholds, and unique factor variances constrained equal.

Statistical significance: **p* < .05; ***p* < .01; ****p* < .001.

.806) but the variance was significant ($\sigma^2_{\Delta\text{social loneliness}} = 0.383$, $p < .001$) suggesting that although there was no general trend regarding increases/decreases in social loneliness, there was significant within-person heterogeneity (Henk & Castro-Schilo, 2016).

5.3.4. Multivariate 2W-LCS

The 2W-LCS model provided adequate fit to the data ($\chi^2[528] = 1713.75$, $p < .001$; CFI = .909; TLI = .935; RMSEA = .043 [90% CI .040, .045]), and explained 17% of the variance relative to Δposttraumatic stress symptoms, 32% relative to Δemotional loneliness, and 29% relative to Δsocial loneliness. While controlling for exogenous covariates, both Δemotional loneliness and Δsocial loneliness were associated with small changes in Δposttraumatic stress symptoms. Moreover, older age, sex (being female), and urbanity were associated with Δposttraumatic stress symptoms. Older age, partner status (no partner), decreased personal network size, and recent negative life events were associated with increased Δemotional loneliness. Older age, sex (being male), urbanity, and decreased personal network size were associated with increased Δsocial loneliness (see Table 5.4 for all parameter estimates, and Figure 5.2 for structural model illustrating the relationship among all latent variables). Additionally, see Table 5.5 for parameter estimates and model fit excluding partner status and personal network size variables, as controlling for these variables may arguably lead to overadjustment.

Table 5.4

Standardised and unstandardised parameter estimates for the 2W-LCS model examining change-to-change relationship between posttraumatic stress symptoms, and emotional and social loneliness.

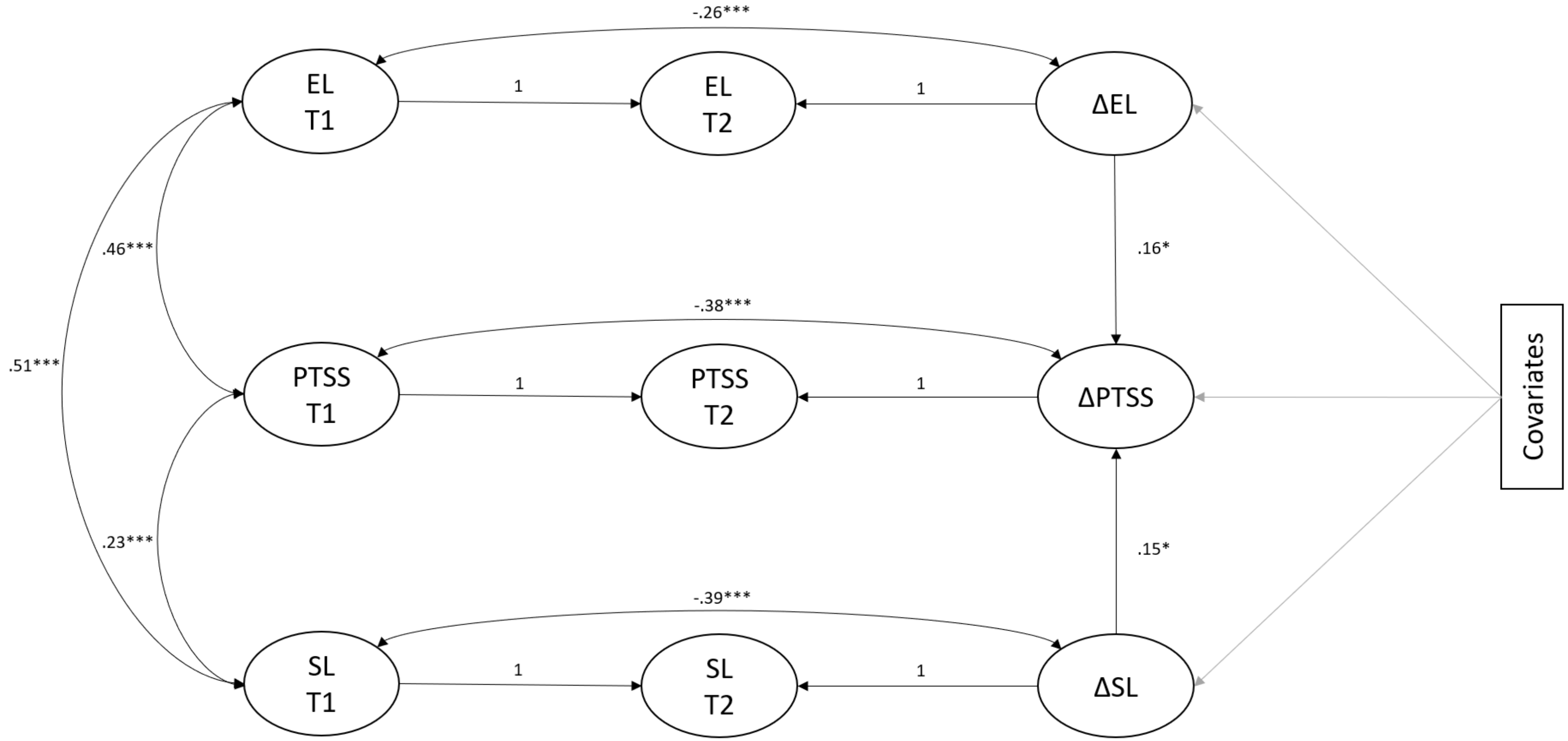
	Δ Posttraumatic stress symptoms		Δ Emotional loneliness		Δ Social loneliness	
	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)
Latent change scores						
Δ Emotional loneliness	.16* (.08)	.16 (.08)	–	–	–	–
Δ Social loneliness	.17* (.08)	.15 (.07)	–	–	–	–
Covariates						
Age	.02*** (.01)	.17 (.05)	.03*** (.01)	.23 (.05)	.02*** (.01)	.18 (.05)
Sex[a]	.18* (.07)	.11 (.04)	.15 (.08)	.09 (.05)	-.26** (.08)	-.17 (.05)
Partner status[b]	.07 (.08)	.04 (.05)	-.53*** (.09)	-.31 (.05)	-.16 (.09)	-.10 (.05)
Urbanity	.05* (.02)	.08 (.04)	.03 (.03)	.05 (.05)	.09** (.03)	.16 (.05)
Education	-.03 (.02)	-.08 (.04)	-.02 (.02)	-.05 (.05)	.00 (.02)	.00 (.05)
Personal network size	.00 (.01)	-.04 (.06)	-.01** (.01)	-.16 (.05)	-.03*** (.01)	-.41 (.05)
Recent NLE	.07 (.04)	.07 (.04)	.15** (.04)	.16 (.04)	.01 (.04)	.01 (.05)

Note: 2W-LCS = two-wave latent change score; Recent NLE = recent negative life events; B = unstandardised estimates; β = standardised estimates; SE = standard error; [a] = sex coded as 0 = male, 1 = female; [b] = partner status coded as 0 = no partner, 1 = partner.

Statistical significance: **p* < .05; ***p* < .01; ****p* < .001.

Figure 5.2

Structural model illustrating the change-to-change relationship between posttraumatic stress symptoms, and emotional and social loneliness.



Note: Figure illustrates the structural model of the change-to-change relationship between posttraumatic stress symptoms, and emotional and social loneliness. Individual exogenous covariate pathways are omitted for visual clarity. T1 = Time 1; T2 = Time 2; PTSS = posttraumatic stress symptoms; EL = emotional loneliness; SL = social loneliness.

Statistical significance: **p* < .05; ***p* < .01; ****p* < .001.

Table 5.5

Standardised and unstandardised parameter estimates for the 2W-LCS model examining change-to-change relationship between posttraumatic stress symptoms, and emotional and social loneliness (excluding partner status and personal network size variables).

	Δ Posttraumatic stress symptoms		Δ Emotional loneliness		Δ Social loneliness	
	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)
Latent change scores						
Δ Emotional loneliness	.17* (.08)	.16 (.07)	–	–	–	–
Δ Social loneliness	.17* (.08)	.14 (.07)	–	–	–	–
Covariates						
Age	.02** (.01)	.17 (.05)	.04*** (.01)	.35 (.05)	.03*** (.01)	.29 (.05)
Sex[a]	.15* (.07)	.10 (.04)	.32*** (.08)	.21 (.05)	-.20** (.08)	-.15 (.06)
Urbanity	.04 (.02)	.08 (.04)	.04 (.03)	.08 (.05)	.09*** (.03)	.20 (.05)
Education	-.03 (.02)	-.08 (.04)	-.04 (.02)	-.10 (.05)	-.01 (.02)	-.04 (.06)
Recent NLE	.07 (.04)	.07 (.04)	.12** (.04)	.14 (.05)	-.01 (.04)	-.02 (.05)
Total variance explained		16.4%		23.3%		14.1%
Model fit statistics						
χ^2 (df)	1448.12*** (478)					
CFI	.932					
TLI	.946					
RMSEA (90% CI)	040 (.038-.043)					

Note: 2W-LCS = two-wave latent change score; Recent NLE = recent negative life events; χ^2 = Chi-square Goodness of Fit statistic; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA (90% CI) = Root-Mean-Square Error of Approximation with 90% confidence intervals; B = unstandardised estimates; β = standardised estimates; SE = standard error; [a] = sex coded as 0 = male, 1 = female. Statistical significance: *p < .05; **p < .01; ***p < .001.

5.4. Discussion

This study was conducted to address a gap in the literature regarding the longitudinal relationship between loneliness and PTSD symptoms by examining the change-to-change relationship between social and emotional loneliness and posttraumatic stress symptoms among a sample of older adults. In line with previous research (Solomon et al., 2015), cross-sectional associations were found between social and emotional loneliness and posttraumatic stress symptoms at both time-points. Furthermore, consistent with the study hypothesis and prior findings (van der Velden et al., 2018; 2019), evidence of a longitudinal association was found with changes in emotional loneliness and social loneliness relating to changes in posttraumatic stress symptoms. Given the limitations of using only two waves of data, the temporal ordering of these constructs cannot be directly inferred. As such, it is possible that this longitudinal association is bidirectional, or that it goes in either of the single possible directions.

These findings suggest that a lack or absence of intimate relationships and close attachments (i.e. emotional loneliness), and the desire for a sense of belonging and companionship within a wider network (i.e. social loneliness) are associated with changes in posttraumatic stress symptoms over time. Previous research (DePrince et al., 2011) has noted that trauma exposed individuals can feel alienated from others in society and these feeling may be associated with a longing for close attachments and a desire to belong within a wider network. These feelings of loneliness may ultimately lead to posttraumatic stress symptoms via a number of pathways. For example, loneliness may lead to the development of negative cognitions (Cacioppo & Hawkley, 2009), which can predict future PTSD symptoms and impact PTSD treatment (Brown et al., 2019). Similarly, loneliness can lead to sleep problems (Matthews et al., 2017; McHugh & Lawlor, 2013), which can also result in increased PTSD symptoms (Dagan

& Yager, 2019). Loneliness can also lead to social withdrawal (Hawkley & Cacioppo, 2010), which is a form of avoidant coping that can maintain PTSD symptoms (Thompson et al., 2018). According to the loneliness loop (Hawkley & Cacioppo, 2010), as loneliness can lead to social withdrawal, this in turn contributes to a greater sense of loneliness. As feelings of loneliness can be reciprocal/self-reinforcing in nature (McHugh Power et al., 2019), loneliness may serve to maintain PTSD symptoms over time. Moreover, as PTSD symptoms can fluctuate over time in later life (Chopra et al., 2014), it is possible that changes in loneliness may be an important precursor to these fluctuations in PTSD symptoms.

In this study, the changes in posttraumatic stress symptoms, emotional loneliness, and social loneliness occurred over the one time period. Therefore, it is possible that this relationship is bidirectional (i.e., that posttraumatic stress symptoms also lead to changes in emotional loneliness and social loneliness). For example, PTSD symptoms such as negative cognitive biases and a sense of threat are similar to those expressed by lonely individuals, such as an implicit hypervigilance for social threat, and can lead to social withdrawal, thereby leading to a sense of loneliness. Moreover, PTSD avoidance symptoms may also lead an individual distancing themselves emotionally from others within their close network (Solomon & Dekel, 2008), which may lead to increased feelings of loneliness. Similarly, Glover (1988) noted a PTSD syndrome characterised by feelings and attitudes of mistrust and alienation among Vietnam veterans. These individuals expressed difficulties feeling intimacy with friends or family members and would often avoid/undermine the possibility of becoming involved in a trusting relationship. It is possible that these feelings of mistrust and inability to engage in a trusting, close relationship may lead to feelings of emotional loneliness, whereas feelings of alienation may lead to social loneliness. However, it is uncertain whether these veterans were less able to build trusting relationships prior to the Vietnam

War. As such, future research should aim to delineate the pathways from PTSD to loneliness, using longitudinal data.

Changes in posttraumatic stress symptoms were associated with older age, female sex, and urbanity. Solomon et al. (2012) noted that an increase in PTSD symptoms in later life may be due to the aging process. For example, retired individuals have more opportunity to reflect on their life and may, therefore, recall early traumatic memories resulting in an increase of PTSD symptoms. Additionally, there is considerable evidence that females are at least twice as likely as males to suffer from PTSD, and those living in cities are also more likely to suffer from PTSD (Tolin & Foa, 2006; Ventimiglia & Seedat, 2019). Thus, these well-established predictors of PTSD appear to hold into older age.

Changes in emotional loneliness were associated with older age, recent negative life events, decreased personal network size, and partner status; whereas changes in social loneliness were associated with older age, being male, urbanity, and decreased personal network size. These findings are generally in line with the wider loneliness literature (Drennan et al., 2008; Luhmann & Hawkley, 2016; Tomaka et al., 2006). Previous research has found an association between emotional loneliness and trauma exposure (Hyland, Shevlin et al., 2019). Moreover, this finding coincides with previous research suggesting that trauma exposure may lead to feelings of mistrust or avoidance which may impede the development of close connections (Glover, 1988; Solomon & Dekel, 2008).

There are several limitations that should be acknowledged. First, the present study used a sample of older Dutch adults, therefore these findings may not be generalisable to older adults in other nations, or to in-patient clinical settings. Second, it is important to note when interpreting differences between social and emotional loneliness that the multidimensional structure of the loneliness measure used (De Jong

Gierveld Loneliness Scale; de Jong Gierveld & Kamphuis, 1985) has been criticised to reflect, at least in part, a method effect associated with the wording of the positively phrased items, compared to the negatively phrased items (Penning et al., 2014). Third, as the changes in the constructs measured only occurred across two time points, it was not possible to determine the precise temporal ordering between posttraumatic stress symptoms and loneliness. Future research should aim to address this limitation using more waves of data.

Loneliness is known to play a key role in numerous psychopathologies and these findings provide further evidence that this extends to PTSD. A longitudinal association between social and emotional loneliness and posttraumatic stress symptoms was found among older adults. Clinicians should be aware of this association when treating older adults who present with symptoms of PTSD, as targeting feelings of loneliness may be an effective means to ameliorating these psychiatric symptoms. For example, if loneliness interacts with PTSD symptoms via reciprocal pathways, then treating loneliness among older adults may be effective in abating symptoms of PTSD. Moreover, treating loneliness among older adults who have experienced a traumatic event may reduce the likelihood of developing future symptoms of PTSD by preventing behaviours, such as social withdrawal, that may impede recovery following trauma exposure. Additionally, these findings may help researchers to better understand the factors that impact the course of PTSD among older adults. In summary, loneliness is likely to be a clinically meaningful construct among trauma-exposed persons and those experiencing PTSD symptoms in later life.

Chapter 6

Posttraumatic stress disorder (PTSD), complex PTSD, and subtypes of loneliness among older adults

A paper based on this chapter has been published in the *Journal of Clinical Psychology*.

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Abstract

Loneliness has a deleterious effect on mental health and has been found to be associated with posttraumatic stress disorder (PTSD). However, there is little research examining the relationship between loneliness and complex PTSD (CPTSD), particularly among older adults. CPTSD includes the core symptoms of PTSD along with additional symptoms reflecting 'disturbances in self-organisation' (DSO). This study aimed to elucidate the relationship between different types of loneliness (emotional and social loneliness) and CPTSD symptoms (i.e., PTSD and DSO symptoms) in older adults. Using a nationally representative sample of people aged 60–70 years from the U.S. (n = 456), the cross-sectional relationship between social and emotional loneliness and CPTSD symptoms was examined using structural equation modelling. While controlling for exogenous covariates (age, sex, urban dwelling, education, household income, and lifetime trauma exposure), emotional loneliness was associated with both PTSD ($\beta = .36$, $p < .001$) and DSO ($\beta = .59$, $p < .001$) symptoms, whereas social loneliness was only associated with DSO symptoms ($\beta = .24$, $p < .001$). In total, the model explained 31.6% of the variance in PTSD symptoms and 70.8% of the variance in DSO symptoms. These findings suggest that emotional loneliness is an important variable in understanding both PTSD and DSO symptoms in later life, whereas social loneliness may only be relevant to DSO symptoms. Moreover, these results have important implications for clinical practices in treating and understanding PTSD/CPTSD and their correlates among older adults.

6.1. Introduction

Traumatic exposure can result in a range of mental health disorders including PTSD and CPTSD. In the *ICD-11* (WHO, 2018), PTSD is defined by three symptom clusters (‘Re-experiencing in the here and now’, ‘Avoidance’, and ‘Sense of Current Threat’) and CPTSD is defined by these PTSD symptoms plus those reflecting the DSO symptom clusters. The DSO symptoms are represented by three clusters (‘Affective Dysregulation’, ‘Negative Self-concept’, and ‘Disturbances in Relationships’), and reflect the psychiatric sequalae that often occur following multiple and prolonged trauma exposure from which escape is difficult or impossible (Shevlin, Hyland, Roberts et al., 2018). Across multiple countries, prevalence rates among the general adult population have been estimated to range between 3.4% and 6.7% for PTSD and between 3.8% and 7.7% for CPTSD (Cloitre et al., 2019; Hyland, Karatzias, Shevlin, Cloitre et al., 2020; Hyland, Vallières, et al., 2020).

PTSD and CPTSD are relatively under-researched disorders among older adults (i.e., those aged 60 years and above) (WHO, 2017). Epidemiological research suggests that both lifetime and current traumatic-stress related disorders tend to decline with age (Gum et al., 2009; Kessler et al., 2005; Reynolds et al., 2016). However, recent research using a large, nationally representative sample of older adults from the U.S. indicates that a substantial proportion of older adults are affected by PTSD symptoms (Fox et al., 2020a, 2020b), with 6.1% of adults aged 60 years and older meeting the lifetime symptom requirements of *ICD-11* PTSD. As the global proportion of adults aged 60 years or older is expected to nearly double from 12% to 22% between the years 2015 and 2050 (WHO, 2017), it is important to examine variables that may be associated with PTSD and CPTSD in later life.

One variable of interest, common among older adults, is loneliness (Ong et al., 2016). Loneliness can be characterised as a ubiquitous, distressing experience that occurs when an individual’s social relationships are of insufficient quality (Peplau & Perlman, 1982). Loneliness is often conceptualised as a multidimensional construct (Weiss, 1973) consisting of ‘emotional loneliness’ - a perceived lack/absence of intimate relationships and close attachments - and ‘social loneliness’ - a perceived lack/absence of an engaging social network that can provide a sense of belonging and companionship (de Jong Gierveld & van Tilburg, 2006). While loneliness is not unique to older adults (Qualter et al., 2015), older adults are disproportionately exposed to risk factors for loneliness such as retirement, the death of a loved one, development of a chronic illness, and impaired mobility (Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2016; Pinquart & Sörensen, 2001).

A wealth of data exists highlighting the association between PTSD and psychosocial variables such as loneliness among adults (Itzhaky et al., 2017; Kuwert et al., 2014; O’Connor, 2010; Shevlin et al., 2015; Solomon et al., 1991, 2015; Tsur et al., 2019). Moreover, longitudinal research has indicated that loneliness both predicts future (van der Velden et al., 2019), and is predicted by past (van der Velden et al., 2018) PTSD symptoms. However, there is a dearth of research regarding the association between CPTSD and loneliness. A longitudinal study of Israeli prisoners of war found that persons displaying symptoms of CPTSD were more likely to experience loneliness later in their lives compared to those displaying symptoms of PTSD, or those who were asymptomatic (Zerach et al., 2019). Additionally, loneliness has been noted among patients with CPTSD in clinical case studies (Dagan & Yager, 2019), and has been found to be associated with the three DSO symptom clusters of emotional dysregulation (Hawkley et al., 2009; Wong et al., 2016), negative self-concepts (Goswick & Jones, 1981; Hawkley & Cacioppo, 2010; Knoke et al., 2010), and disturbances in relationships (Knoke et al., 2010; Solomon & Dekel, 2008). It stands to reason, therefore, that loneliness may play an important role in contributing to, or maintaining, symptoms of CPTSD.

Loneliness may also be associated with increased PTSD/CPTSD symptoms through a number of different pathways. For instance, loneliness is associated with sleep problems in older adults (Matthews et al., 2017; McHugh & Lawlor, 2013) which have also been found to be associated with both PTSD and CPTSD symptomatology (Dagan & Yager, 2019; Elklit et al., 2014; Grossman et al., 2019). Loneliness is also associated with increased negative cognitive biases (Cacioppo & Hawkley, 2009) which can predict future PTSD symptoms and treatment outcomes (Brown et al., 2019). The relationship between PTSD/CPTSD and loneliness may also be bidirectional. For example, increased PTSD symptoms are associated with relational difficulties that may induce loneliness (Solomon et al., 2015; Solomon & Dekel, 2008). Moreover, as social withdrawal can be used as a form coping with PTSD symptoms (Thompson et al., 2018), this behaviour may also lead to increased feelings of loneliness among older adults (Hawkley & Cacioppo, 2010; McHugh Power et al., 2019). Moreover, it is plausible that the DSO symptoms may lead to increased difficulty in maintaining close relationships and thus result in increased feelings of loneliness.

The current study was conducted to assess the associations between social and emotional loneliness and CPTSD symptoms in a nationally representative sample of older adults from the U.S. aged 60–70 years. Although this age range is relatively restricted, Ogle and colleagues (2014) noted that adults in their 60s may be an ideal population for trauma-related research, as they are likely to have a wide trauma history yet are less likely to have been affected by age-related conditions such as cognitive decline and chronic illnesses. Moreover, research has found that older adults exhibiting PTSD symptoms are at an increased risk of experiencing future cognitive decline and physical health problems (Burri et al., 2013; Cook et al., 2017; Rafferty et al., 2018).

For example, a large-scale, longitudinal study (n = 181,093) of military veterans found that older veterans with PTSD were approximately twice as likely to develop common types of dementia such as Alzheimer's disease and vascular dementia, compared to older veterans without PTSD (Yaffe et al., 2010). Therefore, understanding the factors associated with PTSD/CPTSD symptoms in adults aged 60–70 years may have important health and clinical implications in reducing these symptoms and thereby reducing the likelihood of the future onset of conditions associated with age-related elevated risk, such as Alzheimer's disease whereby an individual's risk doubles every five years after the age of 65 (Qiu et al., 2009).

When evaluating loneliness in later life, it can be helpful to disassemble it into social and emotional subtypes since these have different incidences and antecedents in this population (Ó'Luanaigh & Lawlor, 2008; Schnittger et al., 2012). For example, emotional loneliness has been found to have a greater effect on numerous psychopathologies compared to social loneliness (Hyland, Shevlin et al., 2019; McHugh & Lawlor, 2013; Peerenboom et al., 2015). Moreover, given the increased impairment associated with CPTSD relative to PTSD (Elklit et al., 2014; Karatzias et al., 2017), understanding how these different types of loneliness (i.e. social and/or emotional) are related to CPTSD symptoms may provide important information that could enhance clinical interventions. This study had two objectives. The first was to determine the proportion of adults aged 60-70 years who met the diagnostic requirements for PTSD and CPTSD, and the second was to assess if social and emotional loneliness were cross-sectionally associated with PTSD and DSO symptoms. It was hypothesised that social and emotional loneliness would be positively associated with PTSD and DSO symptoms after adjusting for a range of covariates.

6.2. Methods

6.2.1. Design, participants, and recruitment strategy

Participants in this study were drawn from a larger, nationally representative sample of non-institutionalised adults from the U.S., details of which can be found elsewhere (Cloitre et al., 2019). These data were collected in March 2017 by the survey research company GfK, a world-wide market research company. GfK use a nationally representative panel system of the U.S. population who are willing to participate in survey-based research. Participants were selected from the nationally representative research panel using random probability-based sampling methods. The survey design oversampled females and ethnic minorities, both at approximately a 2:1 ratio. To adjust for this oversampling, and to ensure that the data remained nationally representative, the data were weighted to represent adults aged 18-70 years in the U.S. Poststratification weights were used to account for probabilities of selection, nonresponse, and potential shortcomings in the sampling frame on the basis of age (18-29, 30-44, 45-59, 60-70), region, education, household income, and urban dwelling. Inclusion criteria were that respondents had to be between 18 and 70 years of age and had experienced at least one traumatic experience in their lifetime. In total, 3,953 individuals were contacted to take part, and 1,839 (response rate = 46.5%) volunteered and met the inclusion criteria. The survey was conducted entirely online with a median completion time of 18 minutes. Panel members received financial reimbursement for their participation in the GfK panel, and participants were incentivised to participate in this survey through entry into a raffle for prizes. Protocols of this survey received ethical approval from the research ethics committee at the National College of Ireland, and all participants provided their informed consent. Approval for secondary analysis was granted by the ethical review board at Maynooth University.

All reported parameter estimates were adjusted for the weighting of the study population, whereas sample size is based on the unweighted data. Consequently, reported proportions may not correspond to the reported sample sizes. The current sample (n = 456) included respondents who were aged 60-70 from the original survey. The weighted sample included more females (54.4%, n = 317) than males (45.6%, n = 139), and the average age was 65.04 years (SD = 3.33). Most were living in a metropolitan area (82.9%, n = 391). Moreover, 29.2% (n = 129) reported that their highest level of education attained was a bachelor's degree or higher, 33.0% (n = 136) had some college education, 29.6% (n = 160) finished high school, and 8.2% (n = 31) had not finished high school. Regarding annual household income, 44.4% (n = 172) earned \$75,000 or above, 23.2% (n = 99) earned \$50,000–\$74,999, 18.6% (n = 104) earned \$25,000-\$49,999, and 13.8% (n = 81) earned less than \$25,000 per year.

6.2.2. Measures

ICD-11 PTSD and CPTSD

PTSD and DSO symptoms were assessed using the ITQ (Cloitre et al., 2018). The ITQ includes 18 items and is the only validated measure of PTSD and CPTSD, as per the *ICD-11* diagnostic guidelines. Six items measure each past-month PTSD symptom, and six items measure the DSO symptoms. All items are answered in relation to the participant's most distressing traumatic event. Six items measure functional impairment including social impairment, occupational impairment, and impairment in other important areas of life (e.g. parenting or college) in relation to the PTSD and DSO symptoms, respectively. All items were rated using a five-point Likert scale ('not at all' = 0, 'extremely' = 4), and total scores for PTSD and DSO symptoms range from 0–24 with higher scores reflecting greater symptomatology.

For diagnostic purposes, a symptom was deemed to be endorsed if scored ≥ 2 ('Moderately'), as recommended by Cloitre and colleagues (2018) based on standard practice in trauma research. In order to meet the diagnostic requirements of an *ICD-11* PTSD diagnosis, an individual must endorse the presence of at least one of two ‘Re-experiencing in the here and now’ symptoms, one of two ‘Avoidance’ symptoms, and one of two ‘Sense of Current Threat’ symptoms. Endorsement of at least one functional impairment indicator is also required. To meet the diagnostic requirements of an *ICD-11* CPTSD diagnosis, all of the PTSD criteria must be met, and at least one of two ‘Affective Dysregulation’ symptoms, one of two ‘Negative Self-concept’ symptoms, and one of two ‘Disturbances in Relationships’ symptoms must be endorsed. Endorsement of at least one functional impairment indicator relating to the DSO symptoms is also required. According to the diagnostic rules outlined in the *ICD-11,* an individual can meet the requirements for a diagnosis of PTSD or CPTSD, but not both. Moreover, it is important to note that PTSD/CPTSD prevalence was assessed using the *ICD-11* guidelines from a self-reported measure, however, to receive an official PTSD or CPTSD diagnosis, the assessment must be carried out by a clinically trained professional. The psychometric properties of the ITQ in the full sample have previously been supported (Ben-Ezra et al., 2018; Cloitre et al., 2018; Hyland, Shevlin, Brewin et al., 2017; Vallières et al., 2018).

Loneliness

Emotional and social loneliness were assessed using the six-item de Jong Gierveld Loneliness Scale (de Jong Gierveld & van Tilburg, 2006). This multidimensional scale is comprised of three negatively phrased items that assess ‘emotional loneliness’ (e.g. “I experience a general sense of emptiness”) and three positively-phrased items that assess ‘social loneliness’ (e.g. “there are many people I can trust completely”). Items are scored on a three-point Likert scale (‘no’ = 1, ‘more-or-less’ = 2, ‘yes’ = 3). The ‘more-or-less’ response option is merged with ‘no’ for the positive items, and ‘yes’ for the negative items (i.e. responding ‘more-or-less’ indicates loneliness), thereby dichotomising the items (0 = ‘absence of loneliness item’, 1 = ‘presence of loneliness item’). Scores on the positively phrased items are then reversed so that higher scores suggest greater levels of loneliness. Possible scores on the emotional and social loneliness dimensions respectively range from 0–3. The psychometric properties of this measure have previously been supported in large-scale epidemiological studies (de Jong Gierveld & van Tilburg, 2010).

Covariates

A number of sociodemographic variables were measured including age, sex (0 = male, 1 = female), urban dwelling (0 = not living in a metropolitan area, 1 = living in a metropolitan area), education, and household income. Education information was assessed using 14 categories ranging from “no formal education” to “professional or doctorate degree”. Household income was measured using 21 categories that ranged from “less than $5,000” to “$250,000 or more”.

Lifetime exposure to traumatic events was measured using a modified version of the Life Events Checklist for *DSM-5* (LEC-5; Weathers et al., 2013). Participants were presented with a list of 14 common traumatic events (e.g. “natural disaster [for example, flood, hurricane, tornado, or earthquake]” or “sudden, violent death [for example, homicide; suicide]”) and indicated ‘yes’ or ‘no’ to whether each event occurred to them in ‘childhood’ (i.e., before age of 18) and in ‘adulthood’ (i.e., at or after age 18). This created a measure of 28 potential traumatic events (i.e. 14 that may have occurred during childhood and 14 during adulthood). An additional three items were extracted from the Adverse Childhood Experiences questionnaire (ACE; Felitti et al., 1998) reflecting childhood neglect, childhood physical abuse, and childhood sexual abuse. Items were summed to create a total lifetime trauma exposure score that ranged from 0–31, with higher scores representing a greater number of traumatic events experienced.

Following the guidelines set forth by VanderWeele (2019) these covariates were selected to control for potential confounding effects that they may have on the primary variables of interest (i.e. PTSD symptoms, DSO symptoms, emotional loneliness and/or social loneliness) (e.g. Drennan et al., 2008; Fox et al., 2020a; Gum et al., 2009; Hyland, Shevlin et al., 2019; Ogle et al., 2014; Tolin & Foa, 2006; Ventimiglia & Seedat, 2019; Victor & Yang, 2012).

6.2.3. Analytical plan

First, the current sample of adults aged 60–70 years was compared to the remaining sample (i.e. aged 18–59 years) in relation to all study variables. PTSD symptoms, DSO symptoms, and total number of lifetime trauma exposures were assessed using independent samples t-tests (and Cohen's d as a measure of effect size; 0.2 is a small, 0.5 a medium, and 0.8 a large effect). Differences in sex, urban dwelling, PTSD, and CPTSD diagnostic rates were assessed using χ^2 test of independence with ORs. Emotional loneliness, social loneliness, education, and household income differences were compared using Mann-Whitney *U* tests (with *r* as a measure of effect size; .1 is a small, .3 a medium, and .5 a large effect), given the ordinal nature of the variables.

Second, zero-order correlations were used to determine the bivariate associations among all observed study variables. Spearman's rho was used for bivariate associations that involved at least one categorical variable of more than two levels (i.e. social and emotional loneliness, education, and household income), whereas, Pearson's *r* coefficient was used for the remaining bivariate associations.

Third, SEM techniques were applied to examine the relationships between social and emotional loneliness, and PTSD and DSO symptoms, while controlling for exogenous covariates (age, sex, urban dwelling, education, household income, and total number of traumatic events experienced). SEM is advantageous as it can parse out measurement error thereby yielding more accurate parameter estimates (Bollen, 1989). Furthermore, multiple outcomes can be measured simultaneously, reducing type 1 errors associated with multiple comparisons. Prior to evaluating the structural model, it was first necessary to evaluate the fit of the measurement models (i.e. the specification of the latent variables only) (Anderson & Gerbing, 1988). Model fit was determined using several goodness-of-fit indices (Hu & Bentler, 1999): A non-significant χ^2 indicates excellent model fit, however, this test becomes limited in its use at larger sample sizes, therefore, a significant result ($p < .05$) should not lead to the rejection of a model (Tanaka, 1987). In addition, CFI (Bentler, 1990) and TLI (Tucker & Lewis, 1973) values $\geq .90$ indicate adequate model fit. Additionally, RMSEA (Steiger, 1990) values $\leq .08$ suggest adequate model fit.

Due to the nonnormality of the data, as indicated by significant Mardia's multivariate normality tests (all $p < .001$), the second-order measurement model of CPTSD was estimated using the MLR estimator as this estimator is robust to non-normally distributed data and can account for concerns of multivariate non-normality. Given the dichotomous nature of the loneliness items, the two-factor loneliness (social and emotional) measurement model was estimated using the WLSMV estimator, as this estimator performs best with categorical data (Brown, 2006). Moreover, the structural model was estimated using the WLSMV estimator. All analyses were conducted in Mplus 8.2 (Muthén & Muthén, 2018).

Composite reliability (ρ_c) was used to estimate the internal reliability of the PTSD, DSO, and emotional and social loneliness items. Composite reliability is superior to Cronbach's alpha as it estimates the reliability of items without the strict assumption of tau-equivalence (Graham, 2006; Raykov, 1997). Bagozzi and Yi (1988) suggest that composite reliability values $\geq .60$ are acceptable. In order to estimate the composite reliabilities of the emotional and social loneliness measures, a method outlined by Raykov and colleagues (2010) was used for estimating composite reliability for measures with dichotomous items.

Missing data were minimal, with the proportion of missingness on all variables ranging from 0% to 3.9%, with a mean of 0.81%. Missing data were handled using full information maximum likelihood (FIML) when a model was estimated using the MLR estimator; whereas models estimated using the WLSMV estimator handled missing data using the default (Mplus) pairwise deletion method.

6.3. Results

6.3.1. Comparison of adults aged 60-70 to those under 60

Among the study variables, the current sample (adults aged 60–70 years) reported lower PTSD (t[659.76] = 4.30 p < .001, d = 0.22) and DSO (t[650.85] = 6.14 p < .001, d = 0.32) symptoms compared to adults aged < 60 years. There were significant differences in the number of individuals who met the diagnostic requirements for *ICD-11* PTSD (χ^2 [1, n = 1,818] = 6.72, p = .010, OR = 0.28 [95% CI 0.10, 0.78]) with 1.2% (n = 11; 95% CI = 0.1%, 2.4%) of the current sample meeting the diagnostic requirements for PTSD, compared to 3.9% (n = 62; 95% CI = 2.9%, 4.9%) of those aged younger than 60 years. A similar trend was observed for CPTSD (χ^2 [1, n = 1,818] = 5.23, p = .021, OR = 0.38 [95% CI 0.17, 0.89]), with an additional 1.6% (n = 5; 95% CI = 0.0%, 3.0%) of the current sample meeting the diagnostic requirements of CPTSD, compared to 4.4% (n = 75; 95% CI = 3.3%, 5.4%) of adults aged below 60 years. Older adults were more likely to report experiencing a higher number of lifetime traumatic events (t[1,837] = -1.96 p = .050, d = -0.12), however, the magnitude of difference was very small. Older adults reported lower scores on social (Z = 2.28, p = .023, r = .05) and emotional (Z = 3.28, p = .001, r = .08) loneliness. However, the effect sizes were very small. There were no significant differences regarding sex (χ^2 [1, n = 1,839] = 1.027, p = .311, OR = 1.13 [95% CI 0.93, 1.43]), urban dwelling (χ^2 [1, n = 1,839] = 3.65, p =

.056, OR = 0.74 [95% CI 0.54, 1.01]), education ($Z = 1.15$, $p = .250$, $r = .03$), or household income ($Z = 1.18$, $p = .240$, $r = .03$).

6.3.2. Bivariate correlations

The bivariate association between DSO symptoms and emotional loneliness was strong ($\rho = .56$, $p < .001$) and social loneliness was moderate-strong ($\rho = .48$, $p < .001$). The associations between PTSD symptoms and emotional loneliness ($\rho = .19$, $p < .001$) and social loneliness ($\rho = .17$, $p = .001$) were both weak. See Table 6.1 for all correlations.

6.3.3. Measurement model: PTSD and DSO two-factor second-order model

The latent structure (see Figure 6.1) of CPTSD was represented using a two factor (PTSD and DSO) second-order model, where PTSD explains the variance/co-variance between the three first-order factors of ‘Re-experiencing in the here and now’, ‘Avoidance’, and Sense of Current Threat’ and DSO explains the variance/co-variance between the three first order factors of ‘Affective Dysregulation’, ‘Negative Self-concept’, and ‘Disturbances in Relationships’. This model initially produced a Heywood case (factor loading greater than one) between the DSO second-order factor and the ‘Affective Dysregulation’ first-order factor producing a negative residual variance. An exceptionally large factor loading between DSO and ‘Affective Dysregulation’ has been noted previously (e.g., Karatzias et al., 2016). As this residual variance was non-significant, the model was re-evaluated with the residual variance fixed to zero (Chen et al., 2001), which also constrains the factor loading to one. The re-specified model demonstrated excellent statistical fit to the data ($\chi^2[48] = 71.42$, $p = .016$; CFI = .981; TLI = .974; RMSEA = .033 [90% CI .015, .048]). The inter-factor correlation between PTSD and DSO was .63, and all factor loadings were positive and significant ($p < .001$) ranging from .59–1.00. Composite reliability estimates for the

Table 6.1

Zero-order correlations between all observed study variables.

Variables	1	2	3	4	5	6	7	8	9	10
1. PTSD symptoms	–									
2. DSO symptoms	.47***	–								
3. Emotional loneliness	.19***	.56***	–							
4. Social loneliness	.17**	.48***	.36***	–						
5. Age	.03	.01	.04	-.20***	–					
6. Sex[a]	.02	.08	.10	-.05	.01	–				
7. Urban dwelling[b]	.05	-.09	-.13*	.02	-.05	.10	–			
8. Education	-.02	.09	-.06	.01	.02	.01	.04	–		
9. Household income	-.10	-.16**	-.25***	-.08	-.13*	-.15**	.12*	.38***	–	
10. Trauma	.41***	.27***	.28***	.13*	.16**	-.07	.00	.04	-.15**	–

Note: PTSD = posttraumatic stress disorder; DSO = disturbances in self-organisation; [a] = sex coded as 0 = male, 1 = female; [b] = urban dwelling coded as 0 = not living in a metropolitan area, 1 = living in a metropolitan area.

Statistical significance: **p* < .05; ***p* < .01; ****p* < .001.

PTSD (ρ_c = .87) and DSO (ρ_c = .93) factors demonstrated satisfactory internal reliability.

6.3.4. Measurement model: Social and emotional loneliness

A two-factor model (social and emotional loneliness) of loneliness provided excellent statistical fit (χ^2[8] = 14.57, p = .068; CFI = .997; TLI = .995; RMSEA = .042 [90% CI .000, .077]). The inter-factor correlation between social and emotional loneliness was .64, and all factor loadings were positive and significant ($p < .001$) ranging from .43–.95. Composite reliability estimates for the social (ρ_c = .86) and emotional (ρ_c = .67) loneliness factors demonstrated acceptable internal reliability.

6.3.5. Structural model: PTSD, DSO, and social and emotional loneliness

The SEM model (see Figure 6.1) demonstrated satisfactory fit to the data (χ^2[220] = 433.41, $p < .001$; CFI = .927; TLI = .914; RMSEA = .046 [90% CI .040, .052]) and explained 31.6% of the variance in PTSD symptoms and 70.8% of the variance in DSO symptoms.

While controlling for the exogenous covariates, emotional loneliness (β = .36, $p < .001$) but not social loneliness (β = -.03, p = .716), was associated with PTSD symptoms. Emotional loneliness (β = .59, $p < .001$) and social loneliness (β = .24, $p < .001$) were associated with DSO symptoms. Of the covariates in the model, only the total number of lifetime trauma exposures was associated with PTSD (β = .44, $p < .001$) and DSO (β = .30, $p < .001$) symptoms (see Table 6.2 for full details).

Table 6.2

SEM model of PTSD, DSO, and social and emotional loneliness.

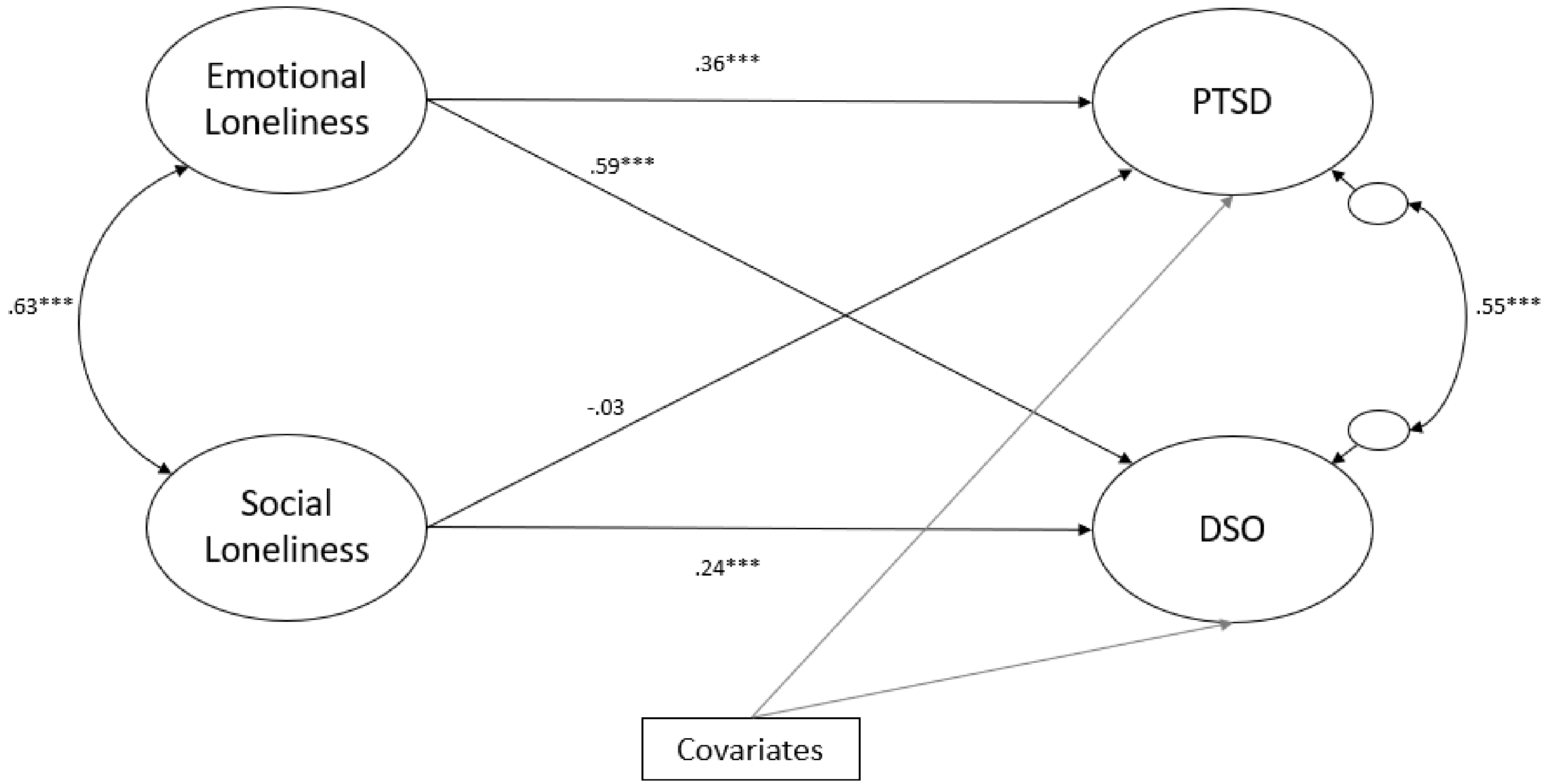
	PTSD		DSO	
	B (SE)	β (SE)	B (SE)	β (SE)
Latent variables				
Emotional loneliness	.12*** (.04)	.36 (.10)	.33*** (.05)	.59 (.06)
Social loneliness	-.01 (.03)	-.03 (.09)	.12*** (.04)	.24 (.07)
Covariates				
Age	.00 (.01)	-.05 (.06)	-.01 (.01)	-.07 (.06)
Sex[a]	.04 (.04)	.06 (.06)	.08 (.07)	.08 (.06)
Urban dwelling[b]	.03 (.05)	.04 (.07)	-.15 (.08)	-.12 (.06)
Education	.00 (.01)	-.03 (.06)	.02 (.02)	.10 (.07)
Household income	.00 (.00)	-.04 (.06)	-.01 (.01)	-.07 (.06)
Trauma	.04*** (.01)	.44 (.05)	.04*** (.01)	.30 (.06)

Note: PTSD = posttraumatic stress disorder; DSO = disturbances in self-organisation; B = unstandardised estimates; β = standardised estimates; SE = standard error; [a] = sex coded as 0 = male, 1 = female; [b] = urban dwelling coded as 0 = not living in a metropolitan area, 1 = living in a metropolitan area.

Statistical significance: **p* < .05; ***p* < .01; ****p* < .001.

Figure 6.1

Structural model illustrating the relationship (standardised estimates) between loneliness (emotional and social loneliness), and PTSD symptoms and DSO symptoms.



Note: Individual exogenous covariate pathways are omitted for visual clarity. PTSD = posttraumatic stress disorder; DSO = disturbances in self-organisation.

Statistical significance: **p* < .05; ***p* < .01; ****p* < .001.

6.4. Discussion

The primary objectives of this study were to determine the proportion of older adults who met the diagnostic requirements for PTSD and CPTSD, and to determine the relationship between social and emotional loneliness and CPTSD symptoms. It was hypothesised that both social and emotional loneliness would be positively associated with PTSD and DSO symptoms, while controlling for a number of covariates. The main study hypothesis was partially supported in that emotional loneliness was associated with PTSD and DSO symptoms; however, social loneliness was associated with DSO symptoms but not PTSD symptoms. Moreover, it was found that adults 60–70 years were approximately 3.5 times less likely to meet the diagnostic requirements for PTSD and 2.5 times less likely to meet the diagnostic requirements for CPTSD, compared to adults aged younger than 60 years.

These findings align with the wider PTSD literature which has consistently demonstrated a decline in PTSD prevalence among adults aged 60 years and older (Gum et al., 2009; Kessler et al., 2005; Reynolds et al., 2016), and an association between loneliness and PTSD (Itzhaky et al., 2017; Kuwert et al., 2014; O'Connor, 2010; Shevlin et al., 2015; Solomon et al., 1991, 2015; Tsur et al., 2019; van der Velden et al., 2018, 2019), and adds to a small-but-growing literature that loneliness is related to symptoms of CPTSD (Dagan & Yager, 2019; Zerach et al., 2019). This is the first study to examine the relationship between subtypes of loneliness and CPTSD symptoms. The large effect of emotional loneliness and small-moderate effect of social loneliness on DSO symptoms suggest that these subtypes of loneliness may play an important role in the development of CPTSD. However, given the cross-sectional nature of this study, it is also possible that the reverse relationship is true, in that CPTSD symptoms may induce feelings of loneliness. Future longitudinal research will be required to determine the temporal relationship between these variables.

These findings provide a useful addition to the trauma literature by highlighting the different associations that social and emotional loneliness have with the DSO symptoms of CPTSD. Specifically, while social loneliness had a small-to-moderate sized effect on DSO symptoms, emotional loneliness had a large effect on these symptoms. This suggests that emotional loneliness, in particular, may be especially important in the conceptualization and treatment of CPTSD among older adults. As older adults may become more vulnerable to emotional loneliness as they age (Ó'Luanaigh & Lawlor, 2008), finding ways to help these people build and maintain close attachments is an important social and clinical objective. This finding is in line with the wider loneliness literature noting a greater association between emotional loneliness and poorer outcomes, compared to social loneliness. For instance, emotional loneliness had been found to be more predictive of both psychiatric and physical health concerns such as increased anxiety and depressive symptoms, poorer psychological wellbeing and sleep quality, and all-cause mortality (Hyland, Shevlin et al., 2019; McHugh & Lawlor, 2013; O'Súilleabháin et al., 2019; Peerenboom et al., 2015).

These results may aid in identifying qualitative differences between PTSD and CPTSD. Exposure to trauma can lead to feelings of alienation from others and a disconnect from society (DePrince et al., 2011; Solomon et al., 2015; Solomon & Dekel, 2008). These feelings of alienation and disconnect from close relationships, and also from the wider community may, in theory, contribute to the self-concept and relational difficulties that are inherent to CPTSD. Indeed, prior to the formulation of CPTSD in *ICD-11*, Herman (1992) wrote that feelings of emptiness, aloneness, and disconnection from others are common features of individuals who have experienced repeated, prolonged, and interpersonal forms of trauma. Notably, CPTSD most typically emerges from prolonged and multiple forms of trauma (i.e. complex trauma) but also can result from single incidents, such as an event in which there is a social/attachment loss (e.g., the unexpected or violent death of a loved one).

As this study used a cross-sectional design, it is not possible to infer the direction of effects. As such, it is possible that CPTSD symptoms engender feelings of loneliness, and not vice-versa, and thus have no impact on the treatment of CPTSD. Nevertheless, while evidence synthesis attempts reveal limited effectiveness of interventions aimed at reducing loneliness, the largest effects are observed for those aimed at reducing maladaptive social cognitions (Cacioppo et al., 2015; Jarvis et al., 2020; Mann et al., 2017; Masi et al., 2011). Evidence has also been found for behavioural and social interventions to reduce loneliness, such as volunteer-based interventions among veterans (Matthieu et al., 2017). Alternatively, technology-based interventions have been found to be effective in alleviating loneliness, among older adults (Poscia et al., 2018). If it is the case that the association between loneliness and CPTSD arises because loneliness causes or exacerbates CPTSD symptomatology, then intervening on loneliness may exert an ameliorative effect on CPTSD. Given the effectiveness of interventions targeting maladaptive social cognitions in reducing loneliness, and the association between reducing negative post-trauma cognitions and positive PTSD treatment outcomes (Brown et al., 2019), these types of interventions may be particularly beneficial. In contrast, meta-analytic findings (Karatzias, Murphy et al., 2019) suggest that standard PTSD interventions are effective in reducing symptoms of CPTSD, most notably among the ‘Negative Self-concept’ and ‘Disturbances in Relationships’ symptom clusters. As such, if it is the case that the reverse-association is true, in that CPTSD symptoms cause or exacerbate loneliness, then effective interventions for CPTSD/PTSD may aid in alleviating loneliness.

A major strength of this study is the use of a nationally representative sample of adults aged 60–70 in conjunction with a validated and reliable questionnaire for assessing CPTSD symptoms (i.e. the ITQ; Cloitre et al., 2018). Moreover, the use of SEM provides more accurate parameter estimates in examining the relationship between loneliness and CPTSD symptoms. This is also the first study to examine the relationship between loneliness and CPTSD using an older adult-specific sample. However, there are a number of limitations associated with this study that should be acknowledged. First, the current study used a nationally representative household sample of older adults residing in the U.S., therefore, these inferences may not be generalisable to older adults in other nations, or to those in clinical settings. Second, participants were incentivised to take part in this study through entry into a raffle. This may affect the generalisability of the findings by resulting in a biased sample, with disadvantaged participants being more likely to volunteer to participate (Cleary et al., 2008). Third, it is also important to note that the multidimensional structure of the loneliness measure used (de Jong Gierveld Loneliness Scale; de Jong Gierveld & van Tilburg, 2006) has previously been criticised to reflect, at least in part, a method effect associated with the wording of the positively phrased items, compared to the negatively phrased items (Penning et al., 2014). This type of method effect can lead to biased estimates. Furthermore, negatively worded items have been found to yield less item information which can lead to less precise estimates (Sliter & Zickar, 2013). Fourth, as this study used a cross-sectional design it was not possible to infer the temporal ordering among the observed relationships.

Future studies should aim to further examine the relationship between social and emotional loneliness and CPTSD symptomatology. Using additional waves of data, the precise pathways explaining this relationship can be delineated. Identifying the temporal relationship (i.e. whether it is unidirectional or bidirectional) has important implications for the development of effective interventions to target CPTSD symptoms among older adults. Moreover, studies should also attempt to examine the impact of loneliness-based interventions (such as those designed to treat maladaptive cognitions) on CPTSD symptoms. In this study, an association was found between social and emotional loneliness and CPTSD symptomatology in a sample of older adults. Moreover, these findings highlight a potential difference between social and emotional loneliness regarding PTSD and DSO symptoms, with emotional loneliness being associated with both PTSD and DSO symptoms, whereas social loneliness was only related to DSO symptoms. These findings have important implications for understanding the qualitative differences between PTSD and CPTSD, and potential clinical implications for the treatment of PTSD and CPTSD among older adults.

Chapter 7

General Discussion

7.1. Introduction

The global population is aging with the number of adults aged 60 years and older expected to rise from 12% in 2015 to 22% in 2050 (WHO, 2017). As such, gaining a better understanding of the mental health of older adults is a crucial topic of research (Cook & Simiola, 2018). The overarching goal of this thesis was to advance current understandings of the nature of posttraumatic stress responses and their correlates in people over the age of 60. To achieve this goal, several objectives were formulated which were to examine the structure, level of comorbidity, and potential determinants and consequences of PTSD in later life. First, the factorial validity of the *ICD-11* and *DSM-5* models of PTSD were tested in a nationally representative sample of U.S. of older adults and were then assessed for item-bias across sex. Second, discernible patterns of comorbidity with *ICD-11* PTSD were identified in a nationally representative sample of U.S. older adults and the association between these patterns of comorbidity and a number of covariates were examined. Third, changes over time in loneliness (social and emotional) and their association with changes over time in posttraumatic stress symptoms were examined using a sample of older adults residing in the Netherlands. Fourth, the prevalence rates of *ICD-11* PTSD and CPTSD were estimated in a nationally representative sample of U.S. older adults and the cross-sectional relationship between social and emotional loneliness, and CPTSD symptomatology was examined.

This chapter will first provide an overview of the main findings from each of the four empirical chapters. Next, the implications of these findings will be discussed, followed by the strengths and limitations of this work, possible future directions for research, and final concluding remarks.

7.2. Overview of Key Findings

7.2.1. Chapter 3

The first empirical chapter (Chapter 3) tested numerous factorial models of PTSD that were previously evidenced through factor analytic research, among a nationally representative sample (n = 5,366) of older adults (aged 60 years and older) in the U.S., all of whom reported experiencing at least one traumatic event in their lifetime. Moreover, the individual items were examined in greater dept, including an assessment of DIF (i.e. item-bias due to sex).

Given the lack of research conducted on PTSD among older adults, an important first step to this thesis was to determine whether the current diagnostic models provided an accurate representation of PTSD among older adults. Seven models of PTSD (ranging from four to seven factors) which encompassed the 20 symptoms as outlined in the *DSM-5* (APA, 2013) were assessed, and three models of PTSD (ranging from one to three factors) which encompassed the six symptoms as outlined in *ICD-11* (WHO, 2018) were assessed. All seven models of *DSM-5* PTSD exhibited excellent, and similar, fit to the data; whereas the three-factor *ICD-11* model exhibited excellent, and significantly better, fit to the data than the alternative models. This suggest that *DSM-5* and *ICD-11* PTSD manifests in the same way in older adults, as it does in the general adult population. This finding supports a fundamental assumption of the *DSM-5* and *ICD-11* classification systems that PTSD manifests in the same way across the entire adult population. The major implication of this finding is that an alternative diagnostic algorithm for PTSD is not needed for older adults. This finding supported the first hypothesis of the thesis.

Prevalence estimates for PTSD were similar across the *DSM-5* and *ICD-11* algorithms with 9.5% of the sample meeting the symptom requirements for a probable diagnosis of lifetime *DSM-5* PTSD, and 8.7% met the symptoms requirements for a probable diagnosis of lifetime *ICD-11* PTSD. This finding is inconsistent with those of the NCS-R (Kessler et al., 2005) which found that a smaller proportion (2.5%) of adults over the age of 60 met the diagnostic criteria for PTSD. The estimated prevalence rate in Chapter 3 would be expected to be higher due to the absence of the functional impairment criterion in calculating PTSD rates, and that all participants in the sample had been exposed to at least one traumatic event. However, what these results suggest is that PTSD is not so uncommon in older adults in the general population. Gum et al. (2009) have noted that without sufficient training and consideration for geriatric populations, it is likely that the psychiatric health care system will be faced with serious challenges in the years to come.

Females were more likely than males to meet criteria for both *DSM-5* and *ICD-11* PTSD. These findings are in line with the wider trauma literature (Cloitre et al., 2019; Tolin & Foa, 2006), suggesting that females are more likely to meet the diagnostic criteria for PTSD. This indicates that the disparity observed in PTSD rates, across males and females, also extends to older adults. This is additional evidence that the current models of PTSD are valid representation of traumatic distress in those aged 60 years and older.

Next, an in dept exanimation was conducted assessing the individual symptoms as per the *DSM-5* and *ICD-11* classifications, across the sexes. Females were significantly more likely to endorse 16 of the 20 *DSM-5* PTSD symptoms while males were more likely to endorse one of the 20 symptoms. Moreover, through the use of a DIF analysis, three of the symptoms were found to be biased for females (i.e. women were more likely to endorse these symptoms despite having the same level on the underlying latent variable), namely 'unwanted memories' (B1), 'feeling upset' (B4), and 'sleep problems' (E6). Alternatively, one symptom was biased for males, ‘reckless or self-destructive behaviour’ (E2). Females were more likely to endorse five of the six

ICD-11 PTSD symptoms, however, none of the items demonstrated the presence of DIF based on sex. Similar effects for the 'feeling upset' and ‘risky behaviours’ symptoms were previously reported in a sample of Malaysian adolescents (Murphy et al., 2019), suggesting that these symptoms may need to be altered, or removed, in the next iteration of the *DSM*. Furthermore, these findings suggest that some the differences in *DSM-5* PTSD rates observed between older males and females might, in part, be due to item-bias. Of course, there may be additional reasons for this difference in PTSD rates across sex, such as differences in peritraumatic response (Christiansen & Hansen, 2015; Olff et al., 2007). This finding supported the second hypothesis of the thesis.

Ultimately, these findings indicate that the *DSM-5* and *ICD-11* models provide good representations of the latent structure of PTSD symptoms among older adults and, therefore, clinicians can use these models to diagnose PTSD with some confidence. However, the fact that endorsement of many of the *DSM-5* items were influenced by the sex of the respondent is a concern and means that prevalence rates of *DSM-5* PTSD between older men and women cannot be reliably performed. On the other hand, the *ICD-11* model showed no evidence of item-bias due to the respondent’s sex, meaning that this model of PTSD appears to offer a sound diagnostic algorithm for older men and women. The more parsimonious nature of the *ICD-11* model of PTSD, and its superior statistical properties relative to the *DSM-5* model of PTSD, means that it may be more useful to both clinicians and researchers interested in studying PTSD among older adults.

7.2.2. Chapter 4

Epidemiological research indicates that psychiatric morbidity (including PTSD) and comorbidity is significantly lower among older adults in comparison to their younger counterparts (Gum et al., 2009; Kessler et al., 2005; Reynolds et al., 2016; Thomas et al., 2016). Considering these differences between older and younger adults, and that the area of PTSD comorbidity among older adults is relatively under-researched, Chapter 4 examined lifetime comorbidity among a sample of older adults who met the symptom criteria for a diagnosis of *ICD-11* PTSD (*n* = 530). The *ICD-11* model of PTSD was chosen for four reasons: First, it is a more parsimonious model of PTSD than the *DSM-5* model (Shevlin et al., 2017; Shevlin, Hyland, Vallières et al., 2018); second, it demonstrated superior psychometric properties to the *DSM-5* model in Chapter 3; third, given the recency of the release of the *ICD-11* model of PTSD, research regarding *ICD-11* PTSD among older adults is almost non-existent and it was hoped this this work could make an original contribution to the literature; and fourth, the *ICD-11* is the diagnostic manual used by all United Nations member states, including the U.S., to track the prevalence of all psychiatric disorders. Thus, empirically, theoretically, and practically, it was deemed most appropriate to focus the remaining analyses on the *ICD-11* model of PTSD (and CPTSD).

In this chapter, the comorbidity between *ICD-11* PTSD and a multitude of other psychiatric disorders was estimated. Results revealed that among older adults who met diagnostic requirements for *ICD-11* PTSD, nearly 80% met criteria for at least one other psychiatric disorder. Comorbidity was most commonly observed with major depressive disorder, alcohol use disorder, borderline personality disorder, and generalised anxiety disorder. These findings are similar to both general population and clinical studies examining PTSD comorbidity (Hyland et al., 2018; Karatzias, Hyland et al., 2019; Pagura et al., 2010; Shevlin, Hyland, Vallières et al., 2018). This suggest that the findings of high PTSD psychiatric diagnostic comorbidity observed among general populations samples also extend to older adult samples. These findings are consistent with the third and fourth hypotheses of the thesis.

Next, distinct patterns of PTSD comorbidity were examined using LCA. The results of the LCA favoured a two-class solution. Class 1 (71.7%; labelled: ‘PTSD with moderate probabilities of depressive/alcohol use disorders') was characterised by moderate probabilities of comorbid major depressive disorder and alcohol use disorder. Class 2 (28.3%; labelled: 'PTSD with general psychopathology') was characterised by a high probability for comorbid major depressive disorder and borderline personality disorder, and moderate probabilities for dysthymia, generalised anxiety disorder, social phobia, specific phobia, agoraphobia, panic disorder, drug use disorders, alcohol use disorder, and schizotypal personality disorder. This finding was somewhat inconsistent with the fifth hypothesis of the thesis and previous studies that found a three-class solution best explained patterns of lifetime PTSD psychiatric comorbidity (Galatzer-Levy et al., 2013; Müller et al., 2014). This indicates that PTSD comorbidity may manifest in a somewhat different way among older adults, however, this cannot be concluded with much confidence given how little empirical evidence currently exists.

Membership of Class 2, compared to Class 1, was associated with lower social support, spousal/partner physical abuse, and history of attempted suicide. Interestingly, members of Class 2 were nearly three times as likely to have attempted suicide as members of Class 1. Consistent with the sixth hypothesis of the thesis and previous research, higher rates of suicidal attempts (Galatzer-Levy et al., 2013; Müller et al., 2014) were associated with the higher comorbidity class. Moreover, similar to previous research, traumatic exposure involving spousal/partner physical abuse predicted membership of the higher PTSD comorbidity latent classes, compared to classes encompassing low probability of psychiatric comorbidity (Galatzer-Levy et al., 2013).

The findings of this chapter indicate that *ICD-11* PTSD commonly co-occurs with other psychiatric disorder in older adults, most notably with major depressive disorder, alcohol use disorder, and borderline personality disorder. These results may be important for clinicians treating older adults who are suffering from PTSD as they indicate that it is exceptionally rare for PTSD to present on its own and without any other psychiatric problem.

7.2.3. Chapter 5

Loneliness can have a pernicious effect on mental health in later life. However, longitudinal research examining loneliness and posttraumatic stress symptoms is scant, especially in older adults. In Chapter 5, to address this gap in the literature, the longitudinal association between loneliness and PTSD was examined using two waves of data from an older adult Dutch sample (N = 1,276). Significant increases were found in both posttraumatic stress symptoms and emotional loneliness scores over time; however, these effects sizes were very small. While social loneliness did not increase or decrease over time, there was significant heterogeneity in responses. This suggests that, although there was no significant average increase/decrease in social loneliness scores, there was significant variance. Therefore, this within-person and between-person change over time among these three latent variables could be examined through the use of a 2W-LCS model.

Changes in both social and emotional loneliness were associated with changes in posttraumatic stress symptoms, suggesting the presence of a longitudinal relationship between the constructs (i.e. changes in one construct will lead to changes in the other). This is line with the wider PTSD literature, in that loneliness has been found to be longitudinally associated with PTSD in the general population (van der Velden et al., 2018, 2019). Furthermore, this finding is in line with the wider literature regarding psychopathology in older adults, in that loneliness has repeatedly been found to be a significant predictor of psychiatric morbidity in later life (Coyle & Dugan, 2012; Tomstad et al., 2017; Wang et al., 2018). Given that only one interval of time was used to assess within-person differences (i.e. across two waves), it was not possible to delineate the precise temporal ordering of the variables. However, a bidirectional relationship among loneliness (social and emotional) and posttraumatic stress symptoms is theoretically plausible. These findings support the seventh hypothesis of the thesis.

Older age, sex (being female), and urban dwelling were associated greater increases in posttraumatic stress symptoms over time. These predictors are generally in line with the wider PTSD literature in the general population (Tolin & Foa, 2006; Ventimiglia & Seedat, 2019). Although PTSD generally declines in older adults (Gum et al., 2009), the weak association between older age and increased posttraumatic stress symptoms over time in older adults has been noted previously (Chopra et al., 2014; Pless Kaiser et al., 2019; Solomon et al., 2012). This may be the result of PTSD symptoms re-emerging in later life due to age-related normative events such as retirement, bereavements, and worsening physical health (Pless Kaiser et al., 2019). For example, retired individuals might have more opportunity to reflect on their life and may, therefore, recall early traumatic memories (Solomon et al., 2012) or veterans who begin to suffer from impaired mobility may re-experience the sense of vulnerability they felt when injured in combat (Pless Kaiser et al., 2019), leading to an increase in PTSD symptoms.

Older age, partner status (no partner), decreased personal network size, and experiencing recent negative life events were associated with greater increases in emotional loneliness over time. Older age, sex (being male), urban dwelling, and decreased personal network size were associated with greater increase in social loneliness over time. These findings are generally in line with the wider loneliness literature (Drennan et al., 2008; Hyland, Shevlin et al., 2019; Luhmann & Hawkley, 2016; Tomaka et al., 2006).

These results suggest that targeting feelings of loneliness may be useful in addressing the symptoms of PTSD and/or vice-versa. Identifying the factors associated with change over time in loneliness and symptoms of PTSD can have important clinical and research implications. For example, these findings can help inform clinicians who are treating older adults who present with, or are at-risk of developing, symptoms of PTSD by providing an additional means of treating/preventing PTSD symptoms in later life. Moreover, by identifying loneliness as a clinically meaningful variable among trauma-exposed older adults, these findings may help researchers better understand the factors that have an impact on the course of PTSD in later life, and may, therefore, guide future research pertaining to PTSD in older adults.

7.2.4. Chapter 6

Chapter 6 sought to examine the relationship between social and emotional loneliness and CPTSD among older adults aged 60–70 years (n = 456), using a nationally representative sample from the U.S. CPTSD encompasses the core symptoms of PTSD along with additional symptoms reflecting the DSO symptom clusters. A higher-order model of CPTSD (consisting of PTSD and DSO second-order factors) provided an excellent fit to the data, suggesting that the *ICD-11* model of CPTSD is valid among adults aged 60–70 years. This model is consistent with the best fitting model of CPTSD among the general adult population (Cloitre et al., 2018; Karatzias et al., 2016). This adds to the findings of Chapter 3 by further demonstrating that standard psychiatric models of PTSD and CPTSD effectively capture the latent structure of these symptoms in older adults.

Furthermore, the prevalence rates of PTSD and CPTSD among adults aged 60–70 years were 1.2% and 1.6%, respectively. Moreover, adults aged 60–70 years were approximately 3.5 times less likely to meet the diagnostic requirements of PTSD and 2.5 times less likely to meet the diagnostic requirements of CPTSD, compared to adults aged younger than 60 years. This finding is in line with the wider traumatic stress literature that there is a substantial decline in the prevalence of traumatic stress disorders among older adults (Gum et al., 2009; Kessler et al., 2005; Reynolds et al., 2016). However, it meaningfully adds to existing knowledge in demonstrating, for the first time, that rates of CPTSD are lower in adults over the age of 60 compared to those under the age of 60.

The cross-sectional relationship between loneliness (social and emotional) and CPTSD symptoms (i.e. PTSD symptoms and DSO symptoms) was examined using SEM. Emotional loneliness was found to have a moderate relationship with the PTSD symptoms and a strong relationship with the DSO symptoms whereas social loneliness had a small-moderate relationship with the DSO symptoms but was not related to the PTSD symptoms. These findings are in line with the wider traumatic stress literature demonstrating a consistent association between loneliness and PTSD symptoms (Itzhaky et al., 2017; Kuwert et al., 2014; O'Connor, 2010; Shevlin et al., 2015; Solomon et al., 1991, 2015; Tsur et al., 2019; van der Velden et al., 2018, 2019). Similarly, these findings are in line with the research, albeit limited, examining the relationship between loneliness and CPTSD symptoms (Dagan & Yager, 2019; Zerach et al., 2019). Moreover, it was found that the number of traumatic events experienced displayed a moderate-strong relationship with the PTSD symptoms and was moderately associated with the DSO symptoms. In total, the model explained large portions of the variance in PTSD symptoms and the variance in DSO symptoms. These findings partially supported the eighth hypothesis of the thesis in that emotional loneliness was associated with PTSD and DSO symptoms; however, social loneliness was associated with DSO symptoms but not PTSD symptoms.

These findings suggest that a small proportion of adults over the age of 60 in the general population are likely to be suffering from CPTSD. Importantly, however, as many older adults appear to suffer from CPTSD as those who suffer from PTSD. Thus, clinicians working with older adults who have experienced traumatic life events should be cognizant for the presence of CPTSD. Furthermore, these findings suggest that there are potential differences between social and emotional loneliness and their association with CPTSD. This has important implications for understanding the qualitative differences between PTSD and CPTSD and offering possible clinical insights for developing effective interventions/treatments that target PTSD and CPTSD symptoms in later life.

7.3. Implications of Findings

The findings of the present thesis make a substantive contribution to the traumatic stress literature and have several important clinical implications. The first major finding of this thesis, and arguably the most important, is that the current diagnostic models of PTSD (i.e. *DSM-5* and *ICD-11*) accurately represent the symptom structure of the disorder in older adults. It has been suggested (Palmer et al., 1997; Thomas et al., 2016) that one reason for the observed decline in prevalence rates of PTSD among older adults is that the latent structure of PTSD is distinct in older adults. In other words, this argument suggests that posttraumatic symptomatology manifests differently in older adults, possibly due to the effects of the normal aging process and developmental changes (Cook & Simiola, 2018). For example, physical impairments might reduce the frequency of individuals coming in contact with external cues that are reminiscent of the traumatic event, or hearing loss may negate a hypervigilant or exaggerated startle response to sounds (Cook & Simiola, 2018). However, the current findings do not support this proposal, and instead indicate that the latent structure of PTSD symptoms – whether modelled in accordance with the *DSM-5* or *ICD-11* guidelines – are valid among older adults. This suggests that differences in PTSD rates across age groups are not the result of qualitative differences in the manifestation of traumatic distress in older adults. Rather, these findings would be more consistent with the assumption that lower rates of PTSD among older adults are due to older adults being more resilient (Gooding et al., 2012; Grossmann et al., 2010; MacLeod et al., 2016; Thomas et al., 2016), having a greater cognitive bias towards positive stimuli and memory recall (Kennedy et al., 2004; Reed & Carstensen, 2012; Thomas et al., 2016), and/or are better at optimising their current resources (Baltes & Baltes, 1990; Ouwehand et al., 2007), relative to younger adults.

This has important implications for understanding, assessing, and diagnosing PTSD in older adults. The support for the predictions of the *DSM-5* and *ICD-11* models means that the same diagnostic algorithms can be applied in older adults. Furthermore, the consistency in the nature of PTSD in older adults means that (a) meaningful comparisons in the rates of PTSD can be made between younger and older adults, and (b) that findings regarding risk factors, comorbidity, and interventions for PTSD can be meaningfully compared across younger and older adults.

Demonstrating the factorial validity of any construct is a fundamental step in utilising a measure in both research and clinical settings. Diagnostic guidelines are aligned to the expected latent structure of PTSD (i.e., symptoms must be present from each cluster/factor to meet diagnostic criteria); therefore, if the latent structure of PTSD in older adults is different to what is observed in other age groups, the diagnostic guidelines will be inaccurate (Shevlin et al., 2017) for some individuals in older age. As both the *ICD-11* and *DSM-5* models were found to be valid, clinicians should have confidence in using these diagnostic guidelines among older adults. Of course, this step in formulating any diagnostic model is a necessary but not a sufficient step in determining the most appropriate diagnostic structure. As it is not appropriate to rely solely on the grounds of statistical fit to determine the superior diagnostic model (Shevlin et al., 2017), alternative aspects should be considered, such as the clinical utility of the model and overlapping symptoms in other psychiatric diagnoses.

Four symptoms were found to be biased across sex, with three items being biased towards females and one item being biased towards males. This suggests that scores on the *DSM-5* measure of PTSD may reflect, in-part, sex differences rather than different levels of PTSD. Therefore, the reconceptualization, or removal, of these symptoms in the next version of the *DSM* is warranted. Alternatively, the individual symptoms can also be weighted differently when administered, in order to account for the systematic bias across the four items which demonstrated DIF. However, this may not be a pragmatic choice. None of the *ICD-11* items demonstrated bias across sex. Therefore, these findings suggest that the *ICD-11* model may be psychometrically superior among older adults, compared to the *DSM-5* model.

The sex differences observed in older adults are in line with the wider traumatic stress literature in the general adult population (Cloitre et al., 2019; Tolin & Foa, 2006), suggesting that these sex differences also extend to older adults. Observing similar trends in a robust predictor of PTSD, such as sex, in both the general adult population and older adults further suggests that the differences observed in PTSD across age is quantitative rather than qualitative.

These findings may also help explain the differences observed in lifetime rates of PTSD across age, as older adults have been found to report lower lifetime rates of PTSD, compared to younger age groups (Kessler et al., 2005). This suggests that there may be a cohort effect, with successive cohorts being more likely to endorse lifetime PTSD. Possible reasons for this observed decline in lifetime PTSD rates may be that (1) generational differences exist whereby older adults who were exposed to a traumatic event may have sought treatment prior to the introduction of PTSD to the *DSM-III* in 1980. Thus, older adults who exhibited symptoms of PTSD in the past may not have received a diagnosis of PTSD and, therefore, do not attribute their experiences at the time to PTSD symptomatology (Cook et al., 2017); (2) older adults generally have more positive biases in their memory (Kennedy et al., 2004; Reed & Carstensen, 2012; Thomas et al., 2016). As a result, older adults may not recall experiencing all the necessary symptoms to meet a diagnosis if they generally focus on the more positive aspects of their past; and (3) similar methodological concerns which lead to decreased rates of current psychiatric morbidity in older adults, such as the diagnostic systems being ill-suited to older adults (see Bodner et al., 2018; Lutz et al., 2018), may also lead to decreased rates of lifetime psychiatric morbidity. In other words, if there are concerns regarding the accuracy of psychiatric assessments for current psychiatric morbidity in older adults, then it is possible that these concerns also extend to cross-sectional lifetime assessments of psychiatric morbidity. However, the results of Chapter 3 indicate that the current models of PTSD adequately represent the psychiatric disorder in later life. Therefore, this suggests that the third reason, regarding methodological concerns, may not adequately explain these differences in lifetime PTSD rates. As such, future research is warranted to better understand these differences in lifetime PTSD across age groups.

In line with the findings that the *ICD-11* model provided excellent statistical fit among adults aged 60 older, the results of Chapter 6 also indicated that the model of CPTSD provided excellent fit among adults aged 60–70 years. Although older adults are a heterogeneous group (likely more so than the younger population; de la Torre-Luque et al., 2020; García-Esquinas et al., 2019; Lafortune et al., 2009; Lowsky et al., 2014), this finding may be seen as preliminary evidence suggesting that the *ICD-11* model of CPTSD is valid among older adults. However, further research on adults older than 70 years is needed.

Although research suggests that psychiatric comorbidity rates (lifetime and 12-month prevalence) generally decrease with age, the results of Chapter 4 revealed that *ICD-11* PTSD lifetime diagnostic comorbidity rates were high among older adults. This finding provides a useful addition to the nascent literature regarding *ICD-11* PTSD among older adults and has important implications for clinical practice. Being cognizant of this high comorbidity rate may be particularly important among geriatric populations presenting with symptoms of PTSD, given the additional difficulties of psychiatric diagnostic assessments among older adults, such as the functional impairment criterion being ill-suited to many older adults (Bodner et al., 2018). For example, older adults may be less likely to attribute social impairment to psychiatric symptoms if they are physically impaired, or occupational impairment if they are retired. Alternatively, as there is lack of research pertaining to PTSD in older adults, it is also possible that the functional impairment criterion is applicable to older adults. However, future research is warranted to ensure that the items measuring functional impairment are applicable to older adults, as inappropriate items may lead to the psychiatric disorders being under-, or mis-diagnosed (see Bodner et al., 2018).

Results suggested that two distinct patterns of PTSD diagnostic psychiatric comorbidity exist in older adults. The HiTOP (Kotov et al., 2017) model of psychopathology may be a useful framework for clinicians to understand which psychiatric disorders are most likely to co-occur in patients who present with PTSD. For example, PTSD sits within the ‘distress’ subfactor of the ‘internalising’ spectrum. As such, PTSD is most likely to co-occur alongside the same disorders within this subfactor (e.g. major depressive disorder, generalised anxiety disorder, and borderline personality disorder). Clinicians should also be aware that the higher comorbidity class (Class 2) was associated less social support, spousal/partner physical abuse, and history of suicide attempts. This suggest that individuals who display multiple psychiatric disorders are likely to require urgent clinical intervention.

Finding similar trends in PTSD comorbidity, the same predictors of the high comorbidity class, and that PTSD also manifests in the same manner in older adults as it does in the general population (i.e. results from Chapter 3) further suggests that differences observed in PTSD rates across different age groups may reflect quantitative, rather than qualitative, differences in PTSD. This suggests that findings from the general population studies may be applicable to older adult populations. This has important implications for understanding, and therefore treating/preventing, PTSD in later life. For example, as PTSD manifests in the same manner in older adults as it does in the general adult population, risk factors identified among general population studies, such as peritraumatic tonic immobility (Kalaf et al., 2015; Möller et al., 2017; Portugal et al., 2012; Rocha-Rego et al., 2009), should also extend to older adults.

Observing high rates of PTSD comorbidity also has important implications for the wider literature pertaining to the *ICD-11* model of PTSD. One of the main goals in revising PTSD for the *ICD-11* was to reduce diagnostic comorbidity by focusing on the core symptoms of PTSD (Maercker et al., 2013). However, coinciding with the results of Chapter 4, previous research has also noted high rates of PTSD diagnostic comorbidity in the general population and clinical samples (Hyland et al., 2018; Karatzias, Hyland et al., 2019; Shevlin, Hyland, Vallières et al., 2018). Therefore, it would appear that this goal has not been attained. Focusing on the core symptoms of PTSD, and removing the transdiagnostic symptoms, should reduce diagnostic comorbidity if the disorders are orthogonal. This is the assumption of the *DSM-5* and *ICD-11* classifications. However, if one assumes a dimensional model of psychopathology - such as in the HiTOP model (Kotov et al., 2017) - where supposedly discrete disorders are actually related manifestations of the same underlying latent variable, high levels of covariation among psychiatric disorders is to be expected. Focusing on the core symptoms of PTSD should reduce measurement error, thereby *increasing* covariation with other psychiatric disorders (Shevlin et al., 2017). Thus, from the perspective of HiTOP, high levels of psychiatric comorbidity are inevitable, and PTSD would be expected to be most strongly correlated with the disorders located within the same subfactor (i.e. distress) and spectra (i.e. internalizing).

Assessing the lifetime comorbidity may provide a more accurate representation of an individual's pattern of PTSD comorbidity. The results of a recent four-decade longitudinal study assessing psychopathology (Caspi et al., 2020) found that psychiatric diagnoses often change over time, are recurrent, and are diverse in their manifestation across multiple dimensions of psychopathology. Therefore, Caspi and colleagues (2020) recommend using a life history approach to understanding psychopathology, rather than measuring current psychopathology at a single point in time. As such, the findings of Chapter 4 may have important implications for understanding the life history of PTSD comorbidity among older adults.

These findings may help clinicians identify the future psychiatric disorders that are more likely to manifest, depending on an individual's latent class. Thus, this can allow a clinician to carefully monitor a patient's wellbeing over time and help them develop the necessary skills to mitigate the future development of additional psychiatric disorders. In other words, if clinicians are aware of the potential psychiatric disorders that their clients are susceptible to, then they will be better able to adapt their treatment strategies to focus on both the current set of psychiatric symptoms (i.e. PTSD symptomatology and any other co-occurring symptoms) and build additional skills in maintaining mental wellbeing. This is in line with the recommendations of Caspi and colleagues (2020) as they suggest, based on the evidence that many patients go on to develop a diverse array of psychiatric symptoms, that clinicians should ensure that they focus on mitigating the present psychiatric disorder but also help the patient develop the necessary skills to maintain enduring mental health beyond the clinical intervention. The results of Chapter 4 build upon this recommendation by demonstrating the specific disorders that are likely to co-occur with PTSD in older adults. Thus, clinicians can be aware of, and focus more attention towards, the more probable comorbid psychiatric disorders that may manifest in patients reporting PTSD symptoms. For example, major depressive disorder and borderline personality disorder were found to be highly probable for members of the second latent class. Therefore, clinicians should attempt to apply preventative measures to reduce the risk of these disorders developing in the future, even if the patient is not currently exhibiting these disorders.

The results of Chapter 5 and Chapter 6 revealed an association between loneliness (social and emotional) and symptoms of PTSD. Moreover, Chapter 5 found a longitudinal association between loneliness and PTSD with changes in both social and emotional loneliness being associated with changes in PTSD symptoms. Given that an association was found between loneliness and posttraumatic stress responses across two different countries, this indicates that the relationship between these constructs is robust and not specific to the idiosyncrasies of one particular nation. Interestingly, it was found (Chapter 6) that both emotional and social loneliness were associated with the additional DSO symptoms that distinguish CPTSD from PTSD. However, emotional loneliness but not social loneliness was associated with the core symptoms of PTSD. Taking the findings of Chapter 5 in conjunction with the findings of Chapter 6, it can be suggested that the longitudinal association between PTSD and loneliness may also extend to CPTSD symptomatology. However, given that there was no association found between social loneliness and the core symptoms of PTSD, the relationship between both types of loneliness (i.e. social and emotional) may only hold for individuals who report experiencing the more severe psychiatric sequalae that distinguishes CPTSD from PTSD. For example, among those who have experienced multiple and prolonged trauma exposure from which escape is difficult or impossible (Shevlin, Hyland, Roberts et al., 2018). Of course, future longitudinal research is required to determine whether a longitudinal association between CPTSD symptomatology and loneliness does exist.

These findings suggest that the lack or absence of intimate relationships and close attachments (i.e. emotional loneliness), and the desire for a sense of belonging and companionship within a wider network (i.e. social loneliness) are associated with more severe responses following trauma exposure (i.e. CPTSD), whereas, the desire for a sense of belonging and companionship within a wider network may not play a role in the development of PTSD. This lack of belonging to a wider community and social network has been noted among CPTSD clinical case studies following childhood abuse (Dagan & Yager, 2019). As such, it is possible that the lack of belonging to a wider community in combination with the lack of close emotional attachments may lead to the additional DSO symptoms of negative self-concept, affective dysregulation, and disturbances in relationships. Similarly, it is possible that symptoms of CPTSD may also lead to a sense of emotional and social loneliness.

These findings may have important implications for clinical interventions designed to target PTSD and CPTSD symptoms among older adults. Given that a positive association between social and emotional loneliness and CPTSD symptomatology and a longitudinal association between PTSD and loneliness was found among older adults, this indicates that: (1) loneliness interventions may be useful in preventing symptoms of PTSD/CPTSD; (2) PTSD/CPTSD interventions among older adults may benefit from incorporating elements of loneliness-based interventions, most notably with regards to the DSO symptoms, given the strong and small-moderate relationship found with emotional loneliness and social loneliness, respectively; (3) PTSD/CPTSD interventions may be useful in preventing feelings of loneliness; and (4) loneliness-based interventions may benefit from incorporating elements of PTSD/CPTSD interventions.

If it is the case that loneliness precedes the onset of PTSD/CPTSD symptoms, then loneliness-based interventions may offer clinicians an alternative, indirect clinical approach to preventing symptoms of CPTSD and PTSD. This may be particularly advantageous towards the treatment of CPTSD given the numerous clinical challenges that can interfere with effectively engaging and treating individuals with CPTSD (Brewin, 2020). For example, loneliness-based interventions which address negative cognitive biases about oneself or others, such as a lack of trust in interpersonal relationships (Mann et al., 2017) and automatic negative thoughts about social interactions (Cacioppo et al., 2015), may help decrease symptoms of CPTSD such as disturbances in relationships and negative self-concept. Moreover, treating negative cognitions following trauma exposure is an important factor in predicting positive outcomes to PTSD treatments (Brown et al., 2019). Although the effectiveness of current interventions for loneliness is somewhat limited (Jarvis et al., 2020; Mann et al., 2017), this may still provide a useful addition to a clinician's repertoire of preventative measures for treating trauma-exposed persons, most notably if more effective interventions for treating loneliness are developed.

Using alternative, indirect approaches to treating symptoms of PTSD and CPTSD may be particularly beneficial among older adults. Older adults may be more reluctant than younger adults to disclose psychiatric symptoms due to fears of stigma (Cook & Simiola, 2018; Pless Kaiser et al., 2019), and this can be particularly problematic with regards to disclosing traumatic experiences (Krammer et al., 2016). Moreover, there is a concern that older adults may not recognise the potential negative impact of trauma or disclose their experiences to healthcare professionals (Cook et al., 2017). This may be due to generational differences, for example, older adults who experienced childhood trauma may have sought treatment prior to the introduction of PTSD to the *DSM-III*. This may result in older adults, who exhibited symptoms of PTSD, not receiving a diagnosis and, therefore, not attributing their current symptoms to earlier traumatic events (Cook et al., 2017). Additionally, as older adults are more susceptible to medical conditions such as cardiac or repository issues, clinicians may be reticent to deliver standard trauma-focused interventions, such as prolonged exposure therapy, that may lead increased physiological arousal (Clapp & Beck, 2012; Cook et al., 2017; Dinnen et al., 2015). However, it should be noted that these interventions can be deemed safe to apply to older adult populations, alongside consultation with the patient's physician (Clapp & Beck, 2012; Cook et al., 2017; Dinnen et al., 2015). Nevertheless, loneliness-based interventions may offer clinicians an alternate means of treating PTSD/CPTSD symptoms for older adults who are considered high risk for standard types of PTSD interventions.

As CPTSD has only recently been officially added to the diagnostic nomenclature, the design and testing of interventions to address CPTSD are at a very early stage, most notably among older adults. It stands to reason, however, given the associations between social and emotional loneliness and CPTSD symptomatology, that CPTSD interventions may benefit from incorporating elements of loneliness-based interventions. For example, interventions designed to address negative cognitive biases about oneself or others and automatic negative thoughts about social interactions (Cacioppo et al., 2015; Mann et al., 2017). This may be particularly beneficial among older adults as a recent meta-analysis found that age moderated the relationship between PTSD treatment and outcome among individuals who have experienced complex interpersonal trauma, with older age being associated with lower effect sizes for the reduction of PTSD symptoms (Mahoney et al., 2019). Therefore, it may be useful to target factors that are more prevalent with older age, for example, older adults become increasingly vulnerable to emotional loneliness as they age (Ó'Luanaigh & Lawlor, 2008). Given the strong relationship between emotional loneliness and the DSO symptoms among older adults, incorporating elements of loneliness-based treatments into CPTSD treatments may address the moderating effect of age. Furthermore, previous research (Vasilopoulou et al., 2020) among older adults has found an indirect effect between childhood trauma and CPTSD symptoms via early maladaptive schemas.

These are defined as pervasive themes, developed during childhood, concerning oneself and their relationship with others such as mistrust in relationships and fear of abandonment and alienation (Young et al., 2003). Incorporating elements of loneliness-based interventions may be useful in addressing these maladaptive schemas by targeting negative cognitive biases, such as a lack of trust in interpersonal relationships, and automatic negative thoughts about social interactions, which may lead to a reduction in CPTSD symptoms.

Similarly, if it is the case that changes in PTSD and CPTSD symptoms lead to changes in feelings of loneliness, then it may be possible that interventions targeted at reducing PTSD/CPTSD symptoms may be effective in preventing loneliness. This might be particularly pertinent regarding treatments such as cognitive behavioural therapies (CBT) that have been found to be effective among older adults (Dinnen et al., 2015). For example, Cognitive Processing Therapy (CPT; Resick & Schnicke, 1992) aims to address dysfunctional thinking patterns about the world and others and help the individual to develop healthy and adaptive thinking styles. It is possible that addressing negative cognitions associated with trauma, such as distrust of others, may also address the negative cognitions associated with loneliness. This is similar to the approach taken in some loneliness interventions, including those that aim to address maladaptive social cognitions about others and negative automatic thoughts regarding social interactions (Cacioppo et al., 2015; Mann et al., 2017; Masi et al., 2011).

Given the strong positive association found between loneliness and CPTSD symptomatology and the longitudinal association found between PTSD and loneliness, it is possible that interventions designed to target PTSD/CPTSD symptoms might also address feelings of loneliness. This suggests that loneliness interventions might benefit from incorporating elements of interventions that target PTSD/CPTSD symptoms. This may be particularly important in developing/adapting new methods of reducing loneliness, as findings from meta-analyses on loneliness interventions note that the effectiveness of current interventions is somewhat limited (Jarvis et al., 2020; Mann et al., 2017). One such approach may be to incorporate elements of Rational Emotive Behaviour Therapy (REBT). REBT aims to address ‘irrational beliefs’ (e.g. negative evaluations of oneself, others, or the world) that are associated with trauma and PTSD symptomatology (Hyland et al., 2014; Woo & Sharma-Patel, 2019), and adapt these beliefs to more healthy ‘rational beliefs’ (e.g. flexible and realistic evaluations of oneself, others, or the world). It stands to reason that treating possible irrational beliefs associated with others and social interactions may help alleviate feelings of loneliness. Recent findings (Hyland, McGinty et al., 2019) have demonstrated that loneliness can be effectively modelled within an REBT framework. As such, it is possible that including REBT elements within loneliness-based interventions that aim to address irrational social beliefs associated with loneliness may be an effective means to enhancing the current interventions that target loneliness.

7.4. Limitations and Strengths

There are several important limitations that should be considered when drawing conclusions from the present thesis. First, all studies used non-clinical samples. Therefore, the findings regarding PTSD may not be generalisable to clinical, in-patient settings. It is important that future research addresses this limitation by replicating these studies using clinical samples. Second, Chapter 3 and Chapter 4 used items drawn from the AUDADIS-5 (Grant et al., 2011) - a structured, diagnostic interview for multiple psychiatric disorders, including PTSD, based on the *DSM-5* guidelines - to represent the *ICD-11* symptoms of PTSD. There are some very subtle differences between these items and those contained in the ITQ (Cloitre et al., 2018) which was specifically designed to capture the *ICD-11* symptoms of PTSD and CPTSD. This measure also did not include items relating to the functional impairment criterion that is a component of the diagnostic algorithm of PTSD in the *DSM-5* and the *ICD-11*. Therefore, the estimated prevalence rates of PTSD reported in these chapter are likely to be somewhat overestimated. Future studies should aim to replicate these findings using measures specifically designed to capture the *ICD-11* PTSD diagnostic criteria and also include items that reflect the functional impairment criterion. Third, as the data used within Chapter 4 and Chapter 6 were cross-sectional, it was not possible to make any inferences regarding the temporal separation of the constructs measured. Future research would benefit from advancing the work described in Chapter 4 by using longitudinal data as this would permit inferences regarding the onset of comorbid psychopathology associated with PTSD. Similarly, future research should aim to advance the work described in Chapter 6 by using longitudinal data to determine the precise temporal ordering of loneliness and CPTSD/PTSD symptomatology. Moreover, although two waves of longitudinal data were used in Chapter 5, future studies should aim to include additional waves of data in order to better delineate the precise pathways between loneliness and PTSD. Fourth, the age at which a traumatic event occurred, and the age-of-onset of PTSD symptomatology were not assessed. Therefore, it was not possible to distinguish between older adults who presented with chronic PTSD, re-emergent PTSD symptoms, delayed/late-onset PTSD, or late-life PTSD (whereby both the index trauma and PTSD symptom manifestation occurred in later life). Therefore, future research should include measures that assess the timing of the traumatic events and onset of PTSD symptomatology.

Despite these limitations, the current thesis also had a number of strengths. First, a major strength of this thesis was the use of multiple large-scale, nationally representative samples of older adults. Given the complex designs and weighting applied to these datasets, these findings can be generalised to the wider population with a high degree of confidence. Second, the use of multiple waves of data in Chapter 5 allowed for the examination of a longitudinal association between loneliness and PTSD symptoms. Third, each empirical chapter employed a sophisticated analytic approach. For example, each study used latent variable modelling procedures that allow for more accurate parameter estimation. This use of latent variable modelling, in combination with large-scale, nationally representative datasets improves the confidence one can have in the findings of the present thesis.

7.5. Future Directions

The present work highlights several important areas of the literature pertaining to PTSD in later life that should be addressed in future research. First, it would be quite beneficial to examine the factorial validity of the CPTSD construct and item-bias across sex (e.g. through DIF analysis) among older adults. This would determine whether the current model of CPTSD is valid and unbiased among older adults. This was partially addressed in Chapter 3 as the *ICD-11* PTSD model was found to be valid and unbiased across sex among older adults, and also partially addressed in Chapter 6 as the current model CPTSD was found to be valid among adults aged 60–70 years. However, it is important that future research addresses the gap in the literature regarding CPTSD among adults older than 70 years and identifies any potential source of systematic bias in this model.

Second, it would be of great clinical benefit to examine the patterns of both PTSD and CPTSD diagnostic psychiatric comorbidity in later life, and the variables that predict such patterns. This would allow for one to determine whether distinct subclasses of PTSD/CPTSD comorbidity exist and the risk factors associated with each class. Moreover, researchers should try to examine this using longitudinal data in order to infer the temporal ordering of the relationship between PTSD/CPTSD and their comorbid disorders (i.e. identifying which disorders are antecedents of PTSD/CPTSD and which disorders develop subsequent to PTSD/CPTSD).

Third, future studies should aim to examine the relationship between loneliness and PTSD/CPTSD symptoms using longitudinal data consisting of more than two waves. The use of additional waves would make it possible to effectively delineate the precise pathways/mechanisms that explain the relationship between PTSD/CPTSD and loneliness. For example, one could investigate pathways such as social withdrawal. Loneliness can lead to social withdrawal (Hawkley & Cacioppo, 2010) which can predict increased PTSD severity (Thompson et al., 2018). Moreover, social withdrawal as an avoidant coping strategy may lead to the maintenance of PTSD symptoms by inhibiting individuals from appropriately processing their fear response following trauma (Thompson et al., 2018). However, it is only possible to test a pathway such as this using longitudinal data. Furthermore, the use of longitudinal data would allow one to infer the temporal ordering of the relationship PTSD/CPTSD and loneliness and determine whether the relationship is unidirectional or bidirectional.

Fourth, symptoms of PTSD have been found to fluctuate and re-emerge for some in later life (Chopra et al. 2014), possibly due to age-related normative events such as retirement, bereavements, and worsening physical health (Pless Kaiser et al., 2019). Future research should aim to identify the variables that are associated with these symptom fluctuations in later life, using longitudinal data. Given that a longitudinal association was found between PTSD and loneliness in later life, it is possible that loneliness is associated with these symptom fluctuations. Using longitudinal data would allow one to examine whether loneliness predicts or is caused by these fluctuations in PTSD, and possibly CPTSD, symptoms. Identifying the variables associated with fluctuations in PTSD/CPTSD symptoms may have important clinical implications for determining markers associated with psychopathology in later life.

Fifth, future research should aim to include measures that assess the timing of the traumatic events and onset of PTSD symptomatology. For example, whether the event occurred in early adulthood or later in life. This will allow one to determine the age-of-onset of the PTSD symptoms. This will aid in discerning between those with chronic PTSD in later life, those with re-emergent PTSD symptoms (whereby PTSD symptoms initially decreased before re-emerging in later life), those with delayed/late-onset PTSD (e.g., those who experienced a traumatic event in early adulthood but did not experience PTSD symptoms until later life), and those who experience a traumatic event in later life which consequently leads to the development of late-life PTSD. To further understand how PTSD manifests in older adults, it would be of clinical interest to examine differences across these groups in order to identify differences in symptom profiles, predictors, and correlates of PTSD in later life (e.g., Desmarais et al., 2020; Horesh et al., 2013; Mota et al., 2016). In addition, examining differences across different trauma types and severity may be important, as older adults who report experiencing their most stressful traumatic event during childhood have been found to exhibit more severe PTSD symptomatology in later life, compared to older adults who reported experiencing their most stressful traumatic event in adulthood (Ogle et al., 2013).

Sixth, future research should include more extensive methods at examining age-based comparisons to provide a greater understanding as to whether PTSD/CPTSD manifests similarly in older adults, compared to their younger counterparts. This can be achieved through the use of measurement invariance testing. Determining whether a measure is invariant or non-invariant across groups has important implications for accurately examining any differences that may exist across these groups (Borsboom, 2006; Sass, 2011). Measurement invariance testing will aid in determining whether PTSD/CPTSD manifests in the same manner in older adults compared to younger age groups and will help in establishing whether measures of PTSD and CPTSD for older adults can be meaningfully compared with younger age groups.

7.6. Conclusion

This thesis was conducted to evaluate the structure, comorbidity, and correlates of posttraumatic stress responses in later life. In Chapter 3, evidence was found to suggest that PTSD manifests in the same manner in older adults as it does in the general adult population. This evidence is consistent with the implicit assumption within the *ICD-11* and *DSM-5* diagnostic systems that PTSD across the general adult population is effectively the same construct and is not qualitatively distinct in older adults. In other words, pertaining to PTSD and CPTSD, specifically, older adults are not uniquely distinct in how they present with the respective symptoms of these psychiatric disorders. This implies that the current diagnostic models of PTSD in the *ICD-11* and *DSM-5* are applicable to older adults. This further suggests that the difference in PTSD/CPTSD rates in older adults, relative to younger age groups, is quantitative rather than qualitative and that clinicians can use these models to diagnose PTSD with some confidence. Additionally, the *ICD-11* model of PTSD was found to be unbiased across sex, further highlighting that this model can be used in clinical settings with some degree of confidence.

In Chapter 4, PTSD was found to be highly comorbid with a range of psychiatric disorders. This addressed an important gap in the literature regarding PTSD comorbidity, most notably *ICD-11* PTSD comorbidity, in later life. Two distinct patterns of *ICD-11* PTSD psychiatric comorbidity were found in older adults, with those experiencing higher levels of PTSD comorbidity being associated with an increased risk of history of attempted suicide. These findings help clinicians identify the future psychiatric disorders that are more likely to manifest. This aids clinicians in monitoring their patient’s wellbeing over time and helps them to develop the necessary skills to mitigate the future development of additional psychiatric disorders. Furthermore, these findings demonstrate that a dimensional framework may be useful for clinicians and researchers in understanding the psychiatric comorbidity of PTSD.

The results of Chapter 5 revealed a longitudinal association between loneliness (social and emotional) and PTSD symptoms among older adults. Moreover, the results of Chapter 6 revealed an association between loneliness (both social and emotional) and CPTSD symptoms among older adults. These findings highlight the clinical importance of loneliness as a meaningful construct in later life. Clinicians should be aware of these associations between loneliness and PTSD/CPTSD symptomatology, as targeting feelings of loneliness in trauma-exposed older adults may be a useful means to preventing the onset of posttraumatic stress responses, and/or vice-versa, in later life. In addition, the results of Chapter 6 revealed that emotional, but not social, loneliness was associated with the core symptoms of *ICD-11* PTSD, whereas both emotional and social loneliness were associated with the additional symptoms of CPTSD. This finding highlights the qualitative differences between PTSD and CPTSD.

This thesis successfully attained its goals of making a substantive contribution to the traumatic stress literature by evaluating the structure, comorbidity, and corelates of posttraumatic stress responses in older adults. These findings can help to shape future research and clinical practices to further our understanding of posttraumatic stress responses in later life.

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