

FORGOTTEN WOUNDS

Recognizing and diagnosing PTSD in older
adults and those with dementia

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Colofon

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Forgotten wounds

Recognizing and diagnosing PTSD in older adults and those with dementia

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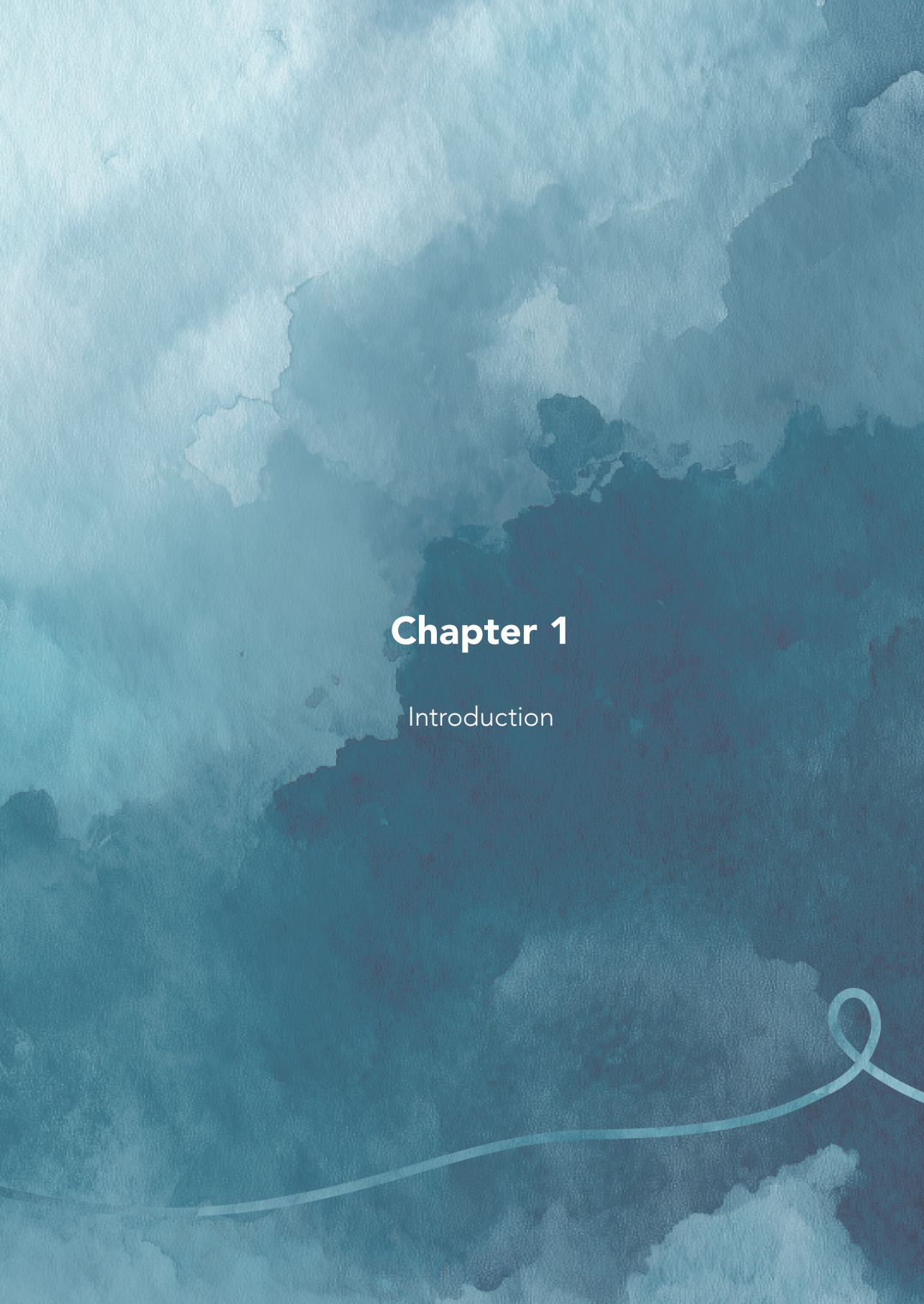
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Chapter 1

Introduction

Potentially traumatic events and PTSD

Most people experience potentially traumatic events (PTEs), such as an accident, violence or natural disaster [1]. After such events, people may experience feelings of shock, numbness, or anxiety. These emotional reactions are natural; however, PTEs can lead to a range of psychological and physical challenges, among which Posttraumatic Stress Disorder (PTSD) is the most well-known and extensively studied [1, 2]. PTSD is a chronic condition that arises following exposure to a PTE, characterized by symptoms such as flashbacks, nightmares, and intense anxiety that persist for more than a month and disrupt daily functioning [1]. Beyond PTSD, PTEs may contribute to issues like depression [2, 3], anxiety [2, 4], sleep disturbances [5, 6], substance abuse [7], or chronic health conditions [8], underscoring the broader impact PTEs can have on an individual's well-being.

Two prominent classification systems, the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and the International Classification of Diseases (ICD-11), are used to diagnose PTSD [1, 9]. The DSM-5, widely utilized in clinical practice and research, defines PTSD through detailed criteria focused on core symptoms such as intrusive memories, avoidance, negative mood alterations, and heightened arousal [1]. In contrast, the ICD-11 simplifies the diagnostic criteria, requiring only six symptoms to identify PTSD, aiming to reduce overlap with other conditions such as depression [10]. Despite these differences, the research of Fox et al. [11] indicates that a greater proportion of older adults meet DSM-5 criteria for PTSD compared to ICD-11 criteria. This discrepancy highlights the importance of carefully selecting diagnostic frameworks when studying PTSD, particularly in older populations.

The majority of the world's population, with prevalence rates between 70.4% to 88.7%, will encounter PTEs at some point in their lives [12-15]. However, not everyone exposed to PTEs develops long-term psychological complaints. Resilience, by definition, refers to the ability to adapt and recover in the face of adversity, making it a key factor in individual outcomes [16]. While many people naturally exhibit resilience and recover over time, others may struggle with the lasting effects of PTEs, leading to severe and debilitating conditions like PTSD [17].

The lifetime prevalence of PTSD in the general population ranges from 7.4% to 17.0% [14, 15, 18]. While PTSD has been extensively researched, especially in veterans, individual responses to PTEs vary due to factors such as demographics, social support, and prior PTEs. Understanding these dynamics is crucial for identifying people at risk and providing effective interventions.

PTSD in older adults

While PTSD is commonly associated with younger populations, it affects people across the lifespan, including older adults (>60 years). This is particularly true for those who experienced PTEs earlier in life. Research indicates that older adults who faced PTEs earlier in life are more likely to exhibit PTSD symptoms in later years compared to those who encountered PTEs during middle or later stages of life [19]. The prevalence of PTSD among older adults ranges from 2.3% to 5.5%, with an additional 7% to 13% experiencing partial PTSD [20, 21]. The study of Hoeboer et al. [15] found the conditional risk of lifetime PTSD of 4.7% in older adults (65-74 years) and 2.4% in older adults above 75 years old. These figures suggest a substantial population affected by PTSD, yet the actual prevalence rates may be underestimated.

Many older adults do not seek formal mental health services for PTSD, often presenting instead with physical health concerns in primary care settings, making PTSD difficult to identify [22]. Feelings of shame, not accurately identifying or acknowledging symptoms as PTSD symptoms, and difficulty expressing emotional distress further contribute to underdiagnosis [22-25]. Additionally, PTSD symptoms in older adults are frequently misattributed to normal aging processes or medical conditions, for example memory deficits, leading to missed opportunities for diagnosis and intervention [26, 27].

The aging process introduces unique stressors that can exacerbate or reignite PTE-related symptoms. Factors such as declining health, loss of loved ones, and major life transitions often interact with past PTEs, creating a complex interplay between historical and current stressors [22, 28].

The global aging population further emphasizes the need to address PTSD in older adults. The World Health Organization [29] projects that by 2050, the number of people aged 60 and older will double to 2.1 billion worldwide. Based on current prevalence rates of PTSD, this means that between 48.3 million and 115.5 million older adults may be affected globally. To put this into perspective, this figure represents at least 2.5 to 6 times the population of the Netherlands.

Addressing PTSD in this growing and vulnerable demographic necessitates a nuanced approach that considers the interplay between PTEs, aging, and the unique challenges faced by older adults. Besides, older adults often face an increase in comorbid conditions, including both somatic illnesses and neurodegenerative disorders [30]. However, while PTSD is a significant clinical concern in older adults, the available empirical research remains limited [22, 31, 32].

To understand how trauma symptoms can emerge or intensify later in life, the DSM-5 provides a clinical definition of the subtype delayed expression PTSD. This subtype specifies that the full diagnostic criteria for PTSD are not met until at least six months after the PTE [1]. In older adults, this form often surfaces when aging-related stressors, such as bereavement or health decline, undermine previously effective coping strategies [28]. In this dissertation, we adopt the DSM-5 definition of PTSD, including its delayed expression subtype, is adopted as the primary diagnostic framework. This approach enables consistent identification and comparison of clinically relevant PTSD cases across studies and supports the development of targeted assessment and treatment strategies for older adults.

PTSD in people with dementia

Dementia, defined as a progressive decline in cognitive function severe enough to disrupt daily life, predominantly affects older adults [33]. As life expectancy continues to rise, so does the number of people living with dementia. The World Health Organization [34] suggests that by 2030, the total number of people affected by dementia will reach 82 million, and this number will increase to 152 million by 2050. Despite this growing population, there is a significant gap in understanding the prevalence of PTSD in people with dementia. For example, while Sobczak et al. [35] reported PTSD prevalence rates between 4.7% and 7.8% among veterans with dementia, these findings are limited to specific populations and did not utilize diagnostic tools for PTSD assessment. This lack of valid, tailored diagnostic tools for people with dementia likely contributes to the underestimation of PTSD-dementia comorbidity rates.

Research suggests a bidirectional connection between PTSD and dementia. People with PTSD are nearly twice as likely to develop dementia compared to those without PTSD [36, 37]. This increased risk may be explained by chronic stress responses in PTSD, such as Hypothalamic–Pituitary–Adrenal (HPA)-axis dysregulation, elevated cortisol levels, and sleep disturbances, which can damage brain regions critical for memory and cognition [37]. Additionally, PTSD is often linked to other dementia risk factors, including depression, cardiovascular issues, and social isolation [38, 39]. On the other hand, as cognitive decline associated with dementia can, in turn, exacerbate PTSD symptoms. For example, theories suggest that people with dementia may experience heightened feelings of confusion, anxiety, or powerlessness in unfamiliar situations, such as in psychogeriatric departments in nursing homes, which can trigger traumatic memories and PTSD symptoms [35, 40, 41].

The recognition of PTSD in people with dementia is critical for establishing a treatment indication. A proper indication ensures that evidence-based treatments, such as trauma-informed approaches or therapies like Eye Movement Desensitization and Reprocessing (EMDR) and Cognitive Behavioral Therapy (CBT) can be considered and tailored to the individual's needs. Besides, an accurate diagnosis allows caregivers to better understand the possible root causes of challenging behaviors often seen in dementia patients, such as agitation or aggression, which may be linked to unresolved PTEs. By addressing PTSD in this population, caregivers can implement strategies that improve the interventions for people with dementia, fostering a more compassionate and effective care environment [42].

Challenges in diagnosing PTSD in people with dementia

Diagnosing PTSD in older adults is already challenging, but diagnosing PTSD in older adults with dementia is like solving a complex puzzle with multiple layers of difficulty [22, 43].

One critical challenge is the lack of validated diagnostic tools specifically tailored for assessing PTSD in people with dementia [42, 44]. Most existing instruments rely heavily on the ability of people to report symptoms, but dementia-related cognitive impairments, such as memory loss and reduced ability to articulate experiences, make accurate self-reporting increasingly unreliable as the condition progresses [45]. Consequently, clinicians often struggle to gather complete or accurate accounts of PTSD symptoms from patients, leading to underdiagnosis or misdiagnosis.

Furthermore, recounting life stories, a cornerstone of trauma-focused diagnostics, is particularly challenging for people with dementia [42]. Cognitive decline can impair the ability to provide coherent or chronological accounts of past events, making it harder to identify PTEs or PTSD triggers [46].

Neuropsychiatric symptoms (NPS) encompass a range of behavioral and psychological manifestations commonly observed in people with cognitive impairments, particularly those with dementia [47]. These symptoms include agitation, depression, anxiety, hallucinations, delusions, apathy, irritability, and sleep disturbances. The prevalence of NPS in people with dementia is notably high, with rates up to 90% [48]. The study by Cations et al. [49] found that referrals with a recorded history of PTEs were rated with a higher rate of both NPS severity and associated caregiver distress. PTSD symptoms such as

flashbacks or hyperarousal may manifest atypically in people with cognitive impairment and could be misinterpreted as NPS. For instance, flashbacks might be mistaken for hallucinations, which are frequent in certain types of dementia [50], while hyperarousal could present as agitation or aggression [51, 52]. This symptomatic overlap can lead clinicians to prioritize managing dementia-related behaviors (NPS) over investigating the potential presence of PTSD [53], resulting in incomplete or inappropriate treatment plans.

The presence of comorbid psychiatric disorders further complicates the clinical presentation of PTSD in people with dementia [43]. Depression and anxiety, which frequently co-occur in people with dementia, share overlapping symptoms with PTSD, such as emotional withdrawal, sleep disturbances, or hypervigilance [54-57]. These overlapping presentations make it difficult to distinguish PTSD from other disorders. For example, hypervigilance may be mistaken for generalized anxiety, while emotional numbing might be interpreted as a symptom of depression [58].

In conclusion, there is a critical need for improving the recognition and diagnosis of PTSD in older adults (>60 years), particularly those with dementia. PTEs lasting impact often reemerges or evolves later in life, influenced by aging-related stressors, health decline, and significant life transitions. For people with dementia, PTSD symptoms frequently overlap with neuropsychiatric symptoms or other psychiatric comorbidities, leading to misdiagnosis or underdiagnosis. Behaviors such as agitation, wandering, and hallucinations are often attributed solely to dementia, overlooking the role of unresolved PTEs. The lack of validated diagnostic tools specifically designed for this population further complicates the clinical picture. The result of misdiagnosis or underdiagnosis is that people may not receive the treatment they need. With the anticipated growth in the global aging and dementia population and the scarcity of empirical research, addressing PTSD in older adults has become a pressing priority. By understanding the unique challenges and needs of this population, we can ensure that people receive an accurate PTSD diagnosis, and the next step being establishing an appropriate treatment indication.

Outline and aims of this dissertation

This dissertation aims to contribute to the recognition and diagnosis of PTSD across the adult lifespan, with a particular emphasis on older adults (>60 years) and those with dementia. Improving recognition and diagnosis is a crucial first step toward ensuring that these people receive the appropriate treatment indication, allowing them access to interventions that address their specific needs. The chapters in this dissertation explore different aspects of PTSD in later life, ranging from challenges in diagnosing PTSD in older adults to the often-overlooked connection between PTSD and cognitive decline. Besides focusing on how PTSD presents and how it can be identified, I also aimed to examine the risk factors that may increase the likelihood of developing dementia in people with PTSD. These insights provide a broader understanding of the diagnostic complexity and underline the need for a more tailored and holistic approach across various care contexts. By addressing these diverse aspects, the research seeks to inform a better approach for this population.

The title of this dissertation, *Forgotten Wounds*, reflects the central themes running through these chapters. It highlights how society often forgets that older adults can suffer from PTSD symptoms, mistakenly assuming PTEs are less relevant in later life, and reflects the forgetting of memories in people with dementia. Additionally, it emphasizes that these “forgotten wounds” are still wounds, deep and impactful, and, like any wound, they require healing and care. It serves as a reminder that even if these wounds are hidden or “forgotten”, they should not be ignored.

In **Chapter 2**, a cross-sectional study is conducted using the Global Psychotrauma Screen (GPS) questionnaire among 7,034 participants from 88 countries. The study aims to investigate whether the impact of PTEs on trauma-related symptoms changes across the adult lifespan (from 16 to 100 years old) and if this association differs for self-reported COVID-19-related PTEs compared to other PTEs.

Chapter 3 presents a systematic review focused on the psychometric properties of PTSD instruments in older adults. The objective of this systematic review is to provide a comprehensive summary of the diagnostic accuracy of PTSD screening and diagnostic instruments tailored for older adults.

In **Chapter 4**, we conduct a systematic review and meta-analysis to explore the connection between PTSD and dementia, as well as potential contributing moderators. This review aims to provide a comprehensive overview, not only

of how PTSD may influence the development of dementia but also of other elements that could play a role in this process.

Chapter 5 describes the protocol of the prospective multi-center TRAuma and DEmentia-study (TRADE-study). The study is divided into two parts. Study A aims to identify and diagnose PTSD in people with dementia. Study B aims to investigate the feasibility of EMDR treatment for this population.

Chapter 6 contains a systematic literature review that covers 13 papers describing 30 cases of PTSD and dementia. This review aims to provide insight into the clinical diagnosis of PTSD in people with dementia by evaluating the clinical presentation of PTSD and other relevant symptoms in this population.

Chapter 7 presents a Delphi study findings among 20 Dutch and 6 international experts in the field of PTSD and/or dementia care or research. The article's aim is to achieve consensus in 3 rounds on the added value, form, content, and application for developing an instrument to diagnose PTSD in people with dementia.

Chapter 8 outlines the importance and possibility of conducting research on PTSD in people with dementia who reside in nursing homes. The article discusses the potential treatment options and care strategies for people with both PTSD and dementia in nursing homes, using a specific case to illustrate practical applications of the information.

Finally, the results of this thesis are discussed in **Chapter 9**, followed by the clinical implications of the study results, methodological considerations and future research directions on PTSD in older adults and people with dementia.

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Clinical vignette: Jan [part 1]

Introduction

Jan is an 88-year-old man who has been living in a nursing home within a specialized dementia care unit for the past six years due to his advancing Alzheimer's dementia. His diagnosis was established eight years ago by a multidisciplinary team based on progressive memory loss, disorientation, and difficulties with daily functioning, consistent with the criteria for Alzheimer's disease. In addition to dementia, Jan has several somatic conditions that require care and may influence his behavior. He has type 2 diabetes, managed with oral medication, and hypertension, which requires regular monitoring and treatment. These somatic conditions increase his vulnerability to complications such as infections and further cognitive decline. Jan's psychiatric history reveals no prior diagnosis of mental illness; however, his dementia has been accompanied by neuropsychiatric symptoms, including anxiety and occasional agitation.

He was born and raised in a small Dutch village as the middle child in a family of five. His upbringing in a warm and close-knit family instilled in him a strong work ethic and a deep appreciation for the outdoors—values that shaped his life and career. After completing technical training, Jan worked as a carpenter for over 40 years, earning a reputation for his meticulous craftsmanship. Beyond his work, Jan found joy in gardening, fishing, and spending time in his workshop, where he enjoyed repairing and creating small projects. These activities provided him with a sense of peace and fulfillment. Jan married his first love, Maria, and together they built a loving family that grew to include four children and several grandchildren.

Despite his fulfilling life, the onset of dementia at the age of 70 brought significant challenges, and Maria, facing her own health issues, found it increasingly difficult to provide the necessary care. After much deliberation, the family decided to admit Jan to a nursing home, ensuring he could receive the professional support he needed.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.



Chapter 2

The mental health impact of the COVID-19
pandemic and exposure to other potentially
traumatic events up to old age

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Abstract

We investigated whether the impact of potentially traumatic events (PTEs) on trauma-related symptoms changes across the transitional adult lifespan (i.e., 16–100 years old) and if this association differs for self-reported COVID-19–related PTEs compared to other PTEs. A web-based cross-sectional study was conducted among 7,034 participants from 88 countries between late April and October 2020. Participants completed the Global Psychotrauma Screen (GPS), a self-report questionnaire assessing trauma-related symptoms. Data were analyzed using linear and logistic regression analyses and general linear models. We found that older age was associated with lower GPS total symptom scores, $B = -0.02$, $p < .001$; this association remained significant but was substantially weaker for self-reported COVID-19–related PTEs compared to other PTEs, $B = 0.02$, $p = .009$. The results suggest an association between older age and lower ratings of trauma-related symptoms on the GPS, indicating a blunted symptom presentation. This age-related trend was smaller for self-reported COVID-19–related PTEs compared to other PTEs, reflecting the relatively higher impact of the COVID-19 pandemic on older adults.

Introduction

Traumatic stress is an emergent global issue [1]. With a prevalence rate ranging from 70.4% to 88.7%, the majority of the world's population will experience a potentially traumatic event (PTE) during their life [2, 3]. In a recent study involving 24 countries, over 70% of participants reported exposure to at least one PTE, and 30.5% of the participants who reported exposure to at least one PTE experienced four or more PTEs in their lifetime [4].

The effects of PTEs, which can be experienced directly or indirectly, on mental health are well-documented. A study by Riedl et al. [5] demonstrated an association between PTE exposure and an increased likelihood of developing posttraumatic stress disorder (PTSD); however, Wisco et al. [6] only found an association between direct PTE exposure and an increased likelihood of PTSD. PTEs are also associated with adverse physical and mental health outcomes, such as depressive disorders [5, 7], sleep disturbances [8, 9], anxiety disorders [5, 10], and substance misuse [11]. The Global Collaboration on Traumatic Stress (GCTS) a committee consisting of psychotrauma researchers and clinicians from several parts of the world [12], developed the Global Psychotrauma Screen (GPS; [13, 14] to cross-culturally screen for a wide range of trauma-related symptoms that may emerge after PTE exposure.

The life-threatening coronavirus disease 2019 (COVID-19) pandemic has been identified as a PTE [15] and may produce a wide range of mental health problems (e.g., depression, anxiety disorders, sleep disorders) stemming from pandemic-related events such as sickness, isolation, losing loved ones, and fear for one's life [16-18]. However, these experiences may not meet PTSD Criterion A as outlined in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; [19]), which has diagnostic implications [20, 21]. Notwithstanding this failure to meet Criterion A, Bridgland et al. [22] found that among participants who were asked to report PTSD symptoms they attributed to the COVID-19 pandemic, 13.2% of the sample met the criteria for probable PTSD [19]. Moreover, Horesh et al. [23] concluded that COVID-19 should be viewed from the perspective of trauma because it will most certainly lead to stress-related mental health issues. In adults, COVID-19-related events have been shown to be associated with more severe trauma-related symptoms than other PTEs [24]. However, the findings from studies examining age differences in COVID-19-related mental health problems have been mixed. In two studies, younger adults reported more mental health problems compared with older adults [25, 26], whereas other studies have reported the opposite [27, 28]. Although older people are considered to be more vulnerable, they seem to adapt better to pandemic-related containment measures [29, 30]. Outside of the pandemic

context, epidemiological studies have consistently shown that current and lifetime PTSD are less prevalent among older adults than in other age groups [4, 31]. Yet, several studies have found higher prevalence rates for subthreshold PTSD symptoms in older adults than their younger counterparts [32, 33].

To improve knowledge on the psychological impact of PTEs across the transitional adult lifespan, we aimed to investigate whether the impact of PTEs on trauma-related symptoms differed by age in a global sample of participants between 16 and 100 years old. Furthermore, we investigated whether this association was different for self-reported COVID-19-related PTEs compared to other PTEs. Owing to the mixed findings in the literature, two-sided tests were performed to consider both possibilities of older and younger adults showing higher symptom levels.

Method

Participants and procedure

For this cross-sectional study, a convenience sample of participants was recruited to complete a web-based survey. Data were collected online between April 25 and November 30, 2020. Individuals were eligible if they were 16 years of age or older, were able to read and write, and had been exposed to at least one event they considered to be frightening, horrible, or traumatic. Eligible participants completed the GPS via a web app or using a PDF version that was available upon request from the GCTS. To recruit more older adults, we approached individuals residing in Dutch nursing homes; approximately 10 participants were recruited that way. There were no reports of older participants having problems completing the questionnaire online. The GPS is available in 35 different languages, allowing participants to choose their preferred language. Several studies have found that the GPS is quick and easy to administer [13].

All procedures were approved by the Medical Ethical Review Committee of the Academic Medical Center Amsterdam (W19_481 # 19.556). Informed consent was obtained at the beginning of the screening process by asking whether a participant accepted the terms of the agreement. No personal details that could identify respondents were stored. Participation was voluntary, and no financial or material reward was offered.

Measures

The self-report GPS [13] was used to assess a range of trauma-related symptoms that might result from PTE exposure (see the Supplementary Materials for the full measure). The GPS begins with demographic questions on gender, age,

and country of residence. Respondents were then asked to provide a short description of the PTE that currently affects them most and indicate whether this PTE included any of the following, choosing as many answers as were applicable: physical violence, sexual violence, emotional abuse, serious injury, threat to life, sudden death of a loved one, respondent having caused harm to someone else, and COVID-19. Participants were considered to have met DSM-5 PTSD Criterion A if they indicated that the PTE concerned physical violence, sexual violence, or serious injury to one's self or another person; was life-threatening to one's self or another person; included the sudden death of a loved one; or entailed the respondent causing harm to another person. When a respondent endorsed both COVID-19 and physical abuse, the response was coded as having experienced COVID-19-related physical abuse (e.g., physical abuse committed by an intimate partner during a COVID-19 lockdown). In addition, participants were asked whether the PTE comprised a single event or happened multiple times or over a longer period. After identifying a PTE, participants were asked to report whether they had experienced trauma-related symptoms stemming from the PTE in the past month. The GPS consists of 22 dichotomous (i.e., "yes" or "no") questions covering both trauma-related symptoms (17 items) and risk factors and protective factors (i.e., other stressful events, childhood trauma, history of mental illness, social support, psychological resilience; five items). Trauma-related symptom items cover the PTSD subdomains (five items), anxiety symptoms (two items), depressive symptoms (two items), insomnia (one item), self-harm (one item), disturbances in self-organization (DSO; two items), dissociation (two items), substance abuse (one item), and other stress-related problems (i.e., physical, emotional, and social problems; one item). The final question requires participants to rate their current level of functioning on a scale from 1 (*poor*) to 10 (*excellent*). A total symptom score is calculated by summing the 17 transdiagnostic trauma-related symptom items (range: 0–17). GPS subdomain scores are calculated by summing the items related to each subdomain. Based on previous studies, clinical cutoff scores for the different subdomains have been proposed (see Supplementary Material). Previous validation studies for the general population have shown good internal consistency (i.e., Cronbach's alpha values of .83 and higher) and convergent validity for the full scale [13, 34, 35]. In the present sample, Cronbach's alpha for the GPS total symptom score was .88, indicating very good internal consistency. Cronbach's alpha values for the GPS total symptom score and subdomain scores for different age groups are reported in the Supplementary Materials.

Data analysis

Data were exported to IBM SPSS Statistics (Version 26) and R for statistical analysis. There were some missing data for age (0.2%), the age at which the identified traumatic event occurred (5.3%), work-relatedness of the event (14.7%),

and event frequency (18.2%). These data were imputed using random forests with R package *missforest* (normalized root mean squared error = .33, proportion of falsely classified entries = .11). This method has some advantages in that it can handle any type of input data and makes as few as possible assumptions about the structural aspects of the data [36]. Cronbach's alpha coefficients were calculated to assess the internal consistency across ages, as the GPS has not yet been validated with older adults. Based on theoretical consideration, the following covariates were added in all analyses [37, 38]: number of risk and protective factors (i.e., other stressful event exposure, childhood trauma exposure, history of mental illness, social support, and psychological resilience), COVID-19–relatedness of the event, work-relatedness of the event, and respondent gender. A two-sided *p*-value of .05 was considered significant for all statistical tests. No adjustment was made for multiple testing. In total, we conducted 20 tests, including two main analyses, 14 subanalyses, one sensitivity analysis, and three post hoc sensitivity analyses.

A linear regression analysis was performed to assess the association between age and GPS total symptom score, with GPS total symptom score entered as the dependent variable and covariates (i.e., gender, work-relatedness, risk and protective factors, COVID-19–relatedness) and age as independent variables. To assess the impact of age on GPS subdomain scores, regression analyses were performed for interval subdomains (i.e., PTSD, anxiety, and depressive symptoms) and dichotomous subdomains (i.e., insomnia, self-harm, substance abuse, and other stress-related problems).

To assess whether the impact of age on GPS total symptom score differed for COVID-19–related events versus other stressful events, a linear regression analysis was performed with GPS total symptom score as the dependent variable and covariates (i.e., gender, work-relatedness, risk and protective factors, and COVID-19–relatedness), age, and the interaction effect of age and event type (i.e., COVID-19–related PTE vs. other PTEs) as independent variables. Second, to assess whether the impact of age on GPS subdomain scores differed for COVID-19–related PTEs versus other stressful events, logistic regression analyses were performed with GPS subdomain scores entered as the dependent variables and age, covariates, and the interaction effect of age and event type entered as independent variables.

Finally, a sensitivity analysis was performed to assess potential confounding as a result of the skewed age distribution of the sample (i.e., a higher proportion of young participants than older participants). We compared GPS total symptom scores for participants aged 16–65 years with those aged 66 years and older as well as between participants 70 years and younger and those aged 71 and older.

These age groups were chosen because there is a lack of clarity in the literature about the age from which someone is regarded as an “older adult.” Note that the age groups are very similar except that in the second analysis, participants between 66 and 70 years old were also included ($n = 133$). We assessed whether the association between age categorization (i.e., 66 years and older or 71 years and older) and GPS total symptom score differed for self-reported COVID-19–related PTEs compared to other PTEs. Finally, we performed three post hoc sensitivity analyses to assess whether the results of the main analysis (i.e., the linear regression analysis) were influenced by participants who did not meet DSM-5 PTSD Criterion A, gender, or time of recruitment.

Results

Demographic characteristics

The demographic characteristics of the study participants are reported in Table 1. A total of 7,034 participants from 88 countries completed the survey. The average respondent age was 38.00 years ($SD = 14.36$), and the sample was predominantly female (74.0%). Most participants came from Europe (45.5%) and Asia (29.3%). Approximately one quarter of the sample reported exposure to COVID-19–related PTEs (26.1%), and these rates were similar for men (27.3%) and women (25.8%). The types of both COVID-19–related PTEs and other traumatic events reported across the age groups (16–65 years and 65 years and older) can be found in the Supplementary Materials.

Table 1. Demographic characteristics of the study participants

Variable	<i>M</i>	<i>Range</i>
Age (years)	38.5	16.0–100.0
	<i>n</i>	<i>%</i>
Age range (years)		
16–25	1,494	21.2
26–35	1,984	28.2
36–45	1,537	21.9
46–55	1,021	14.5
56–65	666	9.5
66–70	133	2.0
71–75	85	1.1
> 75	111	1.6

Table 1. Demographic characteristics of the study participants (continued)

Variable	M	Range
Gender		
Male	1,775	25.2
Female	5,208	74.0
Other	51	0.7
U.N. region		
Africa	268	3.9
Latin America (Southern America, Central America, Mexico and the Caribbean)	830	12.1
Northern America	517	7.6
Eastern Asia	624	9.1
Southeastern Asia	504	7.4
Southern Asia	170	2.5
Western Asia	707	10.3
Eastern Europe	745	10.9
Northern Europe	237	3.5
Southern Europe	1,053	15.4
Western Europe	1,075	15.7
Australia/New Zealand	117	1.7
PTE category		
COVID-19–related	1,838	26.1
Other PTEs	5,196	73.9

Note: N = 7,034. U.N. = United Nations; PTE = potentially traumatic event.

GPS total symptom and subdomain scores

Participants' GPS total symptom and subdomain scores for self-reported COVID-19–related and other PTEs are shown in Tables 3 and 4. The mean GPS total symptom scores were 7.76 ($SD = 4.40$) for self-reported COVID-19–related PTEs and 7.28 ($SD = 4.79$) for other PTEs (see Table 2). Women had higher mean GPS total symptom scores for both self-reported COVID-related PTEs ($M = 8.20$, $SD = 4.33$) and other PTEs ($M = 7.76$, $SD = 4.68$) compared to men ($M = 6.49$, $SD = 4.34$ and $M = 5.69$, $SD = 4.73$, respectively). Post hoc analyses showed similar GPS total symptom scores for self-reported COVID-19–related PTEs for

participants recruited between April and July 2020 ($M = 7.81$, $SD = 4.37$) and those recruited between August and November 2020 ($M = 7.61$, $SD = 4.47$).

Table 2. Global Psychotrauma Screen (GPS) total symptom and subdomain score or endorsement for self-reported potentially traumatic events (PTEs), by PTE category

Scale	COVID-19-related PTEs					Other PTEs			
	Score range	M	SD	n	%	M	SD	n	%
GPS total symptoms	0–17	7.76	4.40			7.28	4.79		
GPS subdomain									
PTSD ^a	0–1	0.50	0.33			0.47	0.35		
Depression ^a	0–1	0.61	0.42			0.55	0.43		
Anxiety ^a	0–1	0.66	0.39			0.59	0.42		
Substance abuse ^b	0–1			473	25.7			1,529	29.4
Other problems ^b	0–1			963	52.4			2,684	51.7
Insomnia ^b	0–1			1,037	56.4			2,778	53.5
Self-harm ^b	0–1			133	7.2			481	9.3

Note: PTSD = posttraumatic stress disorder. ^aSubdomain has between two and five items. ^bSubdomain has one item.

Associations between age and GPS total symptom and subdomain scores

We found that age was negatively related to GPS total symptom scores, $B = -0.02$; $t(7,028) = -7.52$, $p < .001$, partial $r^2 = .005$. We also found that age was negatively related to subdomain scores for PTSD symptoms, $B = -0.001$, $t(7,028) = -5.04$, $p < .001$, partial $r^2 = .003$; depressive symptoms, $B = -0.002$, $t(7,028) = -5.50$, $p < .001$; partial $r^2 = .003$; anxiety symptoms, $B = -0.003$, $t(7,028) = -8.18$, $p < .001$, partial $r^2 = .008$; and self-harm, $B = -0.040$, $\chi^2(1, N=7,034) = 97.46$, $p < .001$, odds ratio (OR) = 0.96.

We found age to be positively related to subdomain scores for insomnia, $B = 0.009$, $\chi^2(1, N=7,034) = 28.20$, $p < .001$, OR = 1.01; and substance abuse, $B = 0.005$, $\chi^2(1, N=7,034) = 6.27$, $p = .008$, OR = 1.01; but unrelated to other problems, $p = .860$.

Table 3. Global Psychotrauma Screen (GPS) total symptom and posttraumatic stress disorder (PTSD), depression, and anxiety subdomain scores, by potentially traumatic event (PTE) category, across the transitional adult lifespan

Variable	Age (years)													
	16–25		26–35		36–45		46–55		56–65		66–75		> 75	
	Score	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
COVID-19-related PTEs														
GPS total symptoms	0–17	8.86	4.45	7.62	4.48	7.77	4.21	7.40	4.11	7.17	4.44	7.30	3.98	6.23
PTSD	0–1	0.58	0.34	0.49	0.33	0.51	0.31	0.47	0.33	0.47	0.32	0.52	0.29	0.37
Depression	0–1	0.69	0.38	0.60	0.42	0.60	0.43	0.57	0.42	0.58	0.42	0.59	0.42	0.46
Anxiety	0–1	0.74	0.37	0.67	0.39	0.69	0.37	0.63	0.39	0.59	0.42	0.57	0.43	0.48
Other PTEs														
GPS total symptoms	0–17	8.37	4.77	7.47	4.82	7.17	4.85	6.86	4.59	6.64	4.32	5.29	4.29	5.59
PTSD	0–1	0.54	0.34	0.48	0.35	0.46	0.35	0.45	0.34	0.43	0.32	0.35	0.31	0.42
Depression	0–1	0.61	0.42	0.57	0.42	0.55	0.43	0.50	0.44	0.51	0.44	0.41	0.44	0.40
Anxiety	0–1	0.67	0.40	0.61	0.42	0.57	0.42	0.56	0.42	0.53	0.40	0.46	0.42	0.43

Note. Each subdomain has between two and five items.

Table 4. Global Psychotrauma Screen (GPS) subdomain endorsement for substance abuse, other problems, insomnia, and self-harm, by potentially traumatic event (PTE) category, across the transitional adult lifespan

Variable	Age (years)											
	16-25		26-35		36-45		46-55		56-65		66-75	
	n	%	n	%	n	%	n	%	n	%	n	%
COVID-19-related PTEs												
Substance abuse	76	22.2	129	25.3	111	29.7	67	25.3	61	31.6	14	19.7
Other problems	182	53.1	257	50.5	196	52.4	140	52.8	93	48.2	41	57.7
Insomnia	184	53.6	270	53.0	216	57.8	171	64.5	110	57.0	42	59.2
Self-harm	60	17.5	29	5.7	16	4.3	10	3.8	11	5.7	1	1.4
Other PTEs												
Substance abuse	292	27.7	435	31.8	354	31.3	213	28.8	151	32.1	32	21.9
Other problems	627	59.4	721	52.7	546	48.3	379	51.2	232	49.4	59	40.4
Insomnia	587	55.6	695	50.8	610	54.0	413	55.8	273	58.1	77	52.7
Self-harm	186	17.6	113	8.3	98	8.7	38	5.1	14	3.0	3	2.1

Note: Each subdomain has one item, scored as 1 for the presence of a symptom or 0 for the absence.

Associations between age and GPS total symptom and subdomain scores for self-reported COVID-19-related PTEs and other PTEs

We found lower GPS total symptom scores among older participants. This association was substantially weaker, but remained significant, for self-reported COVID-19-related PTEs compared to other PTEs, $B = 0.02$, $t(7,027) = 2.47$, $p = .009$, partial $r^2 = .001$ (see Figure 1). The association between lower scores in older age for the subdomain PTSD was substantially weaker for self-reported COVID-19-related PTEs compared to other PTEs, $B = 0.001$, $t(7,027) = 2.13$, $p = .028$; partial $r^2 = .0005$. There was no association between age and PTSD scores for COVID-19-related PTEs, $p = .348$. We found higher insomnia subdomain scores for self-reported COVID-19-related PTEs compared to other PTEs among older participants, $B = 0.008$, $\chi^2(1, N=7,034) = 4.54$, $p = .026$, $OR = 1.008$, but the increase remained significant for both types of PTEs. Notably, although, on average, age was unrelated to other stress-related problems, we found a significant difference between self-reported COVID-19-related and other stressful PTEs, $B = 0.02$, $\chi^2(1, N=7,034) = 19.79$, $p < .001$, $OR = 1.02$, such that older age was positively associated with the endorsement of other problems for self-reported COVID-19-related events, $B = 0.01$, $\chi^2(1, N=7,034) = 14.64$, $p < .001$, $OR = 1.01$, but negatively associated with other problems for other stressful PTEs, $B = -0.005$, $\chi^2(1, N=7,034) = 5.13$, $p = .019$, $OR = .995$. We found no significant interaction effect between age and type of event for the anxiety, depression, and substance abuse subdomains.

Sensitivity analyses revealed that adults aged 65 years and older, $B = -.91$, $t(7,028) = -4.49$, $p < .001$, partial $r^2 = .002$, and those aged 70 and older, $B = -1.20$, $t(7,028) = -4.63$, $p < .001$, partial $r^2 = .002$, had lower GPS total symptom scores compared with younger adults. Notably, for both older age categories, the difference in GPS total symptom score was not significantly different for self-reported COVID-19-related PTEs compared to other PTEs. However, the scores for participants aged 66–75 were substantially higher for self-reported COVID-19-related PTEs compared to other PTEs (see Tables 3 and 4). This increase was not shown for participants aged 75 and older.

Post hoc sensitivity analyses revealed that both for the subset of participants who met DSM-5 PTSD Criterion A, $B = -0.03$, $t(4,667) = -7.37$, $p < .001$, partial $r^2 = .007$, and for all included participants, $B = -0.02$, $t(7,028) = -7.52$, $p < .001$, partial $r^2 = .005$, older age was related to lower GPS total symptom score. The decrease in GPS total symptom score with older age was significantly smaller for self-reported COVID-19-related PTEs compared to other PTEs for both the subset participants who met DSM-5 PTSD Criterion A, $B = 0.02$, $t(7,027) = 2.47$, $p = .014$, partial $r^2 = .001$, and for all included participants, $B = 0.02$, $t(4,666) = 2.20$, $p = .028$, partial $r^2 = .001$.



Figure 1. Global Psychotrauma Screen total symptom score as a function of age and potentially traumatic event (PTE) category

Discussion

This study used the GPS to assess the association between age and total symptom and subdomain scores for self-reported COVID-19–related PTEs and other types of trauma exposure. There were two main findings. First, we found that as age increased, GPS total symptom scores decreased. Second, we observed that the decrease in GPS total symptom scores associated with age was smaller for self-reported COVID-19–related PTEs compared to other PTEs. Notably, although we found that GPS total symptom and subdomain scores decreased with age and that the decrease was smaller for self-reported COVID-19–related PTEs, the effects of age on GPS total symptom scores and subdomain scores were all relatively small, partial r^2 s = .001–.02, ORs = .96–1.02 [39].

These findings are in line with existing evidence from epidemiological studies showing that PTSD symptom severity tends to decrease as adults age [31]. The results of the sensitivity analyses showed that the age difference was not

driven by the large number of young people in the sample. The lower GPS total symptom and subdomain scores for PTSD, depressive, and anxiety symptoms and self-harm in older adults are consistent with the well-documented data on older adults having a higher prevalence of subthreshold mental disorders (e.g., PTSD, depression) compared to younger adults ([40, 41]. A possible explanation might be that the clinical presentation in older adults with mental disorders may differ from that of other age groups [42, 43]. Older adults with PTSD report mostly symptoms of hyperarousal and a lower frequency of the core symptom of avoidance [44].

Although the low scores in the main analyses may be explained by a different symptom presentation in older adults, it is important to consider that many studies with older adult samples have reported similar findings of lower rates of PTSD and other mental disorders in this population [32, 33, 45, 46]. The finding that older adults in this sample more often experienced symptoms of insomnia is also consistent with the existing literature showing insomnia rates of around 70% in older adults [47]. This could be associated with the symptoms of hypervigilance and loneliness reported among older adults with PTSD [48] but could also be the result of normal changes in sleeping patterns in older age (e.g., an increased number and duration of awakenings and decreased amounts of deep slow-wave sleep [49]. In addition, the results show that older adults are more likely to have alcohol-related symptoms (i.e., substance abuse), which is in line with the literature. This may be explained by these individuals' declining ability to metabolize alcohol and an increased likelihood of needing treatment even if they do not meet the diagnostic criteria [50].

Women in the sample reported higher scores for both self-reported COVID-19-related PTEs and other PTEs, which is in line with previous studies [51-53]. Total GPS symptom scores were lower with increasing age, and this effect was smaller for other PTEs compared to self-reported COVID-19-related PTEs. We did not observe an interaction effect between age and event type for the anxiety, depression, and substance abuse subdomains. Research conducted pre-pandemic demonstrated a decline in overall PTSD in older adults, although no difference in the number of PTEs in comparison to other age groups was reported [48]. The findings on age differences in the association between COVID-19-related PTEs and mental health have been mixed. Pearman et al. [54] found that more COVID-19-related stress without proactive coping was associated with higher levels of anxiety in older adults compared to younger adults, whereas Minahan et al. [55] found that despite increased physical vulnerability to COVID-19, older adults had better psychosocial outcomes compared to younger adults.

Although older adults are thought to be more vulnerable to social isolation than their younger counterparts, they tend to display higher coping efficacy that relies on different control strategies (e.g., positive reappraisal instead of efforts to directly change a situation; [55-57]. In the present sample, age was related to higher levels of stress-related problems for self-reported COVID-19-related events, but it was associated with fewer problems for other stressful PTEs. The stronger decrease in PTSD symptom subdomain scores for other PTEs suggests that older adults are more vulnerable to the consequences of self-reported COVID-19-related PTEs than other PTEs. This result may be explained by the fact that the COVID-19 pandemic is unique, ongoing, and of a greater scale and magnitude than other PTEs. The ongoing nature of the pandemic may explain why self-reported COVID-19-related PTE symptom scores were higher than scores for other PTEs, that is, older adults may not have fully processed the impact of pandemic-related events [58]. In addition, not all included participants met the DSM-5 PTSD Criterion A; however, the results of the main analyses did not change when only individuals who met Criterion A were included.

Pre-pandemic research identified the cumulative effect of other PTEs as a strong predictor of PTSD in older adults [59]. Furthermore, Fox et al. [48] found that older adults reported PTEs that occurred in adulthood more frequently than those that occurred during childhood, whereas the reverse was true for younger age groups. During the pandemic, contact with friends, family, and caregivers was limited, and access to protective factors was blocked [60, 61]. In addition, older adults have a higher chance of dying from COVID-19 relative to younger adults, making COVID-19-related PTEs more life-threatening for this group [62]. Further research is needed to examine possible explanations for the differential impacts of self-reported COVID-19-related PTEs and other PTEs on mental health across the transitional adult lifespan.

Some limitations of this study should be considered. First, this study was based solely on self-report measures, which may cause difficulties for cognitively impaired populations [63], including older adults. Second, similar to any self-report study, we cannot be certain that every participant followed the instructions by reporting only one event. However, it is unlikely that this systematically influenced the results of the study. Third, younger individuals were relatively overrepresented, and a few regions were underrepresented (e.g., Africa [3.9%], and Australia and New Zealand [1.7%]). Selection bias may have resulted from a lack of internet access among older adults in poorer and remote regions or from the inability to master one or more of the possible languages, issues that may be less salient in younger adults [64]. A sensitivity analysis was performed, and the results pointed to the same directionality as the main analysis. Although the results for general trauma-related symptoms were

not driven by younger adults, this could be the case for some subscales, such as substance abuse. Moreover, it would have been interesting to investigate the oldest population (i.e., 80 years of age and older), but too few participants in this age range were recruited to separately assess this group. Finally, it is important to note that the internal consistency was low for the DSO (Cronbach's $\alpha = .491$) and dissociation (Cronbach's $\alpha = .57$) subdomains of the GPS; therefore, we excluded these subdomains in further analyses.

There have been two prior publications about the dataset used in the current study. Using partly overlapping data, Marengo et al. [53] found that language features extracted from respondents' textual answers together with some self-report information served reasonably well as a screening device for probable PTSD diagnosis, with good accuracy. Olff et al. [24], who also used the data, found that COVID-19-related PTEs led to more severe mental health symptoms compared to other PTEs in some world regions. More specifically, among Latin American respondents, COVID-19-related PTEs led to more severe mental health symptoms compared to other PTEs, whereas the opposite pattern was observed in Northern America. In the current study, we did not assess whether the association between older age and mental health symptoms differed by region because some regions included a relatively small sample that we did not want to break down further based on age categories.

This study used the GPS to assess the wide-ranging consequences of PTEs across the transitional adult lifespan in a global sample. The study results confirm that older age was related to overall lower transdiagnostic trauma-related stress symptoms and lower levels of specific symptoms related to PTSD, depression, anxiety, and self-harm. In contrast, higher-level insomnia and substance abuse symptoms were found in older adults. The findings indicate that the association between lower overall trauma-related symptoms and PTSD-specific symptoms was stronger for general PTEs than self-reported COVID-19-related PTEs among older adults. Thus, the COVID-19 pandemic seems to have a relatively more substantial impact on older adults than their younger counterparts. When examining GPS subdomains, a relatively higher impact of COVID-19-related PTEs was observed for insomnia and other problems, such as physical or social problems. Age did not appear to influence the association between event type and symptoms of anxiety, depression, or substance abuse.

Although COVID-19-related PTEs may have a more substantial impact on older compared with younger adults, trauma-related symptoms may not always be recognized due to their relatively different clinical presentations [44]. Therefore, it is important for practitioners to consider a range of symptom presentations and be mindful of the increased burden that COVID-19-related PTEs may put on

older adults. It may be beneficial to provide older adults who have experienced a COVID-19–related PTE or other types of PTEs with extra social activities; monitor their complaints; and, when necessary, offer relevant treatment, such as trauma-focused therapy.

Overall, although a recent and threatening event like COVID-19 may impact older adults' resilience, these individuals seem to be more resilient in coping with traumatic events than their younger counterparts; whether this is due to altered symptom presentations, life experience, or other factors requires further investigation. Additional research is needed with participants who are older than 65 years of age and those from regions such as Africa, as these populations are underrepresented in almost all available studies on PTEs. In addition, further research should focus on investigating the possible explanations for the differences between COVID-19–related PTEs and other PTEs across the transitional adult lifespan, such as altered symptom presentations and the influence of life experience.

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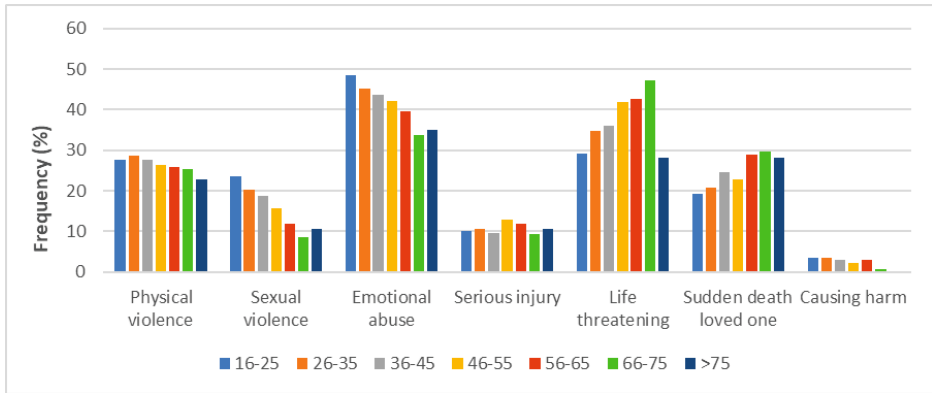
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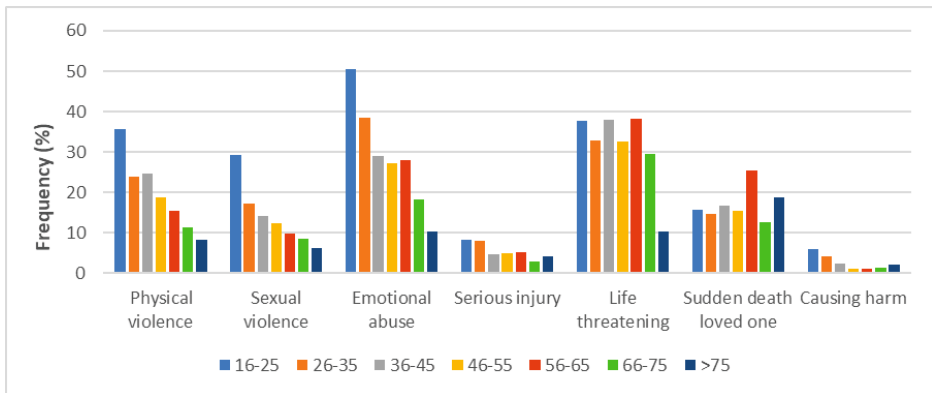
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Supplemental material



Appendix 1. Content of self-reported COVID-19 related PTEs across the transitional adult lifespan



Appendix 2. Content of other PTEs across the transitional adult lifespan

Appendix 3. Cronbach's alpha of the GPS total symptom and subdomain scores across the transitional adult lifespan

Cronbach's Alpha	Age groups						
	16-25	26-35	36-45	46-55	56-65	66-75	>75
GPS Total Symptom	.88	.88	.88	.87	.86	.86	.87
GPS* subdomain scores							
PTSD	.72	.73	.72	.71	.67	.66	.70
Depression	.62	.64	.69	.67	.69	.69	.66
Anxiety	.66	.67	.64	.60	.56	.65	.67

Appendix 4. GPS cutoff scores for the different subdomains

GPS subdomains	Scoring	Cutoff score
PTSD	Sum of items 1-5 (range 0-5)	3
Anxiety	Sum of items 8-9 (range 0-2)	1
Depression	Sum of items 10-11 (range 0-2)	1
Insomnia	Item 12 (range 0-1)	1
Self-harm	Item 13 (range 0-1)	1
Substance abuse	Item 18 (range 0-1)	1
Other problems	Item 16 (range 0-1)	1

Clinical vignette: Jan [part 2]

Introduction (continued)

Before moving into the nursing home, John was known as a reserved and somewhat distant man, but his family believed this to be part of his personality. Initially, Jan exhibited typical dementia-related symptoms, such as memory loss, confusion, and difficulty managing daily tasks. He struggled with simple daily activities, such as dressing and bathing, frequently forgetting where he was. However, as time passed, the nursing staff noticed an increase in certain neuropsychiatric symptoms and behaviors.

Hallucinations and screaming

During the day, Jan frequently experienced hallucinations, calling out and reacting to things that others could not see or hear. According to caregivers, he would sometimes shout unintelligibly or appear deeply distressed by what he perceived as reality. These episodes left him visibly agitated and added to the challenges of providing care.

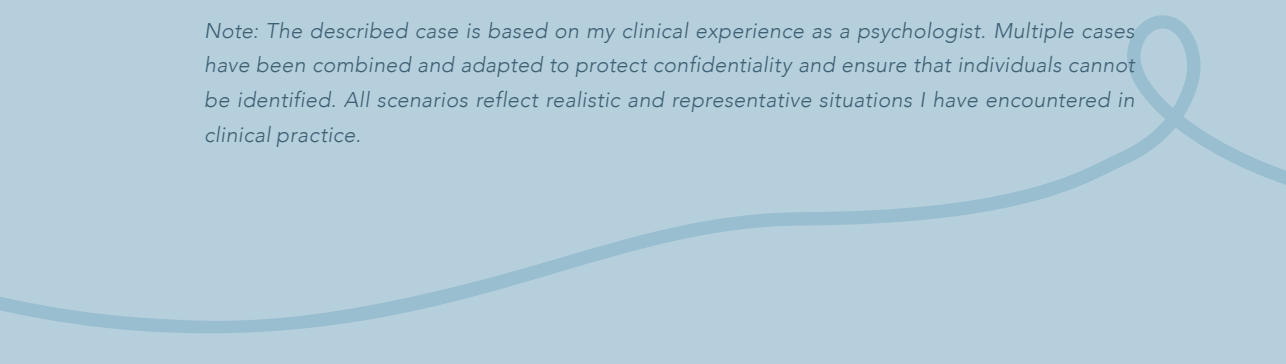
Agitation

Jan's agitation became more noticeable in noisy or crowded environments. Loud sounds or bustling activity in the nursing home often triggered irritability, and he would lash out verbally at caregivers, fellow residents, or even visiting family members. His unpredictable outbursts puzzled staff, who struggled to manage his behaviors effectively and sometimes felt frightened by his reactions.

Wandering and sleep disturbances

Jan experienced compulsive wandering, which was particularly severe during the night. He would roam the hallways restlessly, unable to settle or respond to redirection from caregivers. This nocturnal wandering resulted in poor sleep, leaving him fatigued and disoriented during the day.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.





Chapter 3

The Diagnostic Accuracy of PTSD Assessment Instruments Used in Older Adults: A Systematic Review

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Abstract

Background

As the number of older adults increases worldwide, understanding their mental health is crucial, including the impact of traumatic experiences that can lead to posttraumatic stress disorder (PTSD). However, validated screening and diagnostic instruments for PTSD in older adults are limited.

Objective

The objective of this systematic review is to provide a comprehensive summary of the diagnostic accuracy of PTSD screening and diagnostic instruments used in older adults ($M_{\text{age}} \geq 60$ years).

Method

A systematic search of MEDLINE, EMBASE, PsycINFO and Web of Science databases was conducted for January 1980 through January 10, 2025. All studies that focused on the psychometric properties of PTSD instruments in older adults were included.

Results

Out of 21,197 publications screened, only 40 studies including 24 instruments met the eligibility criteria. Only seven were conducted with participants from the general population or primary care patient samples. There were 14 relevant studies in the last ten years, with only six based on the Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-5) criteria. Validation studies conducted in non-Western and/or non-English speaking older adult samples are rare.

Conclusions

There is a shortage of validation studies of PTSD screening and diagnostic tools in the general older adult population. We recommend using the Clinician-Administered PTSD Scale for DSM-5 in clinical practice. It is the gold standard for assessing current and lifetime PTSD in the general population. Further research is required to establish evidence-based clinical cut-off scores and cross-cultural validity for PTSD screening in different populations of older adults. Future studies should also assess measures that consider the multimorbidity in this population (e.g., cognitive impairment and other psychiatric or medical disorders) and are easy to administer in clinical practice.

Introduction

Human life expectancy has been increasing, and by 2050 the number of individuals aged 60 years and older is expected to double, reaching 2.1 billion, worldwide [1]. As the population ages, expertise in mental health of older adults becomes increasingly important. One crucial aspect of mental health in older adults is the impact of current or past traumatic experiences [2]. Research suggests that the cumulative impact of trauma, over the life course, may increase susceptibility to the development of posttraumatic stress disorder (PTSD) [3, 4], therefore, older adults may be especially vulnerable to such outcomes simply because they have lived longer [4]. Thus, it is surprising that PTSD has an estimated lifetime prevalence of 7 - 8% in the general population [5-7] but a lower prevalence rate of 1 - 4.5% in the older adult general population of the U.S. and Europe [7-10]. Also, in a large global sample older age was found to be associated with lower ratings of trauma-related symptoms [11].

Several factors suggest that the lower reported rate of PTSD prevalence in older adults may be an underestimation. First, older adults may report lower rates of PTSD due to feelings of shame and/or worry about being judged for needing mental health support, preventing them from seeking care [12]. Additionally, less familiarity with symptoms and more difficulty with expressing psychological distress may make it challenging to report mental health difficulties [13, 14]. As a result, they may present to primary care clinics with physical complaints instead of seeking formal mental health services [14, 15]. Notably, many PTSD symptoms overlap with other psychiatric or medical symptoms. For example, an older adult with significant arthritis or pain may exhibit "marked diminished interest or participation in significant activities", "sleep disturbance", and/or "difficulties with concentration" related to pain [16]. In addition, older adults may have more difficulties accessing care due to physical or cognitive limitations (e.g., not being able to obtain transportation) [17]. The lack of valid PTSD assessment instruments and/or adjusted norms in older adults may contribute to lower rates of estimated PTSD in this population. Some studies have reported higher rates of partial or subthreshold PTSD compared to full PTSD among older adults, suggesting that instruments for diagnosing both full and partial PTSD in older adults are needed [18-20]. Furthermore, most instruments are based on self-report or anamnestic interviews with complicated wording and response categories that can be challenging for some older adults, particularly those with cognitive impairments [21]. This underscores the importance of using appropriate and sensitive diagnostic instruments to identify PTSD in older adults.

Research has shown that older adults who suffer from PTSD tend to experience symptoms for a longer period of time than their younger counterparts [10]. Possibly because healthcare professionals do not always recognize the PTSD symptoms, and therefore, the older adults do not receive the most effective treatment (e.g., cognitive behavioral therapy or Eye Movement Desensitization and Reprocessing) [22]. It is essential to improve understanding of the instruments that can help screen for and diagnose PTSD in older adults. This will advance clinical and research efforts to effectively and efficiently assess and treat older adults as well as potentially develop interventions that can address their unique needs and increase prognosis. A previous review on this topic [23] has also described the psychometric properties of PTSD assessment instruments. Our review builds on this by providing an updated and comprehensive evaluation of these instruments, focusing on their diagnostic accuracy and suitability for older adults. This approach aims to provide a more detailed and current evaluation of the tools available for accurately identifying PTSD in this population.

Thus, the objective of this systematic review is to present a comprehensive summary of the psychometric properties and its diagnostic accuracy of PTSD screening and diagnostic instruments used in older adults aged 60 and older. The review aims to recommend the most appropriate instruments and suggest areas for further research to fill gaps in the current evidence.

Method

Search strategy and study selection

This review was registered in PROSPERO CRD42023435611. A systematic search of four databases (MEDLINE, EMBASE, PsychINFO and Web of Science) was conducted for studies that have focused on the psychometric properties of PTSD instruments in older adults published between January 1980 (the year that PTSD was officially acknowledged as a formal psychological condition in the Diagnostic and Statistical Manual of Mental Disorders, 3rd ed. [DSM-III] [24]) to January 10, 2025. The master search strategy was translated for each database and was peer-reviewed by a librarian prior to formal searching (see Appendix 1). Rayyan was used to manage identified studies and facilitate title/abstract and full-text screening [25]. The search results were sorted as follows: (1) duplicate removal with Endnote and Rayyan, (2) at least two reviewers independently screened remaining titles and abstracts for inclusion; conflicts were resolved by a third reviewer, and (3) relevant full-text articles were reviewed by at least two reviewers; conflicts were resolved by a third reviewer.

Inclusion and exclusion criteria

Peer-reviewed articles were selected with the following inclusion criteria: (1) article focused on the development or evaluation of psychometric properties of a PTSD assessment instrument; (2) the mean age of the sample was 60 years or older; (3) instrument was based on the DSM or International Classification of Diseases system; (4) article appeared in search results with use of English search terms (regardless of the language in which the article was written).

Articles were excluded if: there was no report of the diagnostic accuracy of a PTSD assessment instrument; article was not available as full-text; publication had not been peer-reviewed (e.g., dissertations/theses, books/book chapters, and study protocols). Review articles were also excluded after a manual check of articles included in the review to ensure they had all been screened.

Quality rating

The revised Quality Assessment for Diagnostic Accuracy Studies-2 (QUADAS-2) tool [26] was used to assess the risk of bias based on published information. The QUADAS-2 tool evaluates the risk of bias across four core domains: patient selection, the index test, the reference standard, and the flow and timing of assessments. Two independent reviewers applied the QUADAS-2 tool, and consensus was reached through a third reviewer.

Data extraction

Title/abstract screening and full-text screening were performed by DH, EC, OJ, CR, and KAL. Data extraction was conducted in duplicate by DH, EC, and CR; consensus was reached through discussion among DH, EC, CR, and KAL. KAL supervised all stages of screening and extraction. The following data were extracted: geographical information, number of participants enrolled, age, sex, ethnicity, population group, index test, language of the tool, and diagnostic accuracy (e.g., validity, reliability, sensitivity, specificity, Area Under the ROC Curve (AUC), cut-off point and construct validity). Missing information was coded as NR (not reported).

Results

Study selection

The search retrieved 31,319 articles, of which 10,122 duplicates were removed; then, 21,197 titles and abstracts were independently screened by at least two reviewers to assess eligibility based on inclusion criteria resulting in 415 full-text articles. Cross-referencing identified seven more studies, with four study meeting the inclusion criteria. In total, 40 studies were included in the final main analysis after considering the criterion relating to the mean age of the sample (see Figure 1).

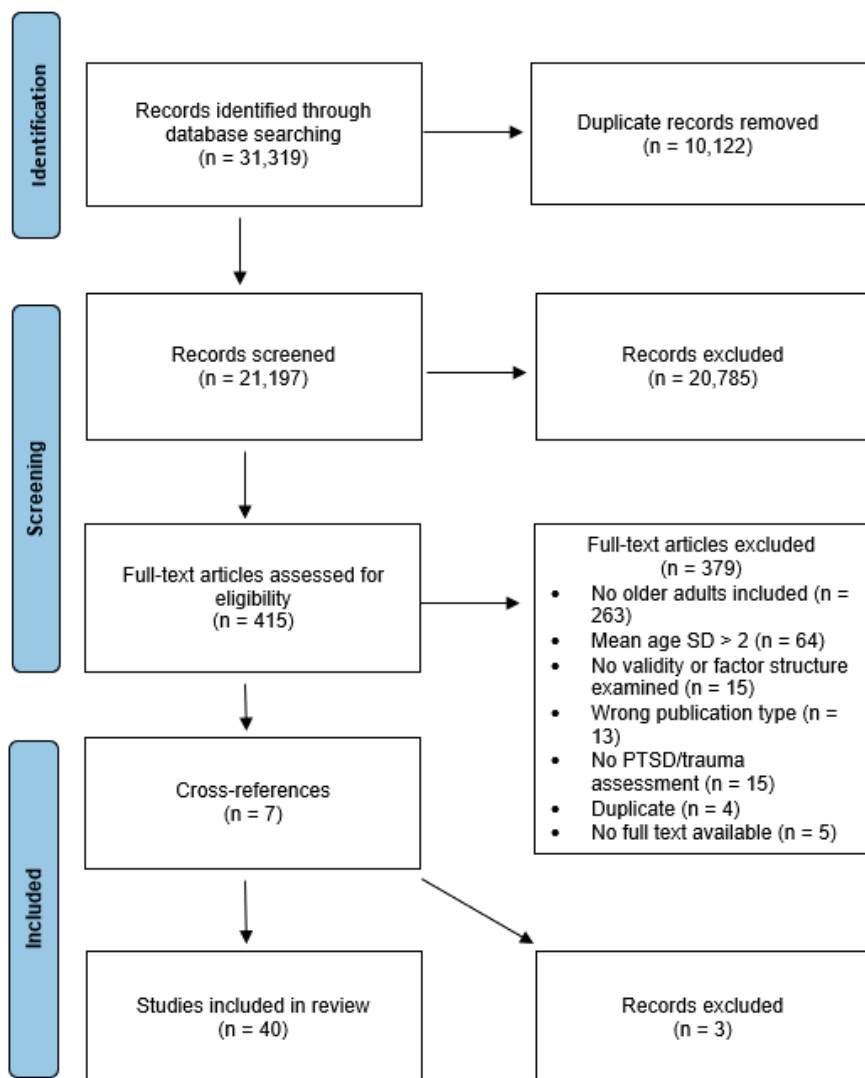


Figure 1. PRISMA flow diagram

Table 1. Characteristics of the included studies

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ethnicity	Sample size (N)	Gender (% female)	Age (years)
Asukai et al. (2002) [27]	IES-R	DSM-IV	Japanese	Japan	Trauma-exposed (earthquake, arsenic poisoning, metro attack)	White 99.3% Other 0.7%	732	9.7%	Mean = 55.88
Baumert et al. (2004) [28]	IES-R	DSM-IV	German	Germany	Survivors of a life-threatening cardiac event	NR	129	12.4%	Mean = 60.5
Bovin et al. (2021) [29]	PC-PTSD	DSM-5	English	USA	Veterans	White 75.1% Other 24.9%	396	15.9%	Mean = 61.4
Carvalho et al. (2015) [30]	PCL-M	DSM-IV	Portuguese	Portugal	Veterans	NR	86	0%	Mean = 64.29
Cook et al. (2024) [31]	PCL-5	DSM-5	English	USA	Veterans	White 85.1% Black 8.3% Hispanic 3.6% Other 3%	3001	96.2%	Mean = 73.2
Cook et al. (2005) [32]	PCL-S	DSM-IV	English	USA	Primary care patients	African American 51.6% Caucasian 38.7% Hispanic 3.2% Asian 2.7% Native American 1.1% Other racial back-grounds 2.7%	142	63.6%	Mean = 74.81

Table 1. Characteristics of the included studies (continued)

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ethnicity	Sample size (N)	Gender (% female)	Age (years)
Cook et al. (2005) [33]	M-PTSD, PCL-S	DSM-III DSM-IV	English	USA	Veterans	Caucasian 77.1% African American 17.1% Asian or American Indian 5.8%	35	0%	Mean = 69.43
Engdahl et al. (1996) [34]	IES, MMPI-2 Pk, M-PTSD	DSM-III DSM-III DSM-III	English	USA	Veterans and POWs	White 99.1% Native American 0.6% Hispanic 0.3%	330	NR	Median = 71
Erbes et al. (2006) [35]	SCID-PTSD, M-PTSD	DSM-III DSM-III	English	USA	Veterans and POWs (standard condition)	White 99.2% Native American 0.5% Hispanic 0.3%	372	0%	Median = 70
Erbes et al. (2006) [35]	SCID-PTSD, M-PTSD	DSM-III DSM-III	English	USA	Veterans and POWs (less standard conditions)	White 93.2% Black 4.4% Other 2.3%	420	0%	Median = 68
Fujii et al. (2008) [36]	SQD-P	DSM-IV	Japanese	Japan	Earthquake survivors	NR	68	77.9%	Mean = 71.2 (male); Mean = 77.9 (female)
Gilmour et al. (2020) [37]	CAPS-5	DSM-5	English	Australia	Vietnam Veterans	NR	267	0%	Mean = 68.72

Table 1. Characteristics of the included studies (continued)

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ethnicity	Sample size (N)	Gender (% female)	Age (years)
Hovens et al. (1994) [38]	CAPS-I	DSM-III	Dutch	Netherlands	Veterans and POWs	NR	100	33%	Mean = 60.3
Hovens et al. (1994) [39]	Dutch PTSD Scale	DSM-III	Dutch	Netherlands	WWII Resistance veterans	NR	987	15%	Range = 60-65
Hudson et al. (2008) [40]	PCL-C	DSM-IV	English	UK	Medical/Psychiatric hospital patients	White 96% Black Caribbean 4%	100	58%	Mean = 82
Hyer et al. (1996) [41]	CAPS-I	DSM-III	English	USA	WWII and Korean Conflict combat veterans	White 83% Other 17%	125	NR	Mean = 69.6
Hyer et al. (1992) [42]	MMPI-PTSD, M-PTSD	DSM-III, DSM-III	English	USA	Vietnam Veterans	White 65-100%	105	NR	Mean range = 61.2 - 68.2
Iwasa et al. (2016) [43]	PCL-S	DSM-IV	Japanese	Japan	Evacuees of the Fukushima Daiichi accident	NR	18,214	51.9%	Mean = 73.7
Jang et al. (2016) [44]	PC-PTSD, SIPS	DSM-IV, DSM-IV	Korean	Korea	Vietnam Veterans	NR	140	0%	Range = 60+

Table 1. Characteristics of the included studies (continued)

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ethnicity	Sample size (N)	Gender (% female)	Age (years)
Kimerling et al. (2014) [45]	CIDI 3.0 -PTSD	DSM-IV	English	USA	Vietnam Veterans	White 86.3% African American 5.6% Other 4.3%	160	100%	Mean = 66.7
Krammer et al. (2013) [46]	TSI	DSM-III	German	Switzerland	Former Swiss placement and institutional children	NR	116	40.5%	Mean = 77.0
Lagana & Schuitevoerder (2009) [47]	BPSSS	DSM-IV	English	USA	General population	White 50% Mexican American 14.9% African American 9.6% Armenian 8.5% Asian American 8.5% Other 8.5%	94	100%	Mean = 70.93
Magruder et al. (2014) [48]	PCL-M	DSM-IV	English	USA	Veterans	White 90.6% Other 9.4%	5141	0%	Mean = 61.1
Mystakidou et al. (2007) [49]	IES-R	DSM-IV	Greek	Greece	Cancer patients	NR	82	53.7%	Mean = 62.3

Table 1. Characteristics of the included studies (continued)

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ ethnicity	Sample size (N)	Gender (% female)	Age (years)
Neal et al. (1995) [50]	IES, MIMPI-PTSD, M-PTSD	DSM-III DSM-III DSM-III	English	England	WWII POWs	Caucasian 100%	30	3.3%	Mean = 75.4
Overstreet et al. (2023) [51]	PCL-C	DSM-IV	English	USA	Veterans	NR	279,897	7.8%	Mean = 65.7
Pietrzak et al. (2012) [52]	PCL-S	DSM-IV	English	USA	Hurricane survivors	White 76.7% Other 23.3%	206	46.7%	Mean = 69.2
Préville et al. (2014) [53]	PTSS Scale	DSM-IV	French	Canada	Primary care patients	NR	1765	57.3%	Mean = 73.2
Prins et al. (2016) [54]	PC-PTSD	DSM-5	English	USA	Veterans	White 57.4% African American 12.1% Hispanic 9.6% Asian 5.5% Other 15.4%	398	4%	Mean = 63.3
Rosendahl et al. (2019) [55]	PCL-5, PTSS-10, PTSS-14	DSM-5	German	Germany	Intensive care sepsis patients	NR	83	39.8%	Median = 64
Schinka et al. (2007) [56]	PCL-C	DSM-IV	English	USA	Hurricane survivors	White 100%	142	50%	Mean = 77.2

Table 1. Characteristics of the included studies (continued)

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ethnicity	Sample size (N)	Gender (% female)	Age (years)
Shevlin et al. (2000) [57]	IES	DSM-III	English	UK	WWII and Korean War veterans	NR	731	0%	Mean = 72
Sistad et al. (2024) [58]	PCL-5	DSM-5	English	USA	Veterans	White 71.6% Black 15.9% Asian 3.4% Native American 0.8 Other 7.8%	385	15.3%	Mean = 61.2
Suzuki et al. (2017) [59]	PCL-5	DSM-IV	Japanese	Japan	Evacuees of the Fukushima Daiichi accident	NR	48	52.1%	Mean = 62.5
Thoma et al. (2025) [60]	ITQ	ICD-11	German	Switzerland	General older adult population	NR	1526	72%	Mean = 72.34
Tiet & Tiet (2024) [61]	PC-PTSD	DSM-5	English	USA	Veterans	White 54.91% Black 14.84% Native American/Alaska 8.86% Asian 6.74% Other 19.08%	519	4.05%	Mean = 63.2

Table 1. Characteristics of the included studies (continued)

Study	Tool(s)	DSM	Language of tool	Study setting (country)	Target population	Nationality/ethnicity	Sample size (N)	Gender (% female)	Age (years)
Van Zelst et al. (2003) [62]	SRIP	DSM-IV	Dutch	Netherlands	Community dwelling older people	NR	1721	54%	Mean = 74.1 (male); Mean = 73.5 (female)
Wawer et al. (2020) [63]	IES-R	DSM-IV	French	France	ICU discharge patients	NR	174	29%	Mean = 62
Witteveen et al. (2005) [64]	SRIP IES	DSM-IV DSM-III	Dutch	Netherlands	War-related trauma victims	NR	74	33.8%	Mean = 60.2
Yarvis et al. (2012) [65]	PCL-M	DSM-IV	English	Canada	Veterans (currently working as peacekeeper)	NR	456	0%	Mean = 60.53
Yeager & Magruder (2014) [66]	PCL-M	DSM-IV	English	USA	Veterans	White 61.7% Other 38.3%	332	20.9%	Range = 65+

Note. CAPS-1 = The Clinician-Administered PTSD Scale; CAPS-5 = The Clinician-Administered PTSD Scale for DSM-5; IES = The Impact of Event Scale; IES-R = The Impact of Event Scale-Revised; MMPI-PTSD = The Minnesota Multiphasic Personality Inventory PTSD subscale; MMPI-2 Pk = the Minnesota Multiphasic Personality Inventory-2 Posttraumatic Stress Disorder-Keane scale; M-PTSD = The Mississippi Scale for Combat-Related PTSD; PCL-C = The PTSD Checklist-civilian; PCL-M = The PTSD Checklist-military; PCL-S = The PTSD Checklist-specific; PC-PTSD-K = The Korean version of the Primary Care Post-Traumatic Stress Disorder Screen; PTSS Scale = The Post-Traumatic Stress Syndrome Scale; SIPS-K = The Korean version of the Single Item PTSD Screener; SRIP = The Self-Rating Inventory for Posttraumatic Stress Disorder; SQD-P = The Screening Questionnaire for Disaster Mental Health subscale PTSD; TSI = The Trauma Symptom Inventory.

Study characteristics

Among the 40 studies (see Table 1), 24 instruments were used in a total of 51 validation tests (see Table 2). Some studies evaluated multiple tools or different versions of the same tool. Among older adults, the most frequently researched instruments were the Mississippi Scale for Combat-Related PTSD (M-PTSD) [33-35, 42, 50] and the PTSD Checklist (PCL-S) [32, 33, 43, 52, 59]. These were followed by the Impact of Event Scale (IES), the Impact of Event Scale Revised (IES-R) and the PTSD Checklist-Military (PCL-M), where each of them was validated in four studies. The remaining instruments were validated in only one to three studies. Only seven studies (7/40; 18%) assessed an instrument based on the DSM-5 [29, 31, 37, 54, 55, 58, 61]. Half of the instruments (12 out of 24) were only validated in veterans or former prisoners of war (POWs). Five studies used the Structured Clinical Interview for DSM Disorders as the reference standard, whereas most studies did not use any reference standard ($n=19$).

Table 2. Results of measurement properties

Tool (references)	Reliability	Structural validity	ROC-analysis
BPSSS Lagana & Schuitevoerder, (2009) [47]	Cronbach's alpha: $\alpha = 0.86$ Test-retest: NR Inter-rater variability: NR	Construct validity: One-factor model $\lambda^2 = 0.58$	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
CAPS-I Hovens et al. (1994) [38]	Cronbach's alpha: $\alpha = 0.89$ Test-retest: NR Inter-rater variability: 0.89	Construct validity: CAPS is correlated with M-PTSD $r = 0.73$	Sensitivity: 0.74 Specificity: 0.84 AUC: NR Cut-off: NR Gold standard: Clinical diagnosis
Hyer et al. (1996) [41]	Cronbach's alpha: $\alpha = 0.95$ Test-retest: NR Inter-rater variability: $\kappa = 0.75$	CAPS is correlated with MMPI $r = 0.74$ Construct validity: NR	Sensitivity: 0.90 Specificity: 0.95 AUC: NR Cut-off: 65 Gold standard: SCID-TREE

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
CAPS-5 Gilmour et al. (2020) [37]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: Six-factor anhedonia model CFI = 0.92 The six-factor anhedonia model is correlated with DASS-21 $r = 0.63-0.69$	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
CIDI 3.0 PTSD module Kimerling et al. (2014) [45]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.64 Specificity: 0.91 AUC: 0.77 Cut-off: NR Gold standard: CAPS-IV
Dutch PTSD Scale Hovens et al. (1993) [67]	Cronbach's alpha: $\alpha = 0.88$ Test-retest: 0.91 Inter-rater variability: NR	Construct validity: Six factor model $\lambda > 1.0$	Sensitivity: 0.84 Specificity: 0.79 AUC: 0.82 Cut-off: 59 Gold standard: SCID

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
IES Engdahl et al. (1996) [34]	Cronbach's alpha: $\alpha = 0.94$ Test-retest: NR Inter-rater variability: NR	Construct validity: One-factor model NFI = 0.99	Sensitivity: 0.78 Specificity: 0.82 AUC: NR Cut-off: 38 Gold standard: SCID
Neal et al. (1995) [50]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: IES is correlated with CAPS-I $r = 0.63$	Sensitivity: 0.67 Specificity: 0.57 AUC: NR Cut-off: 35 Gold standard: CAPS-I
Shevlin et al. (2000) [57]	Cronbach's alpha: $\alpha = 0.91$ Test-retest: NR Inter-rater variability: NR	Construct validity: Model 3 NFI = 0.94 CFI = 0.96 IES is correlated with GHQ-28 $r = 0.52$	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Witteveen et al. (2005) [64]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.77 Specificity: 0.51 AUC: 0.71 Cut-off: 36 Gold standard: CAPS-I

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
IES-R Mystakidou et al. (2007) [49]	Cronbach's alpha: $\alpha = 0.85$ Test-retest: 0.94-0.96 Inter-rater variability: NR	Construct validity: Three-factor structure $\lambda > 1.0$ IES-R-Gr subscales are correlated with HAD depression and anxiety subscales $r = 0.49-0.64$	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Asukai et al. (2002) [27]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: Six-factor first-order model (model 3) CFI = 0.99	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: SCID & CAPS
Baumert et al. (2004) [28]	Cronbach's alpha: $\alpha > 0.8$ for subscales intrusion and avoidance and $\alpha = 0.66$ for hyperarousal Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Wawer et al. (2020) [63]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.63 Specificity: 0.95 AUC: 0.90 Cut-off: 35 Gold standard: NR
ITQ Thoma et al. (2025) [60]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: Two-factor second- order model CFI = 0.98	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
MMPI-PTSD Hyer et al. (1992) [42]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.83 Specificity: 0.79 AUC: NR Cut-off: 34 Gold standard: NR
Neal et al. (1995) [50]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: MMPI-PTSD is correlated with CAPS-I $r = 0.71$	Sensitivity: 0.89 Specificity: 0.62 AUC: NR Cut-off: 17 Gold standard: CAPS-I
MMPI-2 Pk Engdahl et al. (1996) [34]	Cronbach's alpha: $\alpha = 0.93$ Test-retest: NR Inter-rater variability: NR	Construct validity: One-factor model NFI = 0.99	Sensitivity: 0.60 Specificity: 0.84 AUC: 0.82 Cut-off: 14 Gold standard: SCID

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
M-PTSD Engdahl et al. (1996) [34]	Cronbach's alpha: $\alpha = 0.93$ Test-retest: NR Inter-rater variability: NR	Construct validity: One-factor model NFI = 0.99	Sensitivity: 0.66 Specificity: 0.87 AUC: 0.85 Cut-off: 91 Gold standard: SCID
Neal et al. (1995) [50]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: M-PTSD is correlated with CAPS-I $r = 0.81$	Sensitivity: 0.78 Specificity: 0.57 AUC: NR Cut-off: 81 Gold standard: CAPS-I
Hyer et al. (1992) [42]	Cronbach's alpha: $\alpha = 0.85$ Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 1.00 Specificity: 0.93 AUC: NR Cut-off: 100 Gold standard: NR
Cook et al. (2005) [33]	Cronbach's alpha: $\alpha = 0.78$ Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Erbes et al. (2006) [35] (standard conditions)	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.69 Specificity: 0.89 AUC: NR Cut-off: 89 Gold standard:
Erbes et al. (2006) [35] (less standard conditions)	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	SCID-IV Sensitivity: 0.71 Specificity: 0.88 AUC: NR Cut-off: 89 Gold standard: SCID-IV

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
PCL-C Hudson et al. (2008) [40]	Cronbach’s alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.90 Specificity: 0.87 AUC: 0.94 Cut-off: 36 Gold standard: CAPS-IV
Schinka et al. (2007) [56]	Cronbach’s alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: Four-factor model CFI = 0.90	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Overstreet et al. (2023) [51]	Cronbach’s alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: Five-factor dysphoric arousal model CFI = 0.98	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
PCL-M Yarvis et al. (2012) [65]	Cronbach's alpha: $\alpha = 0.93$ Test-retest: NR Inter-rater variability: NR	Construct validity: Four-factor 1 st order model CFI = 0.99 PCL-M is correlated with the CES-D $r = 0.73$	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Carvalho et al. (2015) [30]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.83 Specificity: 0.93 AUC: 0.94 Cut-off: 49 Gold standard: CAPS-IV
Yeager & Magruder, (2014) [66]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.76 Specificity: 0.80 AUC: 0.87 Cut-off: 24 Gold standard: CAPS-IV
Magruder et al. (2014) [48]	Cronbach's alpha: $\alpha = 0.96$ Test-retest: NR Inter-rater variability: NR	Construct validity: PCL-M is correlated with the VET-R $r = 0.9$	Sensitivity: 0.81-0.85 Specificity: 0.80-0.83 AUC: 0.89 Cut-off: 31-33 Gold standard: CIDI

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
PCL-S Cook et al. (2005) [33]	Cronbach's alpha: $\alpha = 0.87$ Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Cook et al. (2005) [32]	Cronbach's alpha: $\alpha = 0.85$ Test-retest: NR Inter-rater variability: NR	Construct validity: PCL-S is correlated with the CES-D $r = 0.53$	Sensitivity: 0.96 Specificity: 0.92 AUC: 0.98 Cut-off: 37 Gold standard: PCL-S
Iwasa et al. (2016) [43]	Cronbach's alpha: $\alpha = 0.95$ Test-retest: NR Inter-rater variability: NR	Construct validity: Five-factor model CFI = 0.96	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
Pietrzak et al. (2012) [52]	Cronbach's alpha: $\alpha = 0.80-0.88$ Test-retest: NR Inter-rater variability: NR	Construct validity: Five-factor model CFI = 0.95	Sensitivity: 0.96 Specificity: 0.95 AUC: 0.98 Cut-off: 37-39 Gold standard: Clinical Diagnosis
Suzuki et al. (2017) [56]	Cronbach's alpha: $\alpha = 0.92$ Test-retest: 0.85 Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.67 Specificity: 0.85 AUC: 0.83 Cut-off: 52 Gold standard: IES-R

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
PCL-5 Rosendahl et al. (2019) [55]	Cronbach's alpha: $\alpha = 0.92$ Test-retest: NR Inter-rater variability: NR	Construct validity: PCL-5 is correlated with CAPS-5 $\rho = 0.90$	Sensitivity: 0.50 Specificity: 0.96 AUC: 0.94 Cut-off: 33 Gold standard: CAPS-5
Sistad et al. (2024) [58]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.82 Specificity: 0.76 AUC: 0.90 Cut-off: 32 Gold standard: CAPS-5
Cook et al. (2024) [31]	Cronbach's alpha: $\alpha = 0.95$ Test-retest: NR Inter-rater variability: NR	Construct validity: Eight-factor model CFI = 0.96	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR
PC-PTSD Jang et al. (2016) [44]	Cronbach's alpha: $\alpha = 0.76$ Test-retest: 0.97 Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.90 Specificity: 0.87 AUC: 0.92 Cut-off: 3 Gold standard: SCID

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
PC-PTSD-5 Bovin et al. (2021) [29]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.90 Specificity: 0.80 AUC: 0.93 Cut-off: 3 Gold standard: CAPS-5
Prins et al. (2016) [54]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.95 Specificity: 0.85 AUC: 0.94 Cut-off: 3 Gold standard: MINI
Tiet & Tiet, (2024) [61]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.94 Specificity: 0.84 AUC: NR Cut-off: 3 Gold standard: NR
PTSS Scale Prévile et al. (2014) [53]	Cronbach's alpha: $\alpha = 0.82$ Test-retest: NR Inter-rater variability: NR	Construct validity: Measurement model of PTSS comprising 3 dimensions $\chi^2 = 2.1$	Sensitivity: 0.94 Specificity: 0.92 AUC: 0.98 Cut-off: 10 Gold standard: IES-R
PTSS-10 Rosendahl et al. (2019) [55]	Cronbach's alpha: $\alpha = 0.83$ Test-retest: NR Inter-rater variability: NR	Construct validity: PTSS-10 is correlated with CAPS-5 $\rho = 0.77$	Sensitivity: 0.60 Specificity: 0.96 AUC: 0.93 Cut-off: 35 Gold standard: CAPS-5
PTSS-14 Rosendahl et al. (2019) [55]	Cronbach's alpha: $\alpha = 0.88$ Test-retest: NR Inter-rater variability: NR	Construct validity: PTSS-14 is correlated with CAPS-5 $\rho = 0.82$	Sensitivity: 0.80 Specificity: 0.92 AUC: 0.94 Cut-off: 40 Gold standard: CAPS-5

Table 2. Results of measurement properties (continued)

Tool (references)	Reliability	Structural validity	ROC-analysis
SIPS-K Jang et al. (2016) [44]	Cronbach's alpha: NR Test-retest: 0.91 Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.85 Specificity: 0.90 AUC: 0.89 Cut-off: item 'bothered a lot' Gold standard: SCID
SRIP Van Zelst et al. (2003) [62]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.74 Specificity: 0.81 AUC: 0.85 Cut-off: 39 Gold standard: CIDI
Witteveen et al. (2005) [64]	Cronbach's alpha: NR Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: 0.86 Specificity: 0.69 AUC: 0.84 Cut-off: 52 Gold standard: CAPS-I
SQD-P Fujii et al. (2008) [36]	Cronbach's alpha: $\alpha = 0.77$ Test-retest: NR Inter-rater variability: NR	Construct validity: NR	Sensitivity: NR Specificity: NR AUC: 0.91 Cut-off: 6 (possible PTSD) Gold standard: CAPS-IV
TSI Krammer et al. (2013) [46]	Cronbach's alpha: $\alpha = 0.73-0.86$ Test-retest: NR Inter-rater variability: NR	Construct validity: Briere three-factor model CFI < 0.08 Three-factor model CFI < 0.08	Sensitivity: NR Specificity: NR AUC: NR Cut-off: NR Gold standard: NR

Risk of bias and applicability

Based on QUADAS-2 quality criteria, all included studies had a low risk of bias in all four domains (see Table 3). Notably, all studies used a consecutive sample, eliminating the possibility of high risk of bias that was usually associated with recruiting non-consecutive or non-random samples. However, for 15 studies (37.5%), it was unclear whether the index test results were interpreted with

any knowledge of the reference standard. 10 studies used confirmatory factor analysis; in these cases, risk of bias based on the use of a reference standard (domain 3) was not assessed.

Characteristics of each screening instrument

BPSSS

The Brief Post-traumatic Stress Screening Scale [BPSSS] is a five-item instrument to perform routine screening for older women's posttraumatic stress symptomatology [47]. Lagana & Schuitevoerder [47] found very good internal consistency for the scale. Factor analysis showed one factor, but no information was provided regarding ROC analysis.

PC-PTSD(-5)

The Korean version of the Primary Care Post-Traumatic Stress Disorder Screen [PC-PTSD-K] [68] is a four-item screener developed to detect PTSD in primary care settings. The instrument was validated in a Korean older adult population [44]. The internal consistency was good, and the test-retest reliability was excellent. Using a cut-off point of 3, the tool showed very good sensitivity and specificity. However, its structural validity has not been assessed.

The PC-PTSD was revised based on the DSM-5 [PC-PTSD-5] [54]. However, no study evaluated the internal consistency or construct validity of the instrument in older adults. Three studies assessed the psychometric properties of the instrument and recommended a cut-off value of 3 with very good sensitivity and specificity [29, 54, 61].

PTSS Scale

The Post-Traumatic Stress Syndrome Scale [PTSS Scale] measures the number of traumatic events and symptom severity and is based on the IES-R index [53]. The PTSS Scale has good internal consistency. Additionally, the ROC analysis in Canadian primary care patients showed excellent accuracy, sensitivity, and specificity for a cut-off score of 10. The PTSS Scale comprises 3 dimensions (number of lifetime traumatic events, the frequency of reactions and symptoms of distress) in the older adult population[53].

PTSS-10/14

The Post-Traumatic Stress Scale-10 [PTSS-10] was developed to screen for PTSD according to the DSM-III-R criteria [69]. Only one study evaluated the psychometric properties and found that the PTSS-10 has good internal consistency [55]. A cut-off value of 35 was recommended, which has been found

to have good sensitivity and very high specificity [55]. However, its structural validity has not been assessed.

The Post-Traumatic Stress Scale-14 [PTSS-14] was developed to screen for PTSD reflecting the PTSD criteria defined in DSM-IV [70]. Only one study assessed the psychometric properties and found that the PTSS-10 exhibits good internal consistency [55]. The study of Rosendahl et al. [55] recommended a cut-off value of 40, which has been found to have very high sensitivity and specificity.

SIPS-K

The Korean version of the Single Item PTSD Screener [SIPS] [71] was developed to screen for PTSD in primary care settings. However, only one study evaluated the SIPS using a Korean older adult population [44]. This study did not mention the internal consistency of the tool, but the test-retest score was excellent. The optimal cut-off point for the SIPS was at the response option “bothered a lot” [44], resulting in a very good sensitivity and specificity. The structural validity of the SIPS was not reported.

SRIP

The Self-Rating Inventory for Posttraumatic Stress Disorder [SRIP] is a screening instrument for PTSD in community-dwelling older adults [39]. Two studies, that were included in this review, were conducted to evaluate the Dutch version of the SRIP [62, 64]. However, the studies did not mention the tool’s reliability, and no factor analysis was carried out. The ROC-curve displays a reasonable discriminating power, good sensitivity and very good specificity, with a recommended cut-off score of 39 in a sample of community dwelling older adults [20]. The study of Witteveen et al. [64] recommended a cut-off value of 52 with very good sensitivity and good specificity in a sample of war-related trauma victims.

SQD-P

The Screening Questionnaire for Disaster Mental Health subscale PTSD [SQD-P] is a simple interview-format scale that screens for disaster mental health issues. The scale has been translated into Japanese in a study including older adults. It has shown good internal consistency and high efficiency with a cutoff point of 6 or higher to indicate possible PTSD [36]. There was no factor analysis performed.

Characteristics of each diagnostic instrument

CAPS(-5)

The Clinician-Administered PTSD Scale [CAPS] [72] is the gold-standard interview for current and lifetime PTSD assessment. The initial psychometric

studies used the Clinician-Administered PTSD Scale (CAPS-I) which was based on the DSM-III criteria [38, 41]. The studies found that the CAPS-I had excellent internal consistency and good inter-rater reliability. The recommended standard cut-off score was found to be effective at detecting PTSD symptoms. At a cut-off score of 65, the sensitivity was very good, and specificity was excellent. However, the study did not report the area under the ROC curve.

The CAPS was revised with the release of DSM-5 [CAPS-5] [73]. However, the original four-factor structure of the DSM-5 model showed slightly less than adequate fit. On the other hand, there is moderate-quality evidence supporting a sufficient six-factor anhedonia model structure [37]. Notably, reliability and ROC analysis of the CAPS-5 has not been evaluated in older adults.

CIDI 3.0 PTSD module

The PTSD module of the CIDI version 3.0 is a structured interview designed to assess PTSD based on the DSM-IV [74]. The internal consistency and factor analysis were not studied in older adults. The ROC analysis in a sample of female Vietnam-era Veterans showed excellent specificity and good sensitivity with a high level of accuracy [45].

Dutch PTSD Scale

The Dutch PTSD scale, based on the DSM-III, was designed to evaluate PTSD in older adult World War II veterans [67]. Hovens et al. [67] reported that the scale had very good internal consistency and excellent test-retest reliability. The ROC analysis revealed that it had high sensitivity and good specificity, with a cut-off value of >59 . However, the AUC score was not reported. Additionally, factor analysis conducted on a large sample of veterans identified six factors.

IES(-R)

The Impact of Event Scale [IES] is a questionnaire designed to measure intrusion and avoidance symptoms that may occur after a traumatic event [75]. Excellent internal consistency was reported in two studies [34, 57], yet the factor structure has been found to vary, with some studies suggesting a one-factor model while others suggested a two-factor model with additional cross-factor loadings [34, 57]. A cut-off value of 35 has been recommended by Neal et al. [50] using ROC analysis. Engdahl et al. [34] suggested a cut-off value of 38 for a community sample of POW, which has been found to have good sensitivity and very good specificity. In addition, a cut-off value of 36 was recommended in a sample of war-related trauma victims [64].

The Impact of Event Scale-Revised [IES-R] is an updated version of the 15-item IES, designed to include 7 extra items that align with the DSM-IV standards

[76]. The study of Baumert et al. [28] found that the IES-R had a good internal consistency for subscales intrusion and avoidance. Factor analysis in a sample of Japanese trauma-exposed older adults identified a six-factor first-order model [27]. A cut-off value of 35 was recommended, which has been found to have good sensitivity and very high specificity [63]. Mystakidou et al. [49] translated the IES-R into Greek to evaluate the psychometric properties in cancer patients, and found that the IES-R had good internal consistency and excellent test-retest reliability. Factor analysis showed three factors, but no information was provided regarding ROC analysis.

ITQ

The German version of the International Trauma Questionnaire [ITQ] was used to assess probable PTSD and CPTSD based on the ICD-11 [77]. The reliability and ROC analysis were not evaluated in older adults. However, factor analysis suggested a two-factor second-order model [60].

MMPI-PTSD(-2 Pk)

The Minnesota Multiphasic Personality Inventory [MMPI] PTSD subscale was created to evaluate PTSD [78]. However, the internal consistency and factor structure of the scale were not studied in older adults. Hyer et al. [42] suggested a cut-off score of 34, which showed very good sensitivity and good specificity in a sample of veterans. On the other hand, in another sample of POW, a cut-off score of 17 is recommended, with very good sensitivity and acceptable specificity [50].

The MMPI-PTSD was revised into the Minnesota Multiphasic Personality Inventory-2 Posttraumatic Stress Disorder-Keane [MMPI-2 PK] scale [79]. Only one study has investigated the psychometric properties of MMPI-2 PK [34]. The study found that the instrument has excellent internal consistency and supports a one-factor model structure. The authors suggest a cut-off value of 14, which provides acceptable sensitivity and very good specificity.

M-PTSD

The Mississippi Scale for Combat-Related PTSD [M-PTSD] is a self-report measure that assesses combat-related PTSD in veteran populations [80]. According to several studies, the tool has good to excellent internal consistency [33, 34, 42]. Only one study evaluated the construct validity, which suggested a one-factor model as the best fit [34]. The tool has several cut-off scores recommended by various studies. A cut-off score of 100 was recommended by Hyer et al. [42], with excellent sensitivity and specificity. Neal et al. [50] adapted the cut-off score for a POW sample and suggested a cut-off of 81, which has been found to have good sensitivity and acceptable specificity. Engdahl et al.

[34] applied a ROC analysis in a sample of World War II (WWII) veterans and POWs and recommended a cut-off value of 91 with acceptable sensitivity and very good specificity. A cut-off value of 89 was recommended by Erbes et al in a sample of veterans and POWs with good sensitivity and very good specificity [35].

PCL

The PTSD Checklist [PCL] is one of the most widely used tools used to measure the symptoms of PTSD according to the DSM-IV [81]. There are three versions: PCL-M (military), PCL-C (civilian) and PCL-S (specific), which only vary slightly in the instructions and wording of the phrase referring to the index event. Psychometric properties were evaluated in five studies for the PCL-S. The internal consistency was found to be very good to excellent in several studies [32, 33, 42, 43, 52, 59] and findings suggested a five-factor model [43, 52]. Two studies have supported a cut-off value of 37, which has excellent sensitivity and specificity [32, 52]. However, the study of Suzuki et al. recommended a cut-off value of 52 with good sensitivity and high specificity [59].

Three studies evaluated the PCL-C's psychometric properties [40, 51, 56], yet internal consistency was not studied in older adults. Confirmatory factor analysis revealed the strongest support for a four-factor model in a sample of hurricane survivors [56] and a five-factor dysphoric arousal model in a sample of veterans [51]. Using a cut-off value of 36, the ROC analysis showed very good sensitivity and specificity [40].

Four studies evaluated the PCL-M's psychometric properties [30, 48, 65, 66], which suggested the four-factor 1st order model as the best fit [65]. The internal consistency of PCL-M was found to be excellent in Yarvis et al. [65] and Magruder et al. [48]. Different cut-off values were recommended by various studies with very good sensitivity and specificity. The cut-off values of 24 and 31 to 33 were recommended for American veterans [48, 66], and a cut-off value of 49 was recommended for a sample of Portuguese veterans [30].

The PCL was revised with the release of DSM-5 [PCL-5] [73, 82]. Two studies found that the instrument has excellent internal consistency [31, 55] and one study supported an eight-factor model structure [31]. The cut-off value of 32 with high sensitivity and specificity was recommended for veterans [58] and a cut-off value of 33 with acceptable sensitivity and very good specificity was suggested for a sample of intensive care patients [55].

TSI

The Trauma Symptom Inventory [TSI] is a self-report questionnaire designed to assess complex symptoms of PTSD [83]. Krammer et al. [46] conducted a study to evaluate the German version of the TSI in older adults who had experienced childhood trauma. When tested using equation models, the data did not provide enough support for the three-factor models created by Briere [83] and Gambetti et al. [84]. Additionally, the reliability and ROC analysis of the TSI have not been evaluated for older adults.

Table 3. Risk of bias and applicability concerns of included studies

	Domain 1: Patient Selection		Domain 2: Index Test(s)			Domain 3: Reference Standard		Domain 4: Timing and Flow	
	Risk of Bias	Concerns Regarding Applicability	Index Test	Risk of Bias	Concerns Regarding Applicability	Reference Standard	Risk of Bias	Concerns Regarding Applicability	Risk of Bias
Asukai et al. (2002) [27]	Low	Low	IES-R	Low	Low	SCID PTSD Module CAPS*	Low	Low	Low
Baumert et al. (2004) [28]	Low	Low	IES-R	Low	Low	Psychophysiological acoustic startle reflex (ASR) paradigm	Low	Low	Low
Bovin et al. (2021) [29]	Low	Low	PC-PTSD-5	Low	Low	CAPS-5	Low	Low	Low
Carvalho et al. (2015) [30]	Low	Low	PCL-M	Low	Low	CAPS	Low	Low	Low
Cook et al. (2024) [31]	Low	Low	PCL-5	Low	Low	N/A**	N/A	N/A	N/A
Cook et al. (2005) [32]	Low	Low	PCL-S	Low	Low	N/A	N/A	N/A	Low
Cook et al. (2005) [33]	Low	Low	M-PTSD PCL-S	Low	Low	N/A	N/A	N/A	Low
Engdahl et al. (1996) [34]	Low	Low	IES MMPI-2 Pk M-PTSD	Low	Low	SCID PTSD Module*	Low	Low	Low

Table 3. Risk of bias and applicability concerns of included studies (continued)

	Domain 1: Patient Selection			Domain 2: Index Test(s)			Domain 3: Reference Standard		Domain 4: Timing and Flow		
	Risk of Bias	Concerns Regarding Applicability	Index Test	Risk of Bias	Concerns Regarding Applicability	Reference Standard	Risk of Bias	Concerns Regarding Applicability	Risk of Bias	Concerns Regarding Applicability	Risk of Bias
Erbes et al. (2006) [35]	Low	Low	SCID	Low	Low	M-PTSD	Low	Low	Low	Low	Low
Fujii et al. (2008) [36]	Low	Low	SQD-P	Low	Low	CAPS-IV*	Low	Low	Low	Low	Low
Gilmour et al. (2020) [37]	Low	Low	CAPS-5	Low	Low	N/A**	N/A	N/A	N/A	N/A	N/A
Hovens et al. (1994) [38]	Low	Low	CAPS-1	Low	Low	Mississippi PTSD Scale MMPI-PTSD IES	Low	Low	Low	Low	Low
Hovens et al. (1994) [39]	Low	Low	Dutch PTSD Scale	Low	Low	SCID DSM-III-R*	Low	Low	Low	Low	Low
Hudson et al. (2008) [40]	Low	Low	PCL-C	Low	Low	CAPS-IV*	Low	Low	Low	Low	Low
Hyer et al. (1996) [41]	Low	Low	CAPS-1	Low	Low	SCID-DTREE*	Low	Low	Low	Low	Low
Hyer et al. (1992) [42]	Low	Low	MMPI M-PTSD	Low	Low	N/A	N/A	N/A	N/A	N/A	Low
Iwasa et al. (2016) [43]	Low	Low	PCL-S	Low	Low	N/A**	N/A	N/A	N/A	N/A	Low

Table 3. Risk of bias and applicability concerns of included studies (continued)

	Domain 1: Patient Selection			Domain 2: Index Test(s)			Domain 3: Reference Standard		Domain 4: Timing and Flow		
	Risk of Bias	Concerns Regarding Applicability	Index Test	Risk of Bias	Concerns Regarding Applicability	Reference Standard	Risk of Bias	Concerns Regarding Applicability	Risk of Bias	Concerns Regarding Applicability	Risk of Bias
Jang et al. (2016) [44]	Low	Low	PC-PTSD SIPS	Low	Low	SCID*	Low	Low	Low	Low	Low
Kimerling et al. (2014) [45]	Low	Low	CIDI	Low	Low	CAPS PCL-C	Low	Low	Low	Low	Low
Krammer et al. (2013) [46]	Low	Low	TSI	Low	Low	N/A**	N/A	N/A	N/A	Low	Low
Lagana & Schuitevoerder (2009) [47]	Low	Low	BPSS	Low	Low	N/A	N/A	N/A	N/A	Low	Low
Magruder et al. (2014) [48]	Low	Low	PCL-M	Low	Low	N/A	N/A	N/A	N/A	Low	Low
Mystakidou et al. (2007) [49]	Low	Low	IES-R	Low	Low	N/A**	N/A	N/A	N/A	Low	Low
Neal et al. (1995) [50]	Low	Low	IES MMPI M-PTSD	Low	Low	CAPS-1*	Low	Low	Low	Low	Low
Overstreet et al. (2023) [51]	Low	Low	PCL-C	Low	Low	N/A**	N/A	N/A	N/A	Low	Low

Table 3. Risk of bias and applicability concerns of included studies (continued)

	Domain 1: Patient Selection			Domain 2: Index Test(s)			Domain 3: Reference Standard		Domain 4: Timing and Flow		
	Risk of Bias	Concerns Regarding Applicability	Index Test	Risk of Bias	Concerns Regarding Applicability	Reference Standard	Risk of Bias	Concerns Regarding Applicability	Risk of Bias	Concerns Regarding Applicability	Risk of Bias
Pietrzak et al. (2012) [52]	Low	Low	PCL-S	Low	Low	Clinical Diagnosis Based on DSM-IV*	Low	Low	Low	Low	Low
Préville et al. (2014) [53]	Low	Low	PTSS Scale	Low	Low	IES-R*	Low	Low	Low	Low	Low
Prins et al. (2016) [54]	Low	Low	PC-PTSD	Low	Low	MINI DSM-5 PTSD module*	Low	Low	Low	Low	Low
Rosendahl et al. (2019) [55]	Low	Low	PTSS-10 PTSS14 PCL-5	Low	Low	CAPS-5*	Low	Low	Low	Low	Low
Schinka et al. (2007) [56]	Low	Low	PCL-C	Low	Low	N/A**	N/A	N/A	N/A	Low	Low
Shevlin et al. (2000) [57]	Low	Low	IES	Low	Low	N/A**	N/A	N/A	N/A	Low	Low
Sistad et al. (2024) [58]	Low	Low	PCL-5	Low	Low	CAPS-5	Low	Low	Low	Low	Low
Suzuki et al. (2017) [59]	Low	Low	PCL-S	Low	Low	IES-R	Low	Low	Low	Low	Low
Thoma et al. (2025) [60]	Low	Low	ITQ	Low	Low	N/A**	N/A	Low	Low	Low	Low

Table 3. Risk of bias and applicability concerns of included studies (continued)

	Domain 1: Patient Selection		Domain 2: Index Test(s)			Domain 3: Reference Standard		Domain 4: Timing and Flow		
	Risk of Bias	Concerns Regarding Applicability	Index Test	Risk of Bias	Concerns Regarding Applicability	Reference Standard	Risk of Bias	Concerns Regarding Applicability	Risk of Bias	Risk of Bias
Tiet & Tiet (2024) [61]	Low	Low	PC-PTSD	Low	Low	MINI DSM-5 PTSD module*	Low	Low	Low	Low
Van Zelst et al. (2003) [62]	Low	Low	SRIP	Low	Low	DSM-IV criteria in the CIDI*	Low	Low	Low	Low
Wawer et al. (2020) [63]	Low	Low	IES-R	Low	Low	N/A	N/A	Low	Low	Low
Witteveen et al. (2005) [64]	Low	Low	IES SRIP	Low	Low	CAPS*	Low	Low	Low	Low
Yarvis et al. (2012) [65]	Low	Low	PCL-M	Low	Low	N/A**	N/A	N/A	Low	Low
Yeager & Magruder (2014) [48]	Low	Low	PCL-M	Low	Low	CAPS	Low	Low	Low	Low

Note. N/A = not applicable; * = No information with regard to blinding of the assessments available; ** No reference standard as it's a CFA

Discussion

Although many PTSD screening and diagnostic instruments have been validated in adults, studies conducted in samples of older adults are relatively rare. This systematic review summarized the psychometric properties of 24 instruments that have been used to detect PTSD in older adults across 40 research studies of sufficient quality.

A large number of studies ($n = 19$; 48%) consisted of small, selective samples, consisting of less than 150 participants. Additionally, most focused on U.S. male combat veterans, former prisoners of war, and Western populations. As a result, there is limited information on the assessment of PTSD in older adults within the general non-Western population; the present review identified only two studies conducted in non-Western samples that were published in the last ten years. One study was conducted in South Korean Vietnam Veterans [37, 44] and the study by [43] was conducted in evacuees of the Fukushima Daiichi accident (Japan). Both studies assessed instruments based on the DSM-IV. Thus, studies in non-Western samples are a significant gap in research. Finally, the finding that only six studies assessed an instrument based on the DSM-5 warrants a call for more research. Given the significant changes in diagnostic classification between DSM-IV and DSM-5 versions and the fact that less is known about PTSD symptom presentation in older adults, validation studies of DSM-5-based instruments in older adults are needed. Furthermore, no validated instruments were found for use in older adults with cognitive impairment and at the end of life, which is consistent with existing literature [21, 85].

For now, several studies have suggested using a lower cut-off score for older adults compared to younger adults [10, 18-20, 32], as older adults may have difficulty expressing psychological difficulties and/or distress compared to the general population. In addition, many older adults have multimorbidity, resulting in overlapping symptoms that make it challenging to diagnose PTSD [21]. This could lead to a failure to provide individuals who might need psychological help with potentially beneficial treatment [15].

The traditional diagnostic accuracy model involves comparing the results of the test being evaluated (index test) with those of the reference standard (gold standard), and it is considered to be the most reliable method for determining the presence or absence of a particular condition or disease [86]. The CAPS-5 is considered the gold standard in PTSD assessment in the general population. However, there is currently no validated gold standard that is more specific for the older adult population, making it challenging to validate existing assessment tools. A validated instrument can aid in diagnosing PTSD earlier, thereby

improving the likelihood that one will receive treatment sooner [87]. However, it is important to consider the suitability of tools for this population in terms of ease of administration and accessibility to all. For example, training is required to administer the CAPS-5, which is often not feasible in clinical practice [88]. Furthermore, the presence of multiple health conditions in this population must be taken into consideration. The existence of more validated instruments could also facilitate more research work on the unique manifestations of PTSD, and the distinctive challenges associated with dealing with such a psychological disorder at an age where physical issues/conditions are most likely to co-occur, in older adults. These lines of research could improve our understanding of the struggles older persons with PTSD might face, and the effective ways to help them (which might differ from those that were useful for younger adults), thereby improving the care they could receive.

Several limitations of the current systematic review should be noted. Firstly, the inclusion criteria were restricted such that only papers that appeared in the search results using English search terms were evaluated so studies using non-English key words were not retrieved. Furthermore, it is important to note that the studies included in this review have some notable limitations (e.g., small and selective samples, mainly Western populations and males). These could affect the generalizability of the findings to larger populations and other cultural contexts. Lastly, it is important to note that the number of validation studies for most of the instruments included in this review was limited. The majority of the instruments were validated by only one or two studies, meaning that these results can mainly be interpreted as preliminary. This also highlights the need for more validation studies to be conducted in the future to ensure that the results obtained are reliable and valid.

We recommend updating existing measurement tools to align with the current diagnostic criteria for PTSD in both DSM-5 and ICD-11. Alternatively, new scales and interviews can be developed to capture these criteria optimally. Additionally, more comprehensively validated diagnostic cut-off values and algorithms should be established to better identify those needing treatment. Given the limitations of the studies included, we suggest that more efforts should also be expended on future validation studies of available and new assessment instruments and to expand validation samples to include larger, linguistically-varied and more culturally diverse groups while balancing sociodemographic variables. In clinical practice we recommend using the CAPS-5 as it is the gold standard for assessing current and lifetime PTSD in the general population.

Conclusions

There is a general lack of research on the accuracy and reliability of PTSD screening and diagnostic instruments in the older adult general population. Validation studies conducted in specific older adult populations are either mostly absent (i.e., studies on cognitively impaired individuals and for use in end of life) or rare (i.e., studies that have used a non-Western sample) as well. The inclusion of older adults in research can be challenging due to mental, physical, and social obstacles (e.g., shame). More research is needed to establish a gold standard and to determine the most appropriate cut-off scores for this population. Additionally, future studies should also assess measures that are based on the DSM-5 or the ICD-11 and are easy to administer in clinical practice. Addressing these recommendations could provide important evidence for the suitability of PTSD screening and diagnostic tools for an often overlooked group (i.e., older adults), which could, in turn, result in more individuals getting the help and treatment they would need.

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Supplemental material

Appendix 1. Search strategy for each database

MEDLINE search

exp Aged/ or (elder* or eldest or senium or septuagenarian* or centarian* or centenarian* or "late life" or old* or senior* or geriatric* or senescent* or veteran*).ti,ab,kf.

AND

exp "Trauma and stressor related disorders"/ or (PTSD or posttraumatic* or post-traumatic* or "vicarious trauma*" or "complex trauma*" or "psychological trauma*" or "traumatic stress" or "trauma* event*" or "adverse childhood experience*").ti,ab,kf. or ((combat* or tortur* or genocide*) adj2 (trauma* or stress*)).ti,ab,kf.

AND

exp Diagnosis/ or exp "Surveys and Questionnaires"/ or Psychometrics/ or exp "Psychiatric Status Rating Scales"/ or Checklist/ or (screening* or checklist* or scale* or "diagnostic* tool*" or "structured interview*" or instrument or "psychological assessment").ti,ab,kf.

AND

exp "Sensitivity and Specificity"/ OR exp "Diagnostic Errors"/ OR exp "reproducibility of results"/ OR validation study/ OR (sensitiv* OR specific* OR accura* OR "gold* standard" OR (reference AND (test* OR standard)) OR "index test" OR valid* OR verif* OR (false AND (positive OR negative)) OR pretest OR pre-test OR posttest OR post-test OR predict* OR ROC Curve OR likelihood OR likelihood OR cutoff OR cut-off OR repeatability OR reproducibility OR efficacy OR reliability OR odds).ti,ab,kf.

Embase Search

exp aged/ or (elder* or eldest or senium or septuagenarian* or centarian* or centenarian* or "late life" or old* or senior* or geriatric* or senescent or veteran*).ti,ab,kf.

AND

exp "posttraumatic stress disorder"/ or (PTSD or posttraumatic* or post-traumatic* or "vicarious trauma*" or "complex trauma*" or "psychological trauma*" or "traumatic stress" or "trauma* event*" or "adverse childhood experience*").ti,ab,kf. or ((combat* or tortur* or genocide*) adj2 (trauma* or stress*)).ti,ab,kf.

AND

exp diagnosis/ or exp questionnaire/ or exp psychometry/ or "psychological rating scale"/ or checklist/ or (screening* or checklist* or scale* or diagnostic* tool* or "structured interview*" or instrument or "psychological assessment").ti,ab,kf.

AND

"sensitivity and specificity"/ OR exp "diagnostic error"/ OR reproducibility/ OR "validation study"/ OR (sensitiv* OR specific* OR accura* OR "gold* standard" OR (reference AND (test* OR standard))) OR "index test" OR valid* OR verif* OR (false AND (positive OR negative)) OR pretest OR pre-test OR posttest OR post-test OR predict* OR ROC Curve OR likelyhood OR likelihood OR cutoff OR cut-off OR repeatability OR reproducibility OR efficacy OR reliability OR odds).ti,ab,kf.

Web of Science Search

TS=(aged or elder* or eldest or senium or septuagenarian* or centarian* or centenarian* or "late life" or old* or senior* or geriatric* or senescent or veteran*)

AND

TS=("trauma and stressor related disorders" or PTSD or posttraumatic* or post-traumatic* or "vicarious trauma" or "complex trauma" or "psychological trauma" or "traumatic stress" or "trauma* event" or "adverse childhood experience*" or ((combat* or tortur* or genocide*) near/2 (trauma* or stress*)))

AND

TS=(diagnosis or "surveys and questionnaires" or psychometrics or "psychiatric status rating scale*" or checklist* or screening* or scale* or "diagnostic* tool*" or "structured interview*" or instrument or "psychological assessment")

AND

TS=("diagnostic error*" OR sensitiv* OR specific* OR accura* OR "gold* standard" OR (reference AND (test* OR standard)) OR "index test" OR valid* OR verif* OR (false AND (positive OR negative)) OR pretest OR pre-test OR posttest OR post-test OR predict* OR ROC Curve OR likelihood OR likelihood OR cutoff OR cut-off OR repeatability OR reproducibility OR efficacy OR reliability OR odds)

PsycInfo Search

DE "Older Adulthood" OR TI (elder* or eldest or senium or septuagenarian* or centarian* or centenarian* or "late life" or old* or senior* or geriatric* or senescent* or veteran*) OR AB (elder* or eldest or senium or septuagenarian* or centarian* or centenarian* or "late life" or old* or senior* or geriatric* or senescent* or veteran*) OR KW (elder* or eldest or senium or septuagenarian* or centarian* or centenarian* or "late life" or old* or senior* or geriatric* or senescent* or veteran*)

AND

DE "Stress and Trauma Related Disorders" OR DE "Acute Stress Disorder" OR DE "Adjustment Disorders" OR DE "Attachment Disorders" OR DE "Posttraumatic Stress Disorder" OR DE "Prolonged Grief Disorder" OR DE "Posttraumatic Stress Disorder" OR DE "Complex PTSD" OR TI (PTSD OR posttraumatic* OR post-traumatic* OR "vicarious trauma*" OR "complex trauma*" OR "psychological trauma*" OR "traumatic stress" OR "trauma* event*" OR "adverse childhood experience*" or ((combat* or tortur* or genocide*) N2 (trauma* or stress*))) OR AB (PTSD OR posttraumatic* OR post-traumatic* OR "vicarious trauma*" OR "complex trauma*" OR "psychological trauma*" OR "traumatic stress" OR "trauma* event*" OR "adverse childhood experience*" or ((combat* or tortur* or genocide*) N2 (trauma* or stress*))) OR KW (PTSD OR posttraumatic* OR post-traumatic* OR "vicarious trauma*" OR "complex trauma*" OR "psychological trauma*" OR "traumatic stress" OR "trauma* event*" OR "adverse childhood experience*" or ((combat* or tortur* or genocide*) N2 (trauma* or stress*)))

AND

DE "Diagnosis" OR DE "Diagnosis Related Groups" OR DE "Differential Diagnosis" OR DE "Medical Diagnosis" OR DE "Psychodiagnosis" OR DE "Checklist (Testing)" OR DE "Interviews" OR DE "Psychodiagnostic Interview" OR DE "Semi-Structured Interview" OR DE "Questionnaires" OR DE "Rating Scales" OR DE "Likert Scales" OR DE "Surveys" OR DE "Psychometrics" OR TI (screening* or checklist* or scale* or diagnostic* tool* or "structured

interview*" or instrument or "psychological assessment") OR AB (screening* or checklist* or scale* or diagnostic* tool* or "structured interview*" or instrument or "psychological assessment") OR KW (screening* or checklist* or scale* or diagnostic* tool* or "structured interview*" or instrument or "psychological assessment")

AND

DE "Consistency (Measurement)" OR DE "Error of Measurement" OR DE "Internal Validity" OR DE "Test Construction" OR DE "Test Reliability" OR DE "Internal Consistency" OR DE "Interrater Reliability" OR DE "Test-Retest Reliability" OR DE "Test Sensitivity" OR DE "Test Specificity" OR DE "Test Validity" OR DE "Construct Validity" OR DE "Content Validity" OR DE "Criterion Validity" OR DE "Research Transparency" OR TI (sensitiv* OR specific* OR accura* OR "gold* standard" OR (reference AND (test* OR standard)) OR "index test" OR valid* OR verif* OR (false AND (positive OR negative)) OR pretest OR pre-test OR posttest OR post-test OR predict* OR ROC Curve OR likelihood OR likelihood OR cutoff OR cut-off OR repeatability OR reproducibility OR efficacy OR reliability OR odds) OR AB (sensitiv* OR specific* OR accura* OR "gold* standard" OR (reference AND (test* OR standard)) OR "index test" OR valid* OR verif* OR (false AND (positive OR negative)) OR pretest OR pre-test OR posttest OR post-test OR predict* OR ROC Curve OR likelihood OR likelihood OR cutoff OR cut-off OR repeatability OR reproducibility OR efficacy OR reliability OR odds) OR KW (sensitiv* OR specific* OR accura* OR "gold* standard" OR (reference AND (test* OR standard)) OR "index test" OR valid* OR verif* OR (false AND (positive OR negative)) OR pretest OR pre-test OR posttest OR post-test OR predict* OR ROC Curve OR likelihood OR likelihood OR cutoff OR cut-off OR repeatability OR reproducibility OR efficacy OR reliability OR odds)

Clinical vignette: Jan [part 3]

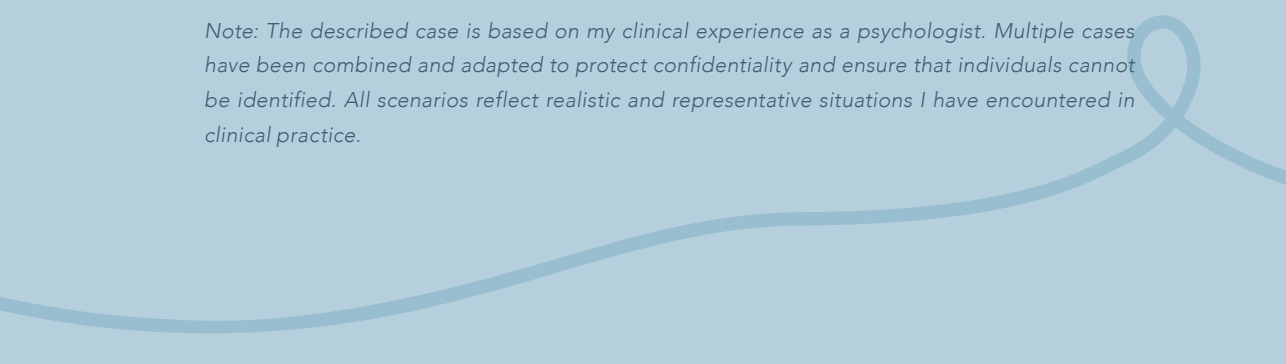
Clinical course and multidisciplinary involvement

Jan's behavior posed significant challenges for both his family and professional caregivers. In the period leading up to his admission, he had increasingly exhibited distressing behaviors—such as emotional outbursts, confusion at night, and persistent restlessness—that neither Maria nor his general care providers fully understood. Maria, his wife, struggled with feelings of guilt, particularly because many of these symptoms seemed to intensify after Jan moved into the nursing home. She questioned whether earlier recognition or intervention might have helped ease his experience.

Nursing home staff also felt ill-equipped to manage Jan's increasing neuropsychiatric symptoms and behaviors. They faced difficulties with his unpredictable emotional outbursts, frequent nighttime agitation, and episodes of wandering. Much of this behavior was attributed to the natural progression of dementia and his advanced age. Despite their best efforts, the emotional and physical demands of Jan's care began to impact the well-being of the team, especially the nurses and direct care staff, who reported increased stress, disrupted routines, and emotional exhaustion.

Due to the severity of his neuropsychiatric symptoms, including frequent nighttime distress and restlessness, the nursing home staff sought the assistance of a psychologist to help develop strategies for managing Jan's behaviors. Before this, the attending physician conducted a thorough medical evaluation to rule out possible somatic causes, such as infections, pain, or medication side effects. With no clear medical explanation for Jan's symptoms, the focus shifted toward psychological and behavioral factors. At that stage, the underlying cause of his distress remained unclear, and interventions focused primarily on symptom management rather than addressing a potential deeper issue.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.





Chapter 4

The role of Posttraumatic Stress Disorder as a risk factor for dementia: a meta-analysis

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Abstract

Background

Dementia is a growing global health concern, particularly among individuals with Posttraumatic Stress Disorder (PTSD). Previous research has established PTSD as a significant risk factor for dementia, but the role of comorbid conditions and other moderating factors remains unclear. This study aims to systematically assess the relationship between PTSD and dementia risk, including potential moderators.

Methods

A systematic literature review and meta-analysis were conducted in PubMed, CINAHL, PsycINFO, The Cochrane Library, and Scopus following predefined criteria. Random-effects meta-analyses were performed separately for unadjusted risk ratios (RRs) and adjusted hazard ratios (HRs). Subgroup and moderator analyses were conducted to examine the impact of population differences, study quality, demographic variables, health-related and lifestyle factors on the PTSD-dementia association.

Results

Seventeen studies were included after screening 28,818 records and reviewing 615 full-text articles. PTSD was associated with a 43% (unadjusted pooled $RR = 1.43$, 95% CI: 1.09–1.89, $I^2 = 99.22\%$, $p = 0.011$; thirteen studies) and 56% (adjusted pooled $HR = 1.56$, 95% CI: 1.27–1.91, $I^2 = 95.50\%$, $p < 0.001$; thirteen studies) increased dementia risk in unadjusted and adjusted models, respectively. Subgroup analyses showed no significant difference in effect size between the general population and veterans. Moderator analyses revealed that diabetes and hypertension strengthened the association between PTSD and dementia, whereas depression, traumatic brain injury, and drinking more alcohol might weaken it. However, post hoc analyses revealed that these moderation effects were no longer significant after exclusion of one influential study. No significant moderating effects were found for age, gender, and race. No evidence of publication bias was detected, as assessed using Egger's test.

Conclusion

These findings confirm PTSD as a significant risk factor for dementia, with metabolic and vascular comorbidities potentially increasing the risk. While depression and alcohol use initially appeared to attenuate the association, these study-level moderator effects were not robust in post hoc analyses. Replication is essential, and future research should focus on identifying mechanisms underlying these effects and developing targeted interventions for at-risk individuals.

Introduction

Dementia is an umbrella term for disorders characterized by a decline in cognitive function beyond that expected from normal aging and is a growing public health concern globally [1]. All-cause dementia, or dementia of any type, currently affects 55 million people worldwide, a number projected to rise to 152 million by 2050 due to population aging [1]. Dementia leads to significant impairments in daily functioning and quality of life, and despite decades of research, no curative treatment is currently available, underscoring the urgency of preventive strategies and early detection [2, 3]. Among the various populations at risk, adults with post-traumatic stress disorder (PTSD) have emerged as a particularly vulnerable group [4, 5]. PTSD, a mental health condition that can develop after exposure to a potentially traumatic event, is marked by symptoms such as intrusive memories, avoidance behaviors, negative changes in thinking and mood, and heightened arousal [6]. The intersection of PTSD and dementia is an area of increasing interest and concern within the medical and psychological communities [7-9].

Despite the growing interest in the relationship between PTSD and dementia, there remain significant gaps regarding the underlying mechanisms and the interplay of various risk and moderating factors. A previous systematic review from Günak et al. [8]. provided an in-depth exploration and meta-analysis of the available literature on this topic, describing the association between PTSD and all-cause dementia. Based on data from over 1.6 million individuals, results indicated that PTSD was associated with a 55% increased risk of developing dementia. This association remained after adjusting for key confounders, including depression and traumatic brain injury (TBI). Interestingly, the link between PTSD and dementia appeared to be stronger in community-based populations than among veterans, possibly reflecting differences in comorbidity profiles or healthcare access. Despite the robustness of these findings, substantial heterogeneity across studies was observed. The authors therefore emphasized the importance of longitudinal research and a more nuanced exploration of potential moderators, such as social support, lifestyle behaviors, and co-existing medical conditions like hypertension and diabetes. In the present meta-analysis, we build on and extend the work of Günak et al. [8] by including studies up to the year 2025, systematically examining potential moderators of the PTSD–dementia relationship rather than focusing solely on PTSD as a risk factor, and applying a more rigorous and broader screening process. Furthermore, by calculating unadjusted risk ratios (RRs) from available raw data in addition to using reported hazard ratios (HRs), we were able to include a greater number of studies in the meta-analysis, thereby increasing the robustness and generalizability of our findings.

Many demographic factors and comorbid conditions are independently associated with an increased dementia risk [3, 10, 11]. When combined with PTSD, they may strengthen this association through multiple biological and behavioral mechanisms. Several studies suggest that certain subgroups (e.g., females [12] and civilians [13]) have an increased risk of developing dementia, highlighting potential differences in biological vulnerability or healthcare access.

Several studies have shown an association between (mid-life) diabetes mellitus and increased dementia risk, due to vascular changes that can impair cognitive function [10, 14, 15]. And other studies highlighted the role of hypertension-related cerebrovascular dysfunction, which can lead to dementia [3, 16, 17]. PTSD itself is associated with chronic stress, dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, and persistent elevated cortisol levels, which can negatively affect the hippocampus, a critical region for memory processing [18, 19]. The co-occurrence of PTSD with metabolic or vascular conditions may accelerate neurodegenerative processes and increase dementia risk beyond the effect of each condition alone[20].

Neurological and psychiatric factors commonly comorbid with PTSD are also independently associated with dementia risk. For example, TBI has been strongly linked to neurodegenerative diseases, potentially due to blood-brain barrier disruption, neuroinflammation, and tau accumulation [21]. Additionally, depression has been associated with a two-fold increased risk of developing dementia potentially due to its impact on brain structure and function, such as hippocampal atrophy, neuroinflammation, and disruption of stress-regulating systems [10, 22, 23]. Conversely, depressive symptoms can be an early manifestation of dementia, particularly Alzheimer's disease, suggesting that depression may be both a prodrome and a consequence of neurodegenerative processes [3, 24, 25]. As both PTSD and depression share these pathways, their combination could intensify cognitive decline. However, depressive symptoms may also reflect prodromal dementia, complicating interpretation [26].

Additionally, behavioral risk factors associated with a diagnosis of PTSD such as alcohol consumption and smoking further contribute to neuronal damage and inflammation, which increases dementia risk [27]. For example, alcohol use and smoking are associated with an increased risk of vascular dementia [28, 29], which highlights the role of modifiable lifestyle factors in dementia risk.

The present systematic literature review and meta-analysis aims to quantify the association between PTSD and dementia risk and identify moderators of this relationship.

Methods

Search strategy

The literature search was conducted in PubMed, CINAHL, PsycINFO, The Cochrane Library and Scopus, and included all articles published between 1980 and March 2025. ProQuest Dissertations and Theses Global were searched for grey literature and unpublished studies. We also hand-searched the reference lists of related articles and secondary literature.

We utilized a comprehensive list of search terms (see Supplemental material) to carry out the systematic review. Two reviewers (DH, TF, ML, CR, CP, CH, SS or KL) independently screened each title and abstract, with a third reviewer available to resolve any disagreements. All full-text articles were also reviewed independently by two reviewers (DH, TP ML, CH, SS or KL), and any disputes were settled through consensus. The search strategy adhered to the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) 2020 guidelines [30]. A full study protocol is available for this review and can be consulted on the PROSPERO international register of systematic reviews (Record number: CRD42019128553).

Study selection

As the primary goal of this study was to identify possible moderators of dementia risk among adults with PTSD, we included all studies in which current post-traumatic stress symptoms in dementia cases were described. Additionally, we used the following inclusion criteria: (a) studies on adults, with an average age of ≥ 50 years at follow-up, who have been diagnosed with PTSD, given earlier onsets associated with some types of dementia; (b) observational longitudinal cohort studies (prospective and retrospective) with 300 or more participants; (c) randomized controlled trials (RCTs) with ≥ 50 participants; (d) studies published between 1980 and March 2025. We limited our search to publications in the English language and involving human subjects and excluded those that focused solely on symptoms of PTSD or dementia, rather than the full diagnosis. The study quality was evaluated using the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) guidelines [31].

Data extraction

Data were extracted into evidence tables in Excel, independently by at least two reviewers (DH, TF, KL). Disagreements between the two reviewers were resolved by consensus or by obtaining a third reviewer's opinion should the two reviewers fail to reach consensus. Extracted data items included: (a) mild cognitive impairment (MCI) and dementia diagnoses; (b) assessment/ diagnostic instruments used for PTSD and dementia; (c) PTSD total and symptom cluster

severity scores; (d) participant characteristics such as average age, gender and race; (e) study methodology including sample size and study design; (f) potential predictor factors (e.g., diabetes, hypertension, TBI/head injury, depression, alcohol use, smoking and substance use); (g) study findings (e.g., RRs and HRs) and; (h) author conclusions. Two reviewers (DH, CR, or TF) independently assessed risk of bias following the recommendations from Grading of Recommendations, Assessment, Development and Evaluations [32].

Statistical analysis

All statistical analyses were conducted using the metafor package in RStudio [33]. Two separate meta-analyses using random-effects meta-analysis with a restricted maximum-likelihood (REML) estimator were performed: one using risk ratios (RR) based on raw (unadjusted) data and the other using hazard ratios (HR) from adjusted estimates. This approach was necessary as many studies reported only HRs without providing raw data for RR calculations, while others lacked time-to-event data required for HR estimation. Corresponding authors were contacted by e-mail if information was missing (e.g., effect estimates or sample sizes), but either no response was received or the data were no longer available.

The pooled effect size with 95% confidence intervals (CI) and corresponding p-value were calculated for each analysis. Heterogeneity was assessed using Q-statistic (Q) with p-value, I^2 , and τ^2 [34]. Egger's test was performed to evaluate publication bias (i.e., small study effects), and visual inspection of funnel plots was also conducted to assess asymmetry. Moderator analyses included regression coefficient (B) with standard error (SE), p-value, QM-statistic (df), I^2 , and R^2 to quantify explained heterogeneity. Subgroup analyses were conducted based on population type (veterans vs. general population), and a sensitivity analysis was performed to assess the impact of study quality. Meta-regression models were performed using the `rma()` function, testing each study-level characteristic (e.g, quality of study, age, race, gender, veteran or general population, diabetes, hypertension, TBI/head injury, depression, alcohol use, smoking and substance use) separately. For example by entering the proportion of female participants as a continuous moderator to examine its influence on the PTSD–dementia association.

To assess the robustness of significant moderator effects, post-hoc analyses were conducted in which the study by Roughead et al. [35], which reported particularly high prevalence rates of depression and alcohol use, was excluded. This allowed us to explore whether the observed moderation effects were driven by this single influential study.

Results

Study selection and characteristics

We initially identified 35,113 abstracts. After removing duplicates, we screened 28,818 records based on title and/or abstract, resulting in 615 articles eligible for full-text review. Of these, 588 records were excluded due to different reasons based on the exclusion criteria (see Figure 1), resulting in 27 studies that met inclusion criteria. All included studies were observational cohort studies; no RCT's were identified. Of the studies that met inclusion criteria, 10 were excluded in the meta-analyses due to missing data required to calculate either a RR or a HR. Thus, a total of 17 studies that met the criteria. Additionally, two studies reported on two independent samples [36, 37], which were treated as separate datasets in the analyses. In total, 13 studies provided sufficient data to be included in the unadjusted RR meta-analysis and 13 in the adjusted HR meta-analysis. Some studies contributed to both analyses, while others could only be included in one due to limitations in the reported data—such as the absence of raw data for RR calculation or a lack of time-to-event information for HR estimation. Characteristics of the included studies are presented in Tables 1 and 2.

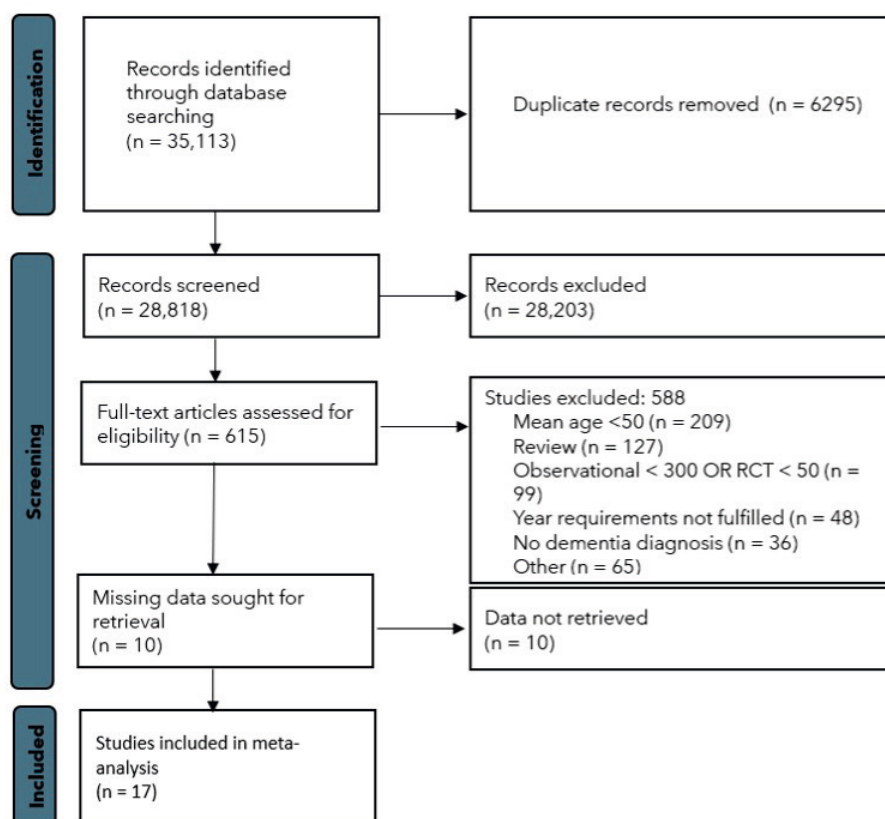


Figure 1. PRISMA flowchart of included studies

Table 1. Characteristics of included studies

Author (year), country	Study type	Study population	Sample at baseline (N)	Age (years)	Assessment/ diagnostic criteria	Effect estimate	Quality rating
Bhattarai et al. (2019) [38], USA	Retrospective	Veterans	4800	M = 64.57	PTSD ICD-9 Dementia ICD-9	RR = 1.28 [1.04, 1.58]	Poor
Clouston et al. (2016) [39], USA	Retrospective	Search and rescue responders	818	M = 51.58 to 54.41	PTSD DSM-IV Dementia MMSE<18	RR = 1.63 [1.10, 2.41]	Poor
Flatt et al. (2018) [12], USA	Retrospective	General population	499,844	M = 71.1	PTSD ICD-9 Dementia ICD-9	RR = 1.10 [0.95, 1.28] HR = 1.20 [1.02, 1.41]	Good
Gardner et al. (2023) [40], USA	Retrospective	Veterans	285,417	M = 66.74	PTSD ICD-9 & ICD-10 Dementia ICD-9 & ICD-10	RR = 1.18 [1.14, 1.22]	Good
Gradius et al. (2019) [41], Denmark	Retrospective	General population	279,188	87% 40-59 13% >60	PTSD ICD-10 Dementia ICD-10	RR = 2.00 [1.60, 2.50] HR = 2.00 [1.27, 3.14]	Good
Islamaska et al. (2021) [42], Denmark	Retrospective	General population	103,484	Mdn = 53	PTSD ICD-10 Dementia ICD-8 & ICD-10	RR = 0.92 [0.55, 1.52] HR = 1.08 [0.64, 1.82]	Good
Kim et al. (2023) [43], Korea	Retrospective	General population	35,624	77.2% 40-59 22.8% >60	PTSD ICD-10 Dementia ICD-10	HR = 1.78 [1.13, 2.81]	Good

Table 1. Characteristics of included studies (continued)

Author (year), country	Study type	Study population	Sample at baseline (N)	Age (years)	Assessment/ diagnostic criteria	Effect estimate	Quality rating
Liu et al. (2024) [44], UK	Prospective	General population	486,297	Range = 40- 69	PTSD ICD-10 Dementia ICD-10	HR = 0.56 [0.08, 4.01]	Poor
Logue et al. (2023) [45], USA	Retrospective	European ancestry veterans	181,473	M = 77.77 to 82.86	PTSD ICD-9 & ICD-10 Dementia ICD-9 & ICD-10	RR = 1.20 [1.13, 1.27]	Poor
Logue et al. (2023) [37], USA	Retrospective	African ancestry veterans	17,634	M = 76.07 to 80.70	PTSD ICD-9 & ICD-10 Dementia ICD-9 & ICD-10	RR = 0.95 [0.84, 1.08]	Poor
Mawanda et al. (2017) [46], USA	Retrospective	Veterans	417,172	M = 67.7	PTSD ICD-9 Dementia ICD-9	HR = 1.55 [1.45, 1.66]	Good
Meziab et al. (2014) [47], USA	Retrospective	Veterans	182,879	M = 68.4	PTSD ICD-9 Dementia ICD-9	HR = 1.52 [1.41, 1.64]	Good
Qureshi et al. (2010) [48], USA	Retrospective	Veterans	10,481	M = 73.3 to 73.9	PTSD ICD-9 Dementia ICD-9	RR = 2.27 [1.97, 2.61]	Good
Roughhead et al. (2017) [35], Australia	Retrospective	Veterans	15,612	Mdn = 57	PTSD ICD-10 Dementia ICD-10	RR = 0.79 [0.62, 1.00] HR = 0.81 [0.62, 1.06]	Good

Table 1. Characteristics of included studies (continued)

Author (year), country	Study type	Study population	Sample at baseline (N)	Age (years)	Assessment/ diagnostic criteria	Effect estimate	Quality rating
Song et al. (2020) [36], Sweden	Prospective	Exposed individuals and matched unexposed individuals	657,083	Mdn = 47	PTSD ICD-9 & ICD-10 Dementia ICD-9 & ICD-10	HR = 1.76 [1.12, 2.77]	Good
Song et al. (2020) [36], Sweden	Prospective	Sibling cohort	123,321	Mdn = 48	PTSD ICD-9 & ICD-10 Dementia ICD-9 & ICD-10	HR = 1.50 [0.57, 3.95]	Good
Wang et al. (2016) [49], Taiwan	Retrospective	General population	8,750	M = 55.4	PTSD ICD-9 Dementia ICD-9	RR = 6.00 [4.27, 8.43] HR = 4.37 [2.53, 7.55]	Poor
Yaffe et al. (2010) [18], USA	Retrospective	Veterans	181,093	M = 68.8	PTSD ICD-9 Dementia ICD-9	RR = 1.61 [1.56, 1.66] HR = 1.77 [1.70, 1.85]	Good
Yaffe et al. (2019) [50], USA	Retrospective	Veterans	109,140	M = 68.5	PTSD ICD-9 Dementia ICD-9	RR = 1.13 [0.87, 1.47] HR = 1.78 [1.34, 2.36]	Good

M = mean, Mdn = Median, PTSD = Posttraumatic Stress Disorder, ICD = International Classification of Diseases, HR = Hazard Ratio, RR = Risk Ratio.

Table 2. Prevalence of potential moderator variables across included studies

Study	White (%)	Female (%)	Diabetes (%)	Hypertension (%)	TBI/head injury (%)	Depression (%)	Alcohol use (%)	Smoking (%)	Substance use (%)
Bhattraei et al 2019	50%	50%	-	-	-	33.33%	-	-	-
Clouston et al 2016	-	7.01%	5.04%	28.04%	31.11%	19.43%	4.92%	7.38%	-
Flatt et al 2018	68.28%	54.68%	17.1%	-	1.38%	8.59%	-	-	-
Gardner et al 2023	79%	5.8%	24.5%	57.2%	33.33%	20.9%	-	-	-
Gradius et al 2019	-	59%	-	-	-	2.07%	2.22%	-	0.74%
Islamaska et al 2021	-	64.71%	-	-	2.22%	-	-	-	-
Kim et al 2023	-	66.8%	25.2%	51%	-	11%	-	-	-
Liu et al 2024	-	53.9%	4.6%	-	-	-	-	-	-
Logue et al 2023	-	2.4%	-	-	7.57%	-	31.59%	74.32%	-
Logue et al 2023	-	3.55%	-	-	4.66%	-	22.35%	71.63%	-
Mawanda et al 2017	82.1%	2.1%	28.2%	70.4%	0.27%	10.9%	12.8%	10.5%	1.18%
Meziab et al 2014	-	-	29.46%	72.6%	0.66%	5.4%	5.6%	17.6%	1.63%
Qureshi et al 2010	69.97%	0.6%	27.51%	63.61%	1.43%	-	2.28%	-	8.95%
Roughead et al 2017	-	0%	9.9%	5.4%	-	53.6%	28.1%	0.76%	8.3%
Song et al 2020	-	60.6%	-	-	-	-	-	-	-
Song et al 2020	-	53.7%	-	-	-	-	-	-	-
Wang et al 2016	-	76.6%	18.11%	37.9%	4%	19.47%	3.14%	-	2.51%
Yaffe et al 2010	-	3.47%	24.76%	60.2%	0.48%	13.49%	7.15%	3.07%	15.9%
Yaffe et al 2019	72.8%	100%	16.05%	47.7%	-	-	1.03%	11.2%	-

Primary meta-analysis of PTSD and dementia risk

Two random-effects meta-analyses were conducted to assess the association between PTSD and the risk of developing dementia (see Table 3 & 4). The first forest plot (Figure 2) displays the results from individual studies as well as the pooled unadjusted RR estimate. Across the thirteen studies included in the analysis, the pooled RR for the association between PTSD and dementia was found to be 1.43 (95% CI: 1.09, 1.89, $I^2 = 99.22\%$, $p = 0.011$). This indicates that individuals with PTSD have a 43% higher risk of developing dementia compared to those without PTSD. Visual inspection of the funnel plot (Fig. 3) suggested no publication bias, which was supported by the Egger test ($z = 0.476$, $p = 0.63$).

The second forest plot (Figure 4) presents a pooled adjusted HR of 1.56 (95% CI: 1.27–1.91, $I^2 = 95.50\%$, $p < 0.001$) for the association between PTSD and dementia. This finding suggests that individuals with PTSD have a 56% increased risk of developing dementia compared to those without PTSD. A visual inspection of the funnel plot (Figure 5) did not indicate signs of publication bias, which was further confirmed by Egger's test ($z = -0.0010$, $p = 0.99$).

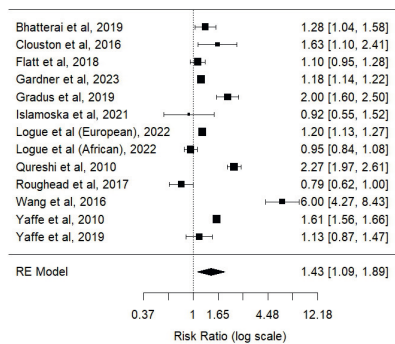


Figure 2. Meta-analysis of RRs of PTSD compared with no PTSD on dementia risk

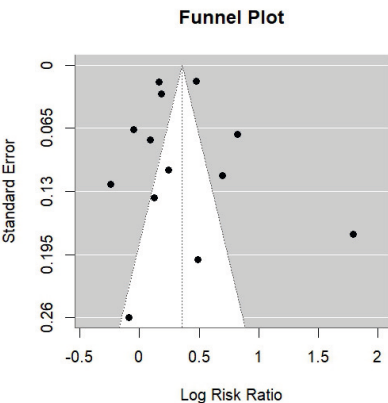


Figure 3. Funnel plot with pseudo 95% confidence limits to inspect publication bias

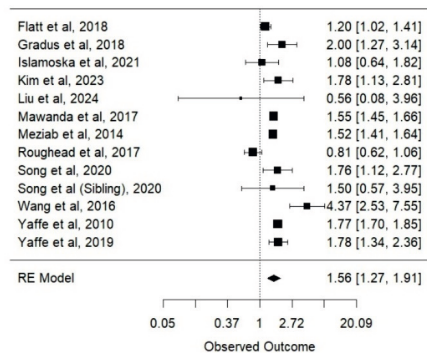


Figure 4. Meta-analysis of HRs of PTSD compared with no PTSD on dementia risk

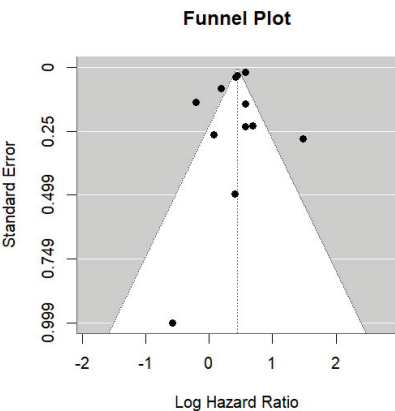


Figure 5. Funnel plot with pseudo 95% confidence limits to inspect publication bias.

Subgroup, moderator, and sensitivity analyses

The results of all the subgroup analyses, sensitivity analyses and moderator analyses are presented in Tables 3, 4, 5 and 6. These tables provide an overview of the pooled effect estimates for different population subgroups, the robustness of findings when restricting analyses to high-quality studies, and the influence of various moderators on the association between PTSD and dementia.

Table 3. Meta-analysis (unadjusted RR) and sensitivity analysis of the association of PTSD and dementia

Analysis	Studies (n)	Pooled RR (95% CI)	p-value	Q, P and I ²	τ^2	Egger's Test (p-value)
Main analysis	13	1.43 (1.09 – 1.89)	0.011	389.37, <0.0001 99.22%	0.24	0.63
Sensitivity analysis Good quality studies	9	1.53 (1.03 – 2.27)	0.034	334.54, <0.0001 99.48%	0.35	0.90
Population						
General population only	5	1.82 (0.96 – 3.46)	0.066	90.29, <0.0001 96.30%	0.50	0.91
Veteran population only	8	1.25 (1.00 – 1.56)	0.050	293.54, <0.0001 98.76%	0.096	0.39

Table 4. Meta-analysis (adjusted HR) and sensitivity analysis of the association of PTSD and dementia

Analysis	Studies (n)	Pooled HR (95% CI)	p-value	Q, P and I²	τ²	Egger's Test (p-value)
Main analysis	13	1.56 (1.27 – 1.91)	<0.0001	77.26, <0.0001 95.50%	0.10	0.99
Sensitivity analysis Good quality studies	11	1.47 (1.25 – 1.73)	<0.0001	63.71, <0.0001 92.80%	0.05	0.97
Population						
General population only	6	1.49 (1.18 – 1.87)	0.0053	45.81, 0.0007 96.89%	0.07	0.75
Veteran population only	5	1.42 (1.10 – 1.83)	0.0069	6.75, 0.1499 44.46%	0.03	0.51

Table 5. Moderator analysis (unadjusted RR)

Moderator	Studies (n)	B	SE	P-value	QM (df)	I²	R²
Quality of study	13	-0.22	0.31	0.48	0.49 (1)	99.14%	0.00%
Age (M)	10	-0.03	0.018	0.051	3.81 (1)	99.12%	25.23%
White (%)	5	-0.001	0.016	0.95	0.0035 (1)	95.27%	0.00%
Female (%)	13	0.004	0.004	0.39	0.74 (1)	99.27%	0.00%
Veterans General population	13	-0.39 0.61	0.28 0.22	0.17 0.007	1.88 (1)	99.19%	7.80%
Diabetes (%)	8	0.020	0.032	0.53	0.39 (1)	99.63%	0.00%
Hypertension (%)	7	0.008	0.013	0.54	0.37 (1)	99.70%	0.00%
TBI/Head injury (%)	9	-0.005	0.016	0.74	0.11 (1)	99.24%	0.00%
Depression (%)	8	-0.015	0.014	0.27	1.22 (1)	99.32%	2.94%
Alcohol use (%)	9	-0.029	0.014	0.036	4.40 (1)	97.65%	31.95%
Smoking (%)	6	-0.002	0.004	0.64	0.22 (1)	93.05%	0.00%
Substance use (%)	5	-0.054	0.062	0.39	0.75 (1)	98.29%	0.00%

Table 5. Moderator analysis (unadjusted RR) (continued)

Moderator	Studies (n)	B	SE	P-value	QM (df)	I²	R²
Post-hoc analysis							
Depression (%)	7	-0.029	0.025	0.91	0.013 (1)	99.25%	0.00%
Alcohol use (%)	8	-0.025	0.017	0.15	2.12 (1)	98.06%	14.96%

Table 6. Moderator analysis (adjusted HR)

Moderator	Studies (n)	B	SE	P-value	QM (df)	I²	R²
Quality of study	13	1.10	0.37	0.003	8.87 (1)	92.13%	48.90%
Age (M)	5	-0.08	0.05	0.11	2.53 (1)	88.64%	25.52%
Female (%)	10	0.0026	0.0029	0.38	0.77 (1)	92.87%	0.00%
Veterans General population	11	0.036 0.40	0.185 0.11	0.84 0.0002	0.037 (1)	93.82%	0.00%
Diabetes (%)	7	0.026	0.012	0.030	4.69 (1)	93.18%	46.30%
Hypertension (%)	6	0.009	0.004	0.008	6.95 (1)	91.81%	64.33%
TBI/Head injury (%)	5	-0.26	0.11	0.015	5.87 (1)	83.69%	63.39%
Depression (%)	7	-0.01	0.005	0.009	6.82 (1)	92.28%	58.08%
Alcohol use (%)	6	-0.029	0.008	<0.001	13.75 (1)	83.59%	84.34%
Smoking (%)	5	0.02	0.02	0.35	0.86 (1)	97.07%	0.00%
Substance use (%)	5	-0.006	0.029	0.84	0.04 (1)	97.42%	0.00%
Post-hoc analysis							
Depression (%)	6	0.008	0.015	0.58	0.30 (1)	85.82%	0.00%
Alcohol use (%)	5	-0.010	0.013	0.44	0.61 (1)	76.53%	0.00%

Study quality

A moderator analysis was performed to formally assess whether study quality influenced effect size. The results for unadjusted RR were non-significant ($B = -0.22$, $SE = 0.31$, $p = 0.483$), indicating that study quality did not systematically impact the effect size. However, for adjusted HR, study quality was a significant moderator ($QM(1) = 8.87$, $p = 0.003$). We found that higher study quality was related to a stronger association between dementia and PTSD ($B = 1.10$, $SE = 0.37$, $p = 0.003$, $I^2 = 92.13\%$, $R^2 = 48.90\%$).

A sensitivity analysis including only high-quality studies was conducted to assess the robustness of the findings. The pooled unadjusted RR was 1.53 (95% CI: 1.03–2.27, $p = 0.034$), indicating a significant association. Despite this, substantial heterogeneity remained ($Q(7) = 334.54$, $p < 0.0001$, $I^2 = 99.48\%$). Similarly, the corresponding adjusted HR analysis also confirmed a significant relationship, with a pooled HR of 1.47 (95% CI: 1.25–1.73, $p < 0.0001$, $I^2 = 92.80\%$), suggesting that PTSD remains a significant risk factor for dementia even when lower-quality studies are excluded.

Demographic characteristics as well as several metabolic, neurological, and psychiatric conditions were assessed as potential moderators of the association between PTSD and dementia.

Demographic factors

A moderator analysis was conducted to assess whether the mean age of study participants influenced the association between PTSD and dementia. The results were not statistically significant for either unadjusted RR ($B = -0.034$, $SE = 0.018$, $p = 0.051$, $I^2 = 99.12\%$, $R^2 = 25.23\%$) or adjusted HR ($B = -0.083$, $SE = 0.052$, $p = 0.11$, $I^2 = 88.64\%$, $R^2 = 25.52\%$). These findings suggest that age does not significantly impact effect sizes, although a trend toward weaker associations in older samples was observed.

The percentage of white participants did not significantly moderate the association between PTSD and dementia. For unadjusted RR, studies with a higher percentage of white individuals did not report significantly different effect sizes ($B = -0.001$, $SE = 0.016$, $p = 0.95$, $I^2 = 95.27\%$, $R^2 = 0.00\%$). Due to insufficient reporting of relevant data, this moderator could not be assessed for the adjusted HR meta-analysis.

Similarly, the percentage of female participants was not a significant moderator according to both the unadjusted RR ($B = 0.004$, $SE = 0.004$, $p = 0.39$) and adjusted HR ($B = 0.003$, $SE = 0.003$, $p = 0.38$). Therefore, neither race nor gender significantly impacted the relationship between PTSD and dementia.

Finally, veteran status did not significantly influence the pooled unadjusted RR ($B = -0.39$, $SE = 0.28$, $p = 0.17$, $I^2 = 99.19\%$, $R^2 = 7.80\%$) or the pooled adjusted HR ($QM(1) = 0.037$, $p = 0.84$), suggesting that the effect of PTSD on dementia does not significantly differ between the veteran population or the population that are not veterans. When examining adjusted HR, veteran status was included as a moderator. The results did not significantly influence the pooled adjusted HR ($QM(1) = 0.037$, $p = 0.84$), indicating that PTSD is a significant risk factor in both populations, but the effect does not significantly differ between veterans and the general population.

Metabolic factors

Neither diabetes nor hypertension significantly influenced the pooled unadjusted RR. However, the percentage of individuals with diabetes significantly influenced the pooled adjusted HR. Studies with a higher prevalence of diabetes reported a larger adjusted HR ($B = 0.026$, $SE = 0.012$, $p = 0.03$, $I^2 = 93.18\%$, $R^2 = 46.30\%$). Similarly, studies with a higher prevalence of hypertension showed a stronger relationship between PTSD and dementia ($B = 0.009$, $SE = 0.004$, $p = 0.008$, $I^2 = 91.81\%$, $R^2 = 64.33\%$), influencing the adjusted HR. Therefore, PTSD may have a greater impact on dementia risk among individuals with diabetes and hypertension.

Neurological and psychiatric factors

Neither TBI nor depression significantly influenced the pooled unadjusted RR. In contrast, studies with a higher percentage of participants with TBI or head injury reported a lower adjusted HR ($B = -0.26$, $SE = 0.11$, $p = 0.015$, $I^2 = 99.02\%$, $R^2 = 0.00\%$), suggesting a weaker association between PTSD and dementia in these populations.

Additionally, a higher proportion of individuals with depression was associated with a weaker relationship between PTSD and dementia ($B = -0.01$, $SE = 0.005$, $p = 0.009$, $I^2 = 92.28\%$, $R^2 = 58.08\%$). To assess the robustness of this finding, a post-hoc analysis was conducted, excluding the study by Roughead et al. [35], which reported a particularly high prevalence of depression. When this study was removed, the moderating effect for RR, the overall effect of depression as a moderator was already non-significant ($B = -0.015$, $SE = 0.014$, $p = 0.27$), and remained so after excluding the same study ($B = -0.029$, $SE = 0.025$, $p = 0.91$, $I^2 = 99.25\%$, $R^2 = 0.00\%$), suggesting that this single study may have strongly influenced the original association. Similarly, adjusted HR was no longer significant ($B = 0.008$, $SE = 0.015$, $p = 0.58$, $I^2 = 85.82\%$, $R^2 = 0.00\%$).

A moderator analysis of alcohol use revealed significant moderation effects for both unadjusted RR and adjusted HR. Alcohol use significantly influenced

the pooled unadjusted RR, with studies including a higher percentage of participants consuming alcohol reporting lower RRs ($B = -0.0293$, $SE = 0.010$, $p = 0.036$). Similarly, for adjusted HR, studies including a higher percentage of participants consuming alcohol reporting lower HRs ($B = -0.029$, $SE = 0.008$, $p < 0.001$, $I^2 = 97.65\%$, $R^2 = 31.95\%$). To further explore the robustness of this finding, a post-hoc analysis was conducted in which the study by Roughead et al. [35] was excluded due to its relatively high alcohol use prevalence and potential influence on the model. After exclusion, the moderating effect of alcohol use was no longer statistically significant for either unadjusted RR ($B = -0.025$, $SE = 0.017$, $p = 0.15$, $I^2 = 98.06\%$, $R^2 = 14.96\%$) or adjusted HR ($B = -0.010$, $SE = 0.013$, $p = 0.44$, $I^2 = 76.53\%$, $R^2 = 0.00\%$). This suggests that the initial effect may have been partially driven by the inclusion of this single study and should be interpreted with caution.

For smoking and substance use, neither RR nor HR analyses revealed a significant moderation effect, indicating that these factors did not contribute to heterogeneity in effect sizes across studies.

Discussion

The present meta-analysis provides further insights into the association between PTSD and dementia, highlighting the role of potential moderators of this relationship. Consistent with a previous meta-analysis [8], our findings confirm that PTSD is a significant risk factor for dementia, with individuals showing a 43% increased risk based on unadjusted RRs and a 56% increased risk based on adjusted HRs. However, the strength of this association appears to be influenced by various metabolic, neurological, and psychiatric comorbidities. Some reported health conditions, such as diabetes and hypertension, intensified the observed association between PTSD and dementia; others, such as TBI, depression and alcohol use, weakened the association. Post hoc analyses further revealed that these moderation effects were not always consistent across studies. Specifically, the significant moderating effects of depression and alcohol use on the adjusted HRs became non-significant when one particular study was removed [35], suggesting that the strength of these associations may be driven by one individual study. This highlights the need for cautious interpretation and replication in future research.

Our results showed that the association between PTSD and dementia was stronger in individuals with comorbid diabetes, suggesting that metabolic dysfunction may amplify neurodegenerative risk [51]. Diabetes is well-established as a risk factor for both vascular dementia and Alzheimer's disease

due to its role in promoting insulin resistance, microvascular damage, and neuroinflammation [10, 14, 15]. However, PTSD is also a risk factor for diabetes. PTSD has been linked to chronic dysregulation of the HPA axis, leading to low cortisol levels [52]. The lower cortisol levels weaken the immune system and lead to chronic inflammation [53], increasing the risk of diabetes [54]. From this perspective, physiological abnormalities in the HPA axis, changes in metabolic hormones, and lifestyle factors may explain why PTSD is a risk factor for diabetes [55]. Thus, PTSD and diabetes may work synergistically to create a heightened state of metabolic stress, which may accelerate neurodegenerative processes ultimately increasing the risk for dementia.

Similarly, hypertension is known to increase the risk of cognitive decline by making blood vessels stiffer, reducing blood flow to the brain, and weakening the blood-brain barrier [3, 16, 17]. PTSD can further contribute to this problem by causing an overactive stress response, which raises blood pressure and puts extra strain on the brain's blood vessels [56]. Over time, stress-related high blood pressure can lead to small, unnoticed strokes, damage to brain tissue, and reduced oxygen supply to certain areas of the brain, which increase the dementia risk [57]. Indeed, a diagnosis of PTSD is associated with a 94% increased risk of hypertension incidence [56]. The combination of PTSD and hypertension may amplify vascular damage, speeding up cognitive decline that could lead to dementia.

Although metabolic conditions strengthened the association between PTSD and dementia, TBI or head injury appeared to weaken the association despite TBI on its own increases dementia risk [21]. One possible reason is that some symptoms of PTSD after a brain injury may actually be caused by TBI-related cognitive issues rather than PTSD itself. This overlap makes it more difficult to distinguish the specific effects of PTSD and TBI in dementia research.

Likewise, moderation by depression was associated with a weaker association between PTSD and dementia. This finding is particularly intriguing given that depression itself is a well-documented risk factor for dementia [10, 22, 23, 58]. Both PTSD and depression are linked to overlapping neurobiological mechanisms, including chronic stress, inflammation, hippocampal atrophy, and HPA-axis dysregulation, that have all been implicated in cognitive decline and dementia development [3, 26]. It is possible that when these pathways are already activated by depression, the additional impact of PTSD may be less detectable, effectively "tapping" the same vulnerability pathways.

Importantly, post hoc analyses suggested that this moderation effect may have been driven by a single study with unusually high depression rates. The

influence of this study highlights how variability in study populations—such as clinical vs. community samples—can shape pooled outcomes and suggests that future research should carefully consider the context and measurement of comorbid conditions. Additionally, our analysis did not distinguish between early- and late-onset depression. Prior literature indicates that late-onset depression, often linked to vascular pathology or prodromal dementia, may carry different implications for dementia risk than early-onset forms [3, 24, 25]. Without detailed onset data or survival analyses, we are limited in interpreting these trajectories. As such, while our findings point to a potentially attenuating role of depression, this observation should be interpreted with caution and warrants further investigation in more finely stratified samples.

The finding that a higher prevalence of people who drink alcohol was associated with a weaker PTSD-dementia relationship appears counterintuitive. An extensive body of literature links alcohol consumption, regardless of amount, to adverse health outcomes, including neurodegeneration and increased dementia risk [28, 29, 59, 60]. Recent studies have challenged earlier suggestions of a protective effect of light-to-moderate alcohol intake, instead emphasizing that even low levels of consumption are associated with increased risks of cancer, cognitive decline, and dementia [61-64].

Since we used aggregated study data rather than individual-level data, the results reflect group-level trends. Thus, moderation effects do not show direct causal links but suggest that the strength of the PTSD–dementia association may vary depending on background levels of certain characteristics. Nonetheless, the association observed in our data warrants further exploration. One possible explanation may lie in the role of alcohol as a form of self-medication among individuals with PTSD [65]. Alcohol and other substances are often used to manage hyperarousal and emotional distress, core symptoms of PTSD, which could confound the observed relationship between trauma exposure, substance use, and cognitive outcomes [66, 67]. Indeed, research has shown that reductions in PTSD symptoms are frequently accompanied by declines in substance and alcohol use, suggesting a dynamic, bidirectional interplay between trauma-related distress and coping behavior [66].

Another explanation may relate to sample composition. Post-hoc analyses indicated that the found moderation effect was largely driven by one particular study with notably high alcohol use prevalence [35]. It is possible that in such populations, higher rates of severe alcohol use may lead to increased early mortality, thereby reducing the number of individuals surviving to old age when dementia risk becomes apparent [68]. This form of survivor bias could

partially account for the observed decrease in dementia risk in studies with higher alcohol use.

Taken together, while our findings suggest a statistically significant moderating effect of alcohol use on the PTSD–dementia association, this should be interpreted with caution. It is important to underscore that these results do not support any protective effect of alcohol. Rather, they point to the complex and potentially confounded nature of alcohol use within PTSD populations and the need for further research to disentangle underlying mechanisms.

Limitations

Despite its strengths, this review has several limitations. One major limitation is that the second meta-analysis relied on unadjusted RRs. This is problematic because unadjusted estimates do not account for confounding factors such as age, sex, comorbidities, or lifestyle behaviors. As a result, the associations between several moderators, PTSD and dementia may be overestimated or underestimated, reducing the reliability of the conclusions. Another limitation is the substantial statistical heterogeneity among studies, which persisted even after conducting multiple subgroup and sensitivity analyses. While efforts were made to explore potential sources of heterogeneity, it remained high, suggesting that unmeasured differences between studies, such as variations in sample characteristics or study methodologies, may have influenced the findings. Additionally, most included studies were observational cohort studies, with many using a retrospective design. Since observational studies cannot establish causality, and retrospective designs are prone to biases and incomplete data, the findings should be interpreted with caution. Another potential limitation is the variability in PTSD assessment across studies, with many instruments lacking validated diagnostic accuracy in older adults or those with cognitive impairment. As shown by Havermans et al. [69], this may have led to misclassification, affecting the observed associations. Finally, several moderator analyses were based on a limited number of studies, which may compromise the statistical power and increase the likelihood of false-positive or false-negative results. Larger and more diverse samples should be used to confirm these findings to strengthen future research.

Conclusion

This meta-analysis confirms that PTSD significantly increases dementia risk, with affected individuals having approximately one and a half times the risk compared to those without PTSD. These findings support previous research and add new insights by identifying factors that may influence this relationship.

Diabetes and hypertension appear to be associated with increased dementia risk in the context of PTSD. In contrast, TBI, depression and alcohol use initially appeared to attenuate the link between PTSD and dementia. Post hoc analyses further suggested that these moderation effects were largely driven by a single influential study. This may reflect overlapping mechanisms with PTSD, sample-specific factors, or measurement issues. More long-term studies, biomarker research, and clinical trials are needed to understand how PTSD leads to dementia. From a clinical perspective, these findings highlight the importance of early screening and managing PTSD and related health conditions. Addressing metabolic and cardiovascular health and providing PTSD treatment could help reduce dementia risk in people with PTSD.

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Medline (PubMed) search

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Rhythm Sleep Disorders [tw])) OR (Sleep Wake Disorders[mesh] OR Sleep Wake Disorder*[tw] OR Subwakefulness Syndrome*[tw] sleep disorder*[tw] OR short sleeper syndrome*[tw])) OR (Gonadal Steroid Hormones[mesh] OR Gonadal Steroid Hormones [tw] OR sex hormones [tw])) OR (Dietary supplements [mesh] OR dietary supplement*[tw])) OR (Antioxidants [mesh] OR antioxidants [tw])) OR (Vitamins [mesh] OR vitamin*[tw])) OR (Dehydroepiandrosterone Leuprolide [mesh] OR DHEA [tw])) OR (Carbohydrates [mesh] OR carbohydrates [tw])) OR (Protein [mesh] OR gene proteins [tw])) OR (Fruit [mesh] OR fruit [tw])) OR Adrenergic alpha-antagonists[mesh]OR Adrenergic alpha-antagonists[tw]) OR Adrenergic beta-antagonists[mesh]OR Adrenergic beta-antagonists[tw]) OR (vasodilator agents [mesh] OR vasodilator agents [tw])) OR (Leisure activities [mesh] OR leisure activities [title/abstract] OR leisure*[tw])) OR (Travel [mesh] OR travel [tw])) OR (Exercise[mesh]OR exercises[tw]OR physical activit*[tw]OR physical exercise*[tw] OR acute exercise* [tw] OR aerobic exercise [tw] OR exercise training [tw])) OR (Physical fitness [mesh] OR physical fitness [tw])) OR (Running [mesh] OR running [tw])) OR (Swimming [mesh] OR swimming [tw])) OR (Walking [mesh] OR walking [tw] OR ambulation [tw])) OR (Anti-inflammatory agents [mesh] OR anti inflammatory agents [tw])) OR (Cholinesterase inhibitors[mesh] OR Cholinesterase Inhibitors [tw] OR Acetylcholinesterase inhibitors [tw])) OR (Prescriptions[mesh] OR prescription[tw])) OR (Benzodiazepines[mesh] OR Benzodiazepine [tw])) OR (Memantine [mesh] OR memantine [tw])) OR (Social support [mesh] OR Social support [tw])) OR (Neurocognitive disorders [mesh] Major topic] OR Neurocognitive disorder*[tw] OR psychotic organic mental disorders [title/abstract]OR traumatic psychoses [tw] OR organic mental disorder*[tw]))

AND

((((((((((((((((((((((((Stress Disorder, Post-Traumatic[MeSH Terms]) OR PTSD[Title/
Abstract])) OR post traumatic stress disorder*[Title/Abstract])) OR posttraumatic
stress disorder*[Title/Abstract]))) OR post traumatic neuros*[Title/Abstract]))
OR "ptsd symptom clusters"[Title/Abstract])) OR "re-experiencing"[Title/
Abstract])) OR avoidance[Title/Abstract]))) OR "hyperarousal"[Title/Abstract]))
OR "intrusive symptoms"[Title/Abstract])) OR "numbing"[Title/Abstract]))
OR "sleep disturbance"*[Title/Abstract])) OR "dizziness"[Title/Abstract])) OR
"startle response"[Title/Abstract])) OR "namc"[Title/Abstract]]))

AND

(((((cognitiv*[Tiab] OR cognition[tiab] OR memory[tiab])))

AND

((declin*[tiab] OR impair*[tiab] OR deteriora*[tiab] OR change*[tiab] OR deficit*[tiab] OR complaint*[tiab])))) OR dementia[tiab] OR alzheimer disease[MeSH Terms] OR (alzheimer*[tiab]) OR cognition disorders[mesh:noexp])) NOT (((“animals”[MeSH Terms] NOT “humans”[MeSH Terms]))))

Scopus (Elsevier) search

(((((TITLE-ABS-KEY (health AND behavior*)) OR TITLE-ABS-KEY (sleep AND apnea AND syndrome* OR sleep AND apnea* OR sleep AND hypopnea OR sleep AND disordered AND breathing))) OR ((TITLE-ABS-KEY (tobacco AND use* OR tobacco AND consumption)) OR (TITLE-ABS-KEY (obesity OR overweight)) OR (TITLE-ABS-KEY (diabetes AND mellitus OR diabetes)) OR (TITLE-ABS-KEY (intelligence AND test* OR mental AND test*)) OR TITLE-ABS-KEY (aptitude AND test*) OR (TITLE-ABS-KEY (traumatic AND brain AND injuries OR traumatic AND brain AND injur* OR brain AND trauma* OR traumatic AND encephalopathy OR traumatic AND encephalopathies)) OR TITLE-ABS-KEY (metabolic AND syndrome*) OR TITLE-ABS-KEY (insuline AND resistance) OR (TITLE-ABS-KEY (hypertension OR high AND blood AND pressure)) OR (TITLE-ABS-KEY (educational AND status OR educational AND achievement* OR maternal AND educational AND status)) OR (TITLE-ABS-KEY (employment OR employment AND status)) OR (TITLE-ABS-KEY (occupation OR vocation*)) OR TITLE-ABS-KEY (retirement*) OR TITLE-ABS-KEY (reading) OR TITLE-ABS-KEY (intelligence) OR TITLE-ABS-KEY (social AND isolation*) OR (TITLE-ABS-KEY (social AND adjustment* OR adjustment)) OR TITLE-ABS-KEY (social AND behavior*) OR (TITLE-ABS-KEY (social AND environment* OR social AND ecolog*)) OR (TITLE-ABS-KEY (interpersonal AND relation* OR social AND interaction OR communication* AND partner OR gender AND issue OR gender AND relation*)) OR TITLE-ABS-KEY (psychological AND resilienc*) OR (TITLE-ABS-KEY (depression* OR depressive AND symptom* OR emotional AND depression*)) OR (TITLE-ABS-KEY (anxiety OR hypervigilance OR nervousness OR social AND anxiet*)) OR (TITLE-ABS-KEY (anxiety AND disorder* OR anxiety AND neuroses)) OR (TITLE-ABS-KEY (smoking OR smoking AND behavior* OR smoking AND habit)) OR TITLE-ABS-KEY (nicotine) OR (TITLE-ABS-KEY (alcohol AND drinking OR alcohol AND consumption)) OR (TITLE-ABS-KEY (persian AND gulf AND syndrome OR gulf AND war AND syndrome)) OR TITLE-ABS-KEY (environmental AND exposure*) OR TITLE-ABS-KEY (learning) OR TITLE-ABS-KEY (agent AND orange) OR TITLE-ABS-KEY (hyperinsulinism) OR (TITLE-ABS-KEY (mental AND health OR mental AND hygiene)) OR TITLE-ABS-KEY (comorbidity) OR (TITLE-ABS-KEY (apolipoproteins AND e OR apoe)) OR TITLE-ABS-KEY (allele) OR TITLE-ABS-KEY (circadian AND rhythm AND sleep AND disorders) OR (TITLE-ABS-KEY (sleep AND wake AND disorder* OR subwakefulness AND syndrome* OR sleep AND disorder* OR short AND sleeper AND syndrome*)) OR (TITLE-ABS-KEY

(gonadal AND steroid AND hormones OR sex AND hormones)) OR TITLE-ABS-KEY (dietary AND supplement*) OR TITLE-ABS-KEY (antioxidants) OR TITLE-ABS-KEY (vitamin*) OR (TITLE-ABS-KEY (dehydroepiandrosterone AND leuprolide OR dhea)) OR TITLE-ABS-KEY (carbohydrates) OR (TITLE-ABS-KEY (protein OR gene AND proteins)) OR TITLE-ABS-KEY (fruit) OR TITLE-ABS-KEY (adrenergic AND alpha-antagonists) OR TITLE-ABS-KEY (adrenergic AND beta-antagonists) OR TITLE-ABS-KEY (vasodilator AND agents) OR (TITLE-ABS-KEY (leisure AND activities OR leisure*)) OR TITLE-ABS-KEY (travel) OR (TITLE-ABS-KEY (exercise* OR physical AND activit* OR physical AND exercise* OR acute AND exercise* OR aerobic AND exercise OR exercise AND training)) OR TITLE-ABS-KEY (physical AND fitness) OR TITLE-ABS-KEY (running) OR TITLE-ABS-KEY (swimming) OR (TITLE-ABS-KEY (walking OR ambulation)) OR (TITLE-ABS-KEY (anti-inflammatory AND agents OR anti AND inflammatory AND agents)) OR (TITLE-ABS-KEY (cholinesterase AND inhibitors OR acetylcholinesterase AND inhibitors)) OR TITLE-ABS-KEY (prescription) OR TITLE-ABS-KEY (benzodiazepine*) OR TITLE-ABS-KEY (memantine) OR TITLE-ABS-KEY (social AND support) OR (TITLE-ABS-KEY (neurocognitive AND disorder* OR psychotic AND organic AND mental AND disorders OR traumatic AND psychoses OR organic AND mental AND disorder*))) AND ((TITLE-ABS-KEY (post AND traumatic AND stress AND disorder) OR TITLE-ABS-KEY (ptsd) OR TITLE-ABS-KEY (post AND traumatic AND stress AND disorder*) OR TITLE-ABS-KEY (posttraumatic AND stress AND disorder*) OR TITLE-ABS-KEY (post AND traumatic AND neuros*) OR TITLE-ABS-KEY (ptsd AND symptom AND clusters) OR TITLE-ABS-KEY (re-experiencing) OR TITLE-ABS-KEY (avoidance) OR TITLE-ABS-KEY (hyperacusis) OR TITLE-ABS-KEY (intrusive AND symptoms) OR TITLE-ABS-KEY (numbing) OR TITLE-ABS-KEY (sleep AND disturbance*) OR TITLE-ABS-KEY (dizziness) OR TITLE-ABS-KEY (startle AND response) OR TITLE-ABS-KEY (negative AND alterations AND in AND cognitions AND mood) OR TITLE-ABS-KEY (nacm))) AND ((TITLE-ABS-KEY (cognitive AND decline OR cognition OR memory AND decline OR impair* OR deteriora* OR change* OR deficit* OR complaint* OR dementia OR alzheimer AND disease OR alzheimer* OR cognition AND disorder*))) AND NOT ((TITLE-ABS-KEY (animal) OR TITLE-ABS-KEY (animals) OR TITLE-ABS-KEY (dog) OR TITLE-ABS-KEY (dogs) OR TITLE-ABS-KEY (canine*) OR TITLE-ABS-KEY (feline) OR TITLE-ABS-KEY (hamster*) OR TITLE-ABS-KEY (mice) OR TITLE-ABS-KEY (lamb) OR TITLE-ABS-KEY (lambs) OR TITLE-ABS-KEY (monkey*) OR TITLE-ABS-KEY (mouse) OR TITLE-ABS-KEY (murine) OR TITLE-ABS-KEY (pig) OR TITLE-ABS-KEY (pigs) OR TITLE-ABS-KEY (piglet*) OR TITLE-ABS-KEY (primate*) OR TITLE-ABS-KEY (rabbit*) OR TITLE-ABS-KEY (rat) OR TITLE-ABS-KEY (rats) OR TITLE-ABS-KEY (rodent*) OR TITLE-ABS-KEY (sheep*)))

CINAHL (EBESCO) search

S147	S145 NOT S146
S146	MH (Animals+ NOT Humans+)
S145	S115 AND S132 AND S144
S144	S133 OR S134 OR S135 OR S136 OR S137 OR S138 OR S139 OR S140 OR S141 OR S142 OR S143 OR dementia
S143	"alzheimer"
S142	(MH "Alzheimer's Disease")
S141	"complaint*"
S140	"deficit*"
S139	"change"
S138	"deteriora"
S137	"impairment"
S136	"decline"
S135	(MH "Memory")
S134	(MH "Cognition") OR (MH "Cognition Disorders")
S133	"cognitive decline"
S132	S116 OR S117 OR S118 OR S119 OR S120 OR S121 OR S122 OR S123 OR S124 OR S125 OR S126 OR S127 OR S128 OR S129 OR S130 OR S131
S131	"negative alterations in cognitions and mood"
S130	"startle response"
S129	(MH "Dizziness")
S128	"sleep disturbance*"
S127	"numbing"
S126	"intrusive symptoms"
S125	"hyperarousal"
S124	"avoidance"
S123	"re-experiencing"
S122	"ptsd symptom clusters"
S121	"post traumatic neuros*"
S120	"posttraumatic stress disorder*"
S119	"posttraumatic stress disorder*"

S118	"post traumatic stress disorder*"
S117	"PTSD"
S116	(MH "Stress Disorders, Post-Traumatic")
S115	("organic mental disorder*") OR (S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59 OR S60 OR S61 OR S62 OR S63 OR S64 OR S65 OR S66 OR S67 OR S68 OR S69 OR S70 OR S71 OR S72 OR S73 OR S74 OR S75 OR S76 OR S77 OR S78 OR S79 OR S80 OR S81 OR S82 OR S83 OR S84 OR S85 OR S86 OR S87 OR S88 OR S89 OR S90 OR S91 OR S92 OR S93 OR S94 OR S95 OR S96 OR S97 OR S98 OR S99 OR S100 OR S101 OR S102 OR S103 OR S104 OR S105 OR S106 OR S107 OR S108 OR S109 OR S110 OR S111 OR S112 OR S113 OR S114)
S114	"organic mental disorder*"
S113	"traumatic psychoses"
S112	(MH "Organic Mental Disorders, Psychotic") OR "psychotic organic mental disorders"
S111	"neurocognitive disorders"
S110	(MH "Support, Psychosocial") OR "social support"
S109	"memantine"
S108	(MH "Antianxiety Agents, Benzodiazepine") OR "benzodiazepines"
S107	(MH "Prescriptions, Non-Drug") OR (MH "Prescriptions, Drug") OR "prescriptions"
S106	(MH "Cholinesterase Inhibitors") OR "cholinesterase inhibitors"
S105	(MH "Antiinflammatory Agents") OR "anti-inflammatory agents"
S104	(MH "Walking") OR "walking"
S103	(MH "Swimming") OR "swimming"
S102	(MH "Running") OR "running"
S101	(MH "Physical Fitness") OR "physical fitness"
S100	"exercise training"
S99	(MH "Aerobic Exercises") OR "aerobic exercise"
S98	"acute exercise"
S97	"physical exercise*"
S96	(MH "Physical Activity")

S95	(MH "Exercise") OR "exercise"
S94	(MH "Travel") OR "travel"
S93	"leisure*"
S92	(MH "Leisure Activities") OR "leisure activities"
S91	(MH "Vasodilator Agents") OR "vasodilator agents"
S90	(MH "Fruit") OR "fruit"
S89	(MH "Carbohydrates") OR "carbohydrates"
S88	(MH "Adrenergic Alpha-Antagonists") OR (MH "Adrenergic Beta-Antagonists") OR "adrenergic alpha-antagonists"
S87	"gene proteins"
S86	(MH "Proteins")
S85	"DHEA"
S84	(MH "Leuprolide") AND (MH "Dehydroepiandrosterone")
S83	"vitamin*"
S82	(MH "Vitamins")
S81	(MH "Antioxidants") OR "antioxidants"
S80	"dietary supplement*"
S79	(MH "Dietary Supplements")
S78	"sex hormones"
S77	"gonadal steroid hormones"
S76	(MH "Sex Hormones")
S75	"sleep disorder*"
S74	"sleep wake disorder*"
S73	"sleep wake disorders"
S72	(MH "Sleep Disorders, Circadian Rhythm") OR "sleep disorders, Circadian rhythm"
S71	(MH "Alleles") OR "allele"
S70	"ApoE"
S69	(MH "Apolipoproteins")
S68	(MH "Comorbidity")
S67	"mental hygiene"
S66	(MH "Mental Health")
S65	(MH "Hyperinsulinism")

S64	(MH "Herbicides")
S63	(MH "Learning")
S62	"environmental exposure**"
S61	(MH "Environmental Exposure")
S60	(MH "Persian Gulf Syndrome")
S59	(MH "Alcohol Drinking")
S58	(MH "Nicotine")
S57	"smoking habit"
S56	"smoking behavior**"
S55	(MH "Smoking")
S54	"anxiety disorder**"
S53	(MH "Anxiety Disorders")
S52	(MH "Social Anxiety Disorders")
S51	"nervousness"
S50	(MH "Anxiety")
S49	"emotional depression**"
S48	"depressive symptom**"
S47	"depression**"
S46	(MH "Depression")
S45	(MH "Adaptation, Psychological")
S44	"gender relation**"
S43	"gender issue"
S42	"communication* partner"
S41	"interpersonal relation**"
S40	(MH "Interpersonal Relations")
S39	"social ecolog**"
S38	"social environment**"
S37	(MH "Social Environment")
S36	"social behavior**"
S35	(MH "Social Behavior")
S34	"social adjustment**"
S33	(MH "Social Adjustment")

S32	"social isolation*"
S31	(MH "Social Isolation")
S30	(MH "Intelligence")
S29	(MH "Reading")
S28	"retirement*"
S27	(MH "Retirement")
S26	(MH "Occupations and Professions")
S25	(MH "Employment Status")
S24	(MH "Employment")
S23	(MH "Academic Achievement")
S22	(MH "Educational Status")
S21	(MH "Hypertension")
S20	(MH "Insulin Resistance")
S19	"metabolic syndrome*"
S18	(MH "Metabolic Syndrome X")
S17	"traumatic encephalopathies"
S16	(MH "Chronic Traumatic Encephalopathy")
S15	"brain trauma*"
S14	"traumatic brain injur*"
S13	(MH "Brain Injuries")
S12	"aptitude test*"
S11	(MH "Aptitude Tests")
S10	"intelligence test*"
S9	(MH "Intelligence Tests")
S8	(MH "Diabetes Mellitus")
S7	(MH "Obesity")
S6	(MH "Tobacco Products")
S5	(MH "Tobacco") OR "tobacco use"
S4	(MH "Sleep Apnea, Central")
S3	(MH "Sleep Apnea Syndromes") OR (MH "Sleep Disorders, Intrinsic")
S2	"health behavior*"
S1	(MH "Health Behavior")

PsychINFO (EBSCO) search

S74	S72 NOT S73
S73	DE Animal research OR DE Animal models OR DE Animals
S72	S69 AND S70 AND S71
S71	S67 OR S68
S70	S64 OR S65 OR S66
S69	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59 OR S60 OR S61 OR S62 OR S63
S68	TI "memory change*" OR AB "memory change*" OR TI "memory deficit*" OR AB "memory deficit*" OR TI cognitive complaint* OR AB cognitive complaint* OR TI dementia OR AB dementia OR TI "alzheimer disease" OR AB "alzheimer disease" OR TI alzheimer* OR AB alzheimer* OR TI "cognition disorders" OR AB "cognition disorders"
S67	DE "cognitive impairment" OR DE dementia OR TI cognition OR AB cognition OR TI "memory declin*" OR AB "memory declin*" OR TI memory impair* OR AB memory impair* OR TI cognitive deteriora* OR AB cognitive deteriora*
S66	AB "startle response" OR TI "startle response" OR AB namc OR TI namc OR AB ("negative alterations in cognitions and mood") OR TI ("negative alterations in cognitions and mood")
S65	AB avoidance OR TI avoidance OR AB hyperarousal OR TI hyperarousal OR AB "intrusive symptoms" OR TI "intrusive symptoms" OR AB numbing OR TI numbing OR AB "sleep disturbance" OR TI "sleep disturbance" OR AB dizziness OR TI dizziness DE "posttraumatic stress disorder" OR TI PTSD OR AB PTSD OR TI ("post traumatic stress disorder*" OR "posttraumatic stress disorder*") OR AB ("post traumatic stress disorder*" OR "posttraumatic stress disorder*") OR TI "post traumatic neuros*" OR AB "post traumatic neuros*" OR TI "ptsd symptom clusters" OR AB "ptsd symptom clusters" OR TI re-experiencing OR AB re-experiencing DE "neurocognitive disorders" OR TI "neurocognitive disorder*" OR AB "neurocognitive disorder*" OR TI "psychotic organic mental disorders" OR AB "psychotic organic mental disorders" OR TI "traumatic psychoses" OR AB "traumatic psychoses" OR TI "organic mental disorder*" OR AB "organic mental disorder*"
	DE "social support" OR TI "social support" OR AB "social support"
	DE memantine OR TI memantine OR AB memantine

	DE benzodiazepines OR TI benzodiazepine OR AB benzodiazepine
	DE "prescription drugs" OR TI prescription OR AB prescription
	DE "cholinesterase inhibitors" OR TI "cholinesterase inhibitors" OR AB "cholinesterase inhibitors" OR TI "acetylcholinesterase inhibitors" OR AB "acetylcholinesterase inhibitors"
	DE "cholinesterase inhibitors" OR TI "cholinesterase inhibitors" OR AB "cholinesterase inhibitors" OR TI "acetylcholinesterase inhibitors" OR AB "acetylcholinesterase inhibitors"
	DE "anti-inflammatory agents" OR TI "anti inflammatory agents" OR AB "anti inflammatory agents"
	DE walking OR TI walking OR AB walking OR TI ambulation OR AB ambulation
	DE swimming OR TI swimming OR AB swimming
S54	DE running OR TI running OR AB running
	DE exercise OR TI exercises OR AB exercises OR TI "physical activit*" OR AB "physical activit*" OR TI "physical exercise*" OR AB "physical exercise*" OR TI "acute exercise*" OR AB "acute exercise*" OR TI ("aerobic exercise" OR "exercise training") OR AB ("aerobic exercise" OR "exercise training")
	DE traveling OR TI travel OR AB travel
	DE "leisure time" OR TI "leisure activities" OR AB "leisure activities" OR TI leisure* OR AB leisure*
S50	DE "vasodilator drugs" OR TI "vasodilator agents" OR AB "vasodilator agents"
S49	DE "adrenergic blocking drugs" OR TI "adrenergic beta-antagonists" OR AB "adrenergic beta-antagonists"
S48	TI fruit OR AB fruit
S47	DE proteins OR AB "gene proteins" OR TI "gene proteins"
S46	DE carbohydrates OR AB Carbohydrates OR TI carbohydrates
S45	TI "dehydroepiandrosterone Leuprolide" OR AB "dehydroepiandrosterone leuprolide" OR AB DHEA OR TI DHEA
S44	DE vitamins OR TI vitamin* OR AB vitamin*
S43	DE antioxidants OR TI antioxidants OR AB antioxidants
S42	DE "dietary supplements" OR TI "dietary supplement*" OR AB "dietary supplement*"
S41	AB "gonadal steroid hormones" OR TI "gonadal steroid hormones" OR TI "sex hormones" OR AB "sex hormones"

S40	AB "circadian rhythm sleep disorder*" OR TI "circadian rhythm sleep disorder*" OR TI "sleep wake disorders" OR AB "sleep wake disorders" OR TI "subwakefulness syndrome*" OR AB "subwakefulness syndrome*" OR TI "sleep disorder*" OR AB "sleep disorder*" OR TI "short sleeper syndrome*" OR AB "short sleeper syndrome*"
S39	DE alleles OR TI allele* OR AB allele*
S38	DE Apolipoproteins E OR TI ApoE OR AB ApoE
S37	DE comorbidity OR TI comorbidity OR AB comorbidity
S36	DE "mental health" OR TI "mental hygiene" OR AB "mental hygiene"
S35	AB hyperinsulinism OR TI hyperinsulinism
S34	AB "agent orange" OR TI "agent orange"
S33	DE learning OR TI learning OR AB learning
S32	AB "environmental exposure*" OR TI "environmental exposure*"
S31	AB "persian gulf syndrome" OR TI "persian gulf syndrome" OR AB "gulf war syndrome" OR TI "gulf war syndrome"
S30	DE "alcohol drinking attitudes" OR DE "alcohol drinking patterns" OR TI "alcohol drinking" OR AB "alcohol drinking" OR TI "alcohol consumption" OR AB "alcohol consumption"
S29	DE nicotine OR TI nicotine OR AB nicotine
S28	TI smoking OR AB smoking OR AB "smoking behavior*" OR TI "smoking behavior*" OR AB "smoking habit" OR TI "smoking habit"
S27	DE "anxiety disorders" OR TI "anxiety disorder*" OR AB "anxiety disorder*" OR TI "anxiety neuroses" OR AB "anxiety neuroses"
S26	DE anxiety OR TI hypervigilance OR AB hypervigilance OR TI nervousness OR AB nervousness OR TI "social anxiet*" OR AB "social anxiet*"
S25	DE depression OR TI depression* OR AB depression* OR TI "depressive symptom*" OR AB "depressive symptom*" OR TI "emotional depression*" OR AB "emotional depression*"
S24	DE "psychological resilience" OR TI "psychological resilienc*" OR AB "psychological resilienc*"
S23	DE "interpersonal relationships" OR TI "interpersonal relation*" OR AB "interpersonal relation*" OR TI "social interaction" OR AB "social interaction" OR TI "communication* partner" OR AB "communication* partner" OR TI "gender issue" OR AB "gender issue" OR TI "gender relation*" OR AB "gender relation*"
S22	DE "social environment" OR TI "social environment*" OR AB "social environment*" OR TI "social ecolog*" OR AB "social ecolog*"
S21	DE "social behavior" OR TI "social behavior*" OR AB "social behavior*"

S20	DE "social adjustment" OR TI "social adjustment*" OR AB "social adjustment*" OR TI adjustment* OR AB adjustment*
S19	DE "social isolation" OR TI "social isolation*" OR AB "social isolation*" OR TI isolation* OR AB isolation*
S18	DE intelligence OR TI intelligence OR AB intelligence
S17	DE reading OR TI reading OR AB reading
S16	DE retirement OR TI retirement* OR AB retirement*
S15	DE occupation OR TI occupation OR AB occupation OR TI vocation* OR AB vocation*
S14	DE "employment status" OR TI "employment status" OR AB "employment status"
S13	DE "educational background" OR TI "educational achievement*" OR AB "educational achievement*" OR TI "maternal educational status" OR AB "maternal educational status"
S12	DE hypertension OR TI hypertension OR AB hypertension OR TI "high blood pressure" OR AB "high blood pressure"
S11	AB "insulin resistance" OR TI "insulin resistance"
S10	DE "metabolic syndrome" OR TI "metabolic syndrome*" OR AB "metabolic syndrome*" OR TI syndrome* OR AB syndrome*
S9	DE "traumatic brain injury" OR TI "traumatic brain injur*" OR AB "traumatic brain injur*" OR TI "brain trauma*" OR AB "brain trauma*" OR TI "traumatic encephalopathy*" OR AB "traumatic encephalopathy*" OR TI encephalopathy* OR AB encephalopathy*
S8	TI "aptitude test*" OR AB "aptitude test*" OR TI test* OR AB test*
S7	DE "intelligence measures" OR TI "intelligence test*" OR AB "intelligence test*" OR TI "mental test*" OR AB "mental test*" OR TI test* OR AB test*
S6	DE "diabetes mellitus" OR TI diabetes OR AB diabetes
S5	DE overweight OR TI overweight OR AB overweight
S4	DE "obesity" OR TI "obesity" OR AB "obesity"
S3	DE "tobacco smoking" OR TI "tobacco use*" OR AB "tobacco use*" OR TI "tobacco consumption" OR AB "tobacco consumption"
S2	DE "Sleep apnea" OR TI "sleep apnea syndrome*" OR AB "sleep apnea syndrome*" OR TI "sleep hypopnea*" OR AB "sleep hypopnea*" OR TI "sleep disordered breathing" OR AB "sleep disordered breathing"
S1	DE "Health behavior" OR TI "health behavior*" OR AB "health behavior*" OR TI behavior* OR AB behavior*

Dissertations and Theses Global (Proquest) search

((ab(health behavior*) OR ti(Health behavior*)) OR (ab(Sleep apnea syndrome*) OR ti(sleep apnea syndrome*) OR ab(sleep apnea*) OR ti(sleep apnea*) OR ab(sleep hypopnea*) OR ti(sleep hypopnea*) OR ab(sleep disordered breathing) OR ti(sleep disordered breathing)) OR (ab(tobacco use*) OR ti(tobacco use*) OR ab(tobacco consumption) OR ti(tobacco consumption)) OR (ab(obesity) OR ti(obesity) OR ab(overweight) OR ti(overweight)) OR (ab(diabetes mellitus) OR ti(diabetes mellitus) OR ab(diabetes) OR ti(diabetes)) OR (ab(intelligence test*) OR ti(intelligence test*) OR ab(mental test*) OR ti(mental test*)) OR (ab(apptitude test*) OR ti(apptitude test*)) OR (ab(traumatic brain injuries) OR ti(traumatic brain injuries) OR ab(traumatic brain injur*) OR ti(traumatic brain injur*) OR ab(brain trauma*) OR ti(brain trauma*) OR ab(traumatic encephalopath*) OR ti(traumatic encephalopath*)) OR (ab(metablic syndrome*) OR ti(metabolic syndrome*)) OR (ab(metabolic syndrome*) OR ti(metabolic syndrome*)) OR (ab(insulin resistance) OR ti(insulin resistance)) OR (ab(hypertension) OR ti(hypertension) OR ab(high blood pressure) OR ti(high blood pressure)) OR (ab(educational status) OR ti(educational status) OR ab(educational achievement*) OR ti(educational achievement*)) OR ab(maternal educational status) OR ti(maternal educational status)) OR (ab(employment) OR ti(employment) OR ab(employment status) OR ti(employment status) OR ab(occupation) OR ti(occupation) OR ab(vocation*) OR ti(vocation*)) OR (ab(retirement*) OR ti(retirement*)) OR (ab(reading) OR ti(reading)) OR (ab(intelligence) OR ti(intelligence)) OR (ab(social isolation*) OR ti(social isolation*)) OR (ab(social adjustment*) OR ti(social adjustment*)) OR ab(adjustment*) OR ti(adjustment*)) OR (ab(social behavior*) OR ti(social behavior*)) OR (ab(social environment*) OR ti(social environment*)) OR ab(social ecolog*) OR ti(social ecolog*)) OR (ab(interpersonal relation*) OR ti(interpersonal relation*) OR ab(social interaction) OR ti(social interaction) OR ab(communication* partner) OR ti(communication* partner) OR ab(gender issue) OR ti(gender issue) OR ab(gender relation*) OR ti(gender relation*)) OR (ab(psychological resilienc*) OR ti(psychological resilienc*)) OR (ab(depression*) OR ti(depression*)) OR ab(depressive symptom*) OR ti(depressive symptom*)) OR ab(emotional depression*) OR ti(emotional depression*)) OR (ab(anxiety) OR ti(anxiety) OR ab(hypervigilance) OR ti(hypervigilance) OR ab(nervousness) OR ti(nervousness) OR ab(social anxiet*) OR ti(social anxiet*)) OR (ab(anxiety disorder*) OR ti(anxiety disorder*) OR ab(anxiety neuroses) OR ti(anxiety neuroses)) OR (ab(smoking) OR ti(smoking) OR ab(smoking behavior*) OR ti(smoking behavior*)) OR ab(smoking habit) OR ti(smoking habit)) OR (ab(nicotine) OR ti(nicotine)) OR (ab(alcohol drinking) OR ti(alcohol drinking) OR ab(alcohol consumption) OR ti(alcohol consumption)) OR (ab(persian gulf syndrome) OR ti(persian gulf syndrome) OR ab(gulf war syndrome) OR ti(gulf war syndrome)) OR (ab(environmental exposure*) OR ti(environmental exposure*)) OR (ab(learning) OR ti(learning)) OR (ab(agent orange) OR ti(agent orange)) OR

(ab(hyperinsulinism) OR ti(hyperinsulinism)) OR (ab(mental health) OR ti(mental health) OR ab(mental hygiene) OR ti(mental hygiene)) OR (ab(comorbidity) OR ti(comorbidity)) OR (ab(Apolipoproteins E) OR ti(apolipoproteins E) OR ab(ApoE) OR ti(ApoE)) OR (ab(allele) OR ti(allele)) OR (ab(Circadian Rhythm sleep disorder*) OR ti(circadian rhythm sleep disorder*)) OR (ab(sleep disorder*) OR ti(sleep disorder*)) OR ab(sleep wake disorder*) OR ti(sleep wake disorder*) OR ab(subwakefulness syndrome*) OR ti(subwakefulness syndrome*) OR ab(short sleeper syndrome*) OR ti(short sleeper syndrome*)) OR (ab(gonadal steroid hormones) OR ti(gonadal steroid hormones) OR ab(sex hormones) OR ti(sex hormones)) OR (ab(dietary supplement*) OR ti(dietary supplement*)) OR (ab(antioxidants) OR ti(antioxidants)) OR (ab(vitamin*) OR ti(vitamin*)) OR (ab(dehydroepiandrosterone leuprolide) OR ti(dehydroepiandrosterone leuprolide) OR ab(DHEA) OR ti(DHEA)) OR (ab(carbohydrates) OR ti(carbohydrates)) OR (ab(protein) OR ti(protein) OR ab(gene protein) OR ti(gene protein)) OR (ab(fruit) OR ti(fruit)) OR (ab(adrenergic alpha-antagonists) OR ti(adrenergic alpha-antagonists) OR ab(adrenergic beta-antagonists) OR ti(adrenergic beta-antagonists)) OR (ab(vasodilator agents) OR ti(vasodilator agents)) OR (ab(leisure activities) OR ti(leisure activities) OR ab(leisure*) OR ti(leisure*)) OR (ab(travel) OR ti(travel)) OR (ab(exercise*) OR ti(exercise*)) OR ab(physical activit*) OR ti(physical activit*) OR ab(physical exercise) OR ti(physical exercise) OR ab(acute exercise* OR aerobic exercise) OR ti(acute exercise* OR aerobic exercise) OR ab(exercise training) OR ti(exercise training)) OR (ab(physical fitness) OR ti(physical fitness)) OR (ab(running) OR ti(running) OR ti(swimming) OR ab(swimming) OR ab(walking) OR ti(walking) OR ab(ambulation) OR ti(ambulation)) OR (ab(anti-inflammatory agents) OR ti(anti-inflammatory agents) OR ti(anti inflammatory agents) OR ab(anti inflammatory agents)) OR (ab(cholinesterase) OR ti(cholinesterase) OR ti(cholinesterase inhibitors) OR ab(cholinesterase inhibitors) OR ab(acetylcholinesterase inhibitors) OR ti(acetylcholinesterase inhibitors)) OR (ab(prescription*) OR ti(prescription*)) OR (ab(benzodiazepines) OR ti(benzodiazepines)) OR (ab(memantine) OR ti(memantine)) OR (ab(social support) OR ti(social support)) OR (ab(neurocognitive disorder*) OR ti(neurocognitive disorder*)) OR ab(psychotic organic mental disorder) OR ti(psychotic organic mental disorder) OR ab(traumatic psychoses) OR ti(traumatic psychoses) OR ab(organic mental disorder*) OR ti(organic mental disorder*)) AND ((ab(post traumatic stress disorder*) OR ti(post traumatic stress disorder*)) OR ab(PTSD) OR ti(PTSD) OR ab(posttraumatic stress disorder*) OR ti(posttraumatic stress disorder*)) OR ab(post traumatic neuros*) OR ti(post traumatic neuros*) OR ab(ptsd symptom clusters) OR ti(ptsd symptom clusters)) OR (ab(re-experiencing) OR ti(re-experiencing) OR ab(avoidance) OR ti(avoidance) OR ab(hyperarousal) OR ti(hyperarousal) OR ab(intrusive symptoms) OR ti(intrusive symptoms) OR ab(numbing) OR ti(numbing)) OR (ab(sleep disturbance) OR ti(sleep disturbance)

OR ab(dizziness) OR ti(dizziness) OR ab(startle response) OR ti(startle response)
 OR ab(negative alterations in cognitions AND mood) OR ti(negative alterations
 in cognitions AND mood) OR ab(namc) OR ti(namc))) AND ((ab(cognitive decline)
 OR ti(cognitive decline) OR ab(cognition) OR ti(cognition) OR ab(memory
 AND declin*) OR ti(memory AND declin*) OR ab(impair*) OR ti(impair*) OR
 ab(deteriora*) OR ti(deteriora*)) OR (ab(change*) OR ti(change*) OR ab(deficit*)
 OR ti(deficit*) OR ab(complaint*) OR ti(complaint*) OR ab(alzheimer disease
 OR alzheimer*) OR ti(alzheimer disease OR alzheimer*) OR ti(dementia) OR
 ab(dementia) OR ab(cognition disorder*) OR ti(cognition disorder*))))

Cochrane Library (Wiley) search

- #1 MeSH descriptor: [Health Behavior] explode all trees
- #2 ("health behavior"):ti,ab,kw
- #3 #1 OR #2
- #4 MeSH descriptor: [Sleep Apnea Syndromes] explode all trees
- #5 ("sleep-apnea syndrome"):ti,ab,kw
- #6 ("sleep apnea"):ti,ab,kw
- #7 (sleep NEAR/2 hypopnea):ti,ab,kw
- #8 ("sleep-disordered breathing"):ti,ab,kw
- #9 #4 OR #5 OR #6 OR #7 OR #8
- #10 MeSH descriptor: [Tobacco Use] explode all trees
- #11 ("tobacco use"):ti,ab,kw
- #12 ("tobacco consumption"):ti,ab,kw
- #13 #10 OR #11 OR #12
- #14 MeSH descriptor: [Obesity] 4 tree(s) exploded
- #15 (obesity):ti,ab,kw
- #16 #14 OR #15
- #17 MeSH descriptor: [Overweight] 3 tree(s) exploded
- #18 (overweight):ti,ab,kw
- #19 #17 OR #18
- #20 MeSH descriptor: [Diabetes Mellitus] explode all trees
- #21 (diabetes):ti,ab,kw
- #22 #20 OR #21
- #23 MeSH descriptor: [Intelligence Tests] explode all trees
- #24 ("intelligence test"):ti,ab,kw
- #25 ("mental test"):ti,ab,kw
- #26 #23 OR #24 OR #25
- #27 MeSH descriptor: [Aptitude Tests] explode all trees
- #28 ("aptitude test"):ti,ab,kw
- #29 #27 OR #28
- #30 MeSH descriptor: [Brain Injuries, Traumatic] explode all trees
- #31 ("traumatic brain injury"):ti,ab,kw

#32 ("brain trauma"):ti,ab,kw
#33 ("traumatic encephalopathy"):ti,ab,kw
#34 #30 OR #31 OR #32 OR #33
#35 MeSH descriptor: [Metabolic Syndrome] explode all trees
#36 ("metabolic syndrome"):ti,ab,kw
#37 #35 OR #36
#38 MeSH descriptor: [Insulin Resistance] explode all trees
#39 ("insulin-resistance"):ti,ab,kw
#40 #38 OR #39
#41 MeSH descriptor: [Hypertension] explode all trees
#42 (hypertension):ti,ab,kw
#43 ("High blood pressure"):ti,ab,kw
#44 #41 OR #42 OR #43
#45 MeSH descriptor: [Educational Status] explode all trees
#46 ("educational achievement"):ti,ab,kw
#47 ("maternal educational status"):ti,ab,kw
#48 #45 OR #46 OR #47
#49 MeSH descriptor: [Employment] explode all trees
#50 ("employment status"):ti,ab,kw
#51 #49 OR #50
#52 MeSH descriptor: [Occupations] explode all trees
#53 (occupation):ti,ab,kw
#54 (vocation):ti,ab,kw
#55 #52 OR #53 OR #54
#56 MeSH descriptor: [Retirement] explode all trees
#57 (retirement):ti,ab,kw
#58 #56 OR #57
#59 MeSH descriptor: [Reading] explode all trees
#60 (reading):ti,ab,kw
#61 #59 OR #60
#62 MeSH descriptor: [Intelligence] explode all trees
#63 (intelligence):ti,ab,kw
#64 #62 OR #63
#65 MeSH descriptor: [Social Isolation] explode all trees
#66 ("social isolation"):ti,ab,kw
#67 #65 OR #66
#68 MeSH descriptor: [Social Adjustment] explode all trees
#69 ("social adjustment"):ti,ab,kw
#70 #68 OR #69
#71 MeSH descriptor: [Social Behavior] explode all trees
#72 ("social behavior"):ti,ab,kw
#73 #71 OR #72

- #74 MeSH descriptor: [Social Environment] explode all trees
- #75 (social NEXT environment*):ti,ab,kw
- #76 (social NEXT ecolog*):ti,ab,kw
- #77 #74 OR #76
- #78 MeSH descriptor: [Interpersonal Relations] explode all trees
- #79 (interpersonal NEXT relation*):ti,ab,kw
- #80 ("social interaction"):ti,ab,kw
- #81 (communication* NEXT partner):ti,ab,kw
- #82 (gender NEXT issue*):ti,ab,kw
- #83 (gender NEXT relation*):ti,ab,kw
- #84 #78 OR #79 OR #80 OR #81 OR #82 OR #83
- #85 MeSH descriptor: [Resilience, Psychological] explode all trees
- #86 (psychological NEXT resilience*):ti,ab,kw
- #87 #85 OR #86
- #88 MeSH descriptor: [Depression] 1 tree(s) exploded
- #89 (depression*):ti,ab,kw
- #90 ("depressive symptom"):ti,ab,kw
- #91 ("emotional depression"):ti,ab,kw
- #92 #88 OR #89 OR #90 OR #91
- #93 MeSH descriptor: [Anxiety] explode all trees
- #94 (hypervigilance):ti,ab,kw
- #95 (nervousness):ti,ab,kw
- #96 ("social anxiety"):ti,ab,kw
- #97 #93 OR #94 OR #95 OR #96
- #98 MeSH descriptor: [Anxiety Disorders] explode all trees
- #99 (anxiety NEXT disorder*):ti,ab,kw
- #100 ("anxiety neuroses"):ti,ab,kw
- #101 #98 OR #99 OR #100
- #102 MeSH descriptor: [Smoke] explode all trees
- #103 ("smoking behavior"):ti,ab,kw
- #104 ("smoking habit"):ti,ab,kw
- #105 #102 OR #103 OR #104
- #106 MeSH descriptor: [Nicotine] explode all trees
- #107 (nicotine):ti,ab,kw
- #108 #106 OR #107
- #109 MeSH descriptor: [Alcohol Drinking] explode all trees
- #110 ("alcohol consumption"):ti,ab,kw
- #111 #109 OR #110
- #112 MeSH descriptor: [Persian Gulf Syndrome] 1 tree(s) exploded
- #113 ("gulf war syndrome"):ti,ab,kw
- #114 #112 OR #113
- #115 MeSH descriptor: [Environmental Exposure] explode all trees

- #116 (environmental NEXT exposure*):ti,ab,kw
- #117 #115 OR #116
- #118 MeSH descriptor: [Learning] explode all trees
- #119 (learning):ti,ab,kw
- #120 #118 OR #119
- #121 MeSH descriptor: [Agent Orange] explode all trees
- #122 ("agent orange"):ti,ab,kw
- #123 #121 OR #122
- #124 MeSH descriptor: [Hyperinsulinism] explode all trees
- #125 (hyperinsulinism):ti,ab,kw
- #126 #124 OR #125
- #127 MeSH descriptor: [Mental Health] explode all trees
- #128 ("mental hygiene"):ti,ab,kw
- #129 #127 OR #128
- #130 MeSH descriptor: [Comorbidity] explode all trees
- #131 (comorbidity):ti,ab,kw
- #132 #130 OR #131
- #133 MeSH descriptor: [Apolipoproteins E] explode all trees
- #134 (ApoE):ti,ab,kw
- #135 (allele):ti,ab,kw
- #136 #133 OR #134 OR #135
- #137 MeSH descriptor: [Sleep Disorders, Circadian Rhythm] explode all trees
- #138 ("circadian rhythm sleep disorders"):ti,ab,kw
- #139 ("sleep wake disorders"):ti,ab,kw
- #140 ("sleep wake disorder"):ti,ab,kw
- #141 (sleep NEXT disorder*):ti,ab,kw
- #142 #137 OR #138 OR #140 OR #141
- #143 MeSH descriptor: [Gonadal Steroid Hormones] explode all trees
- #144 ("gonadal steroid hormones"):ti,ab,kw
- #145 ("sex hormones"):ti,ab,kw
- #146 #143 OR #144 OR #145
- #147 MeSH descriptor: [Dietary Supplements] explode all trees
- #148 (dietary NEXT supplement*):ti,ab,kw
- #149 #147 OR #148
- #150 MeSH descriptor: [Antioxidants] 3 tree(s) exploded
- #151 (antioxidants):ti,ab,kw
- #152 #150 OR #151
- #153 MeSH descriptor: [Vitamins] 3 tree(s) exploded
- #154 (vitamin*):ti,ab,kw
- #155 #153 OR #154
- #156 MeSH descriptor: [Dehydroepiandrosterone] explode all trees
- #157 (Dehydroepiandrosterone Leuprolide):ti,ab,kw

- #158 #156 OR #157
- #159 MeSH descriptor: [Carbohydrates] explode all trees
- #160 (carbohydrates):ti,ab,kw
- #161 #159 OR #160
- #162 MeSH descriptor: [Proteins] explode all trees
- #163 (gene NEAR/2 proteins):ti,ab,kw
- #164 #162 OR #163
- #165 MeSH descriptor: [Fruit] explode all trees
- #166 (fruit):ti,ab,kw
- #167 #165 OR #166
- #168 MeSH descriptor: [Adrenergic alpha-Antagonists] explode all trees
- #169 ("adrenergic alpha-antagonists"):ti,ab,kw
- #170 #168 OR #169
- #171 MeSH descriptor: [Adrenergic beta-Antagonists] explode all trees
- #172 (adrenergic beta-antagonists):ti,ab,kw
- #173 #171 OR #172
- #174 MeSH descriptor: [Vasodilator Agents] explode all trees
- #175 ("vasodilator agents"):ti,ab,kw
- #176 #174 OR #175
- #177 MeSH descriptor: [Leisure Activities] explode all trees
- #178 ("leisure activities"):ti,ab,kw
- #179 (leisure*):ti,ab,kw
- #180 #177 OR #178 OR #179
- #181 MeSH descriptor: [Travel] explode all trees
- #182 (travel):ti,ab,kw
- #183 #181 OR #182
- #184 MeSH descriptor: [Exercise] explode all trees
- #185 (exercises):ti,ab,kw
- #186 (physical NEAR/2 activit*):ti,ab,kw
- #187 (physical NEXT exercise*):ti,ab,kw
- #188 (acute NEXT exercise*):ti,ab,kw
- #189 (aerobic NEXT exercise*):ti,ab,kw
- #190 ("exercise training"):ti,ab,kw
- #191 #184 OR #185 OR #186 OR #187 OR #188 OR #189 OR #190
- #192 MeSH descriptor: [Swimming] explode all trees
- #193 (swimming):ti,ab,kw
- #194 #192 OR #193
- #195 MeSH descriptor: [Walking] explode all trees
- #196 (walking):ti,ab,kw
- #197 (ambulation):ti,ab,kw
- #198 #195 OR #196 OR #197
- #199 MeSH descriptor: [Anti-Inflammatory Agents] explode all trees

- #200 ("anti inflammatory agents"):ti,ab,kw
- #201 #199 OR #200
- #202 MeSH descriptor: [Cholinesterase Inhibitors] explode all trees
- #203 ("cholinesterase inhibitors"):ti,ab,kw
- #204 ("acetylcholinesterase inhibitors"):ti,ab,kw
- #205 #202 OR #203 OR #204
- #206 MeSH descriptor: [Prescriptions] explode all trees
- #207 (prescription):ti,ab,kw
- #208 #206 OR #207
- #209 MeSH descriptor: [Benzodiazepines] explode all trees
- #210 (benzodiazepine):ti,ab,kw
- #211 #209 OR #210
- #212 MeSH descriptor: [Memantine] explode all trees
- #213 (memantine):ti,ab,kw
- #214 #212 OR #213
- #215 MeSH descriptor: [Social Support] explode all trees
- #216 ("social support"):ti,ab,kw
- #217 #215 OR #216
- #218 MeSH descriptor: [Neurocognitive Disorders] explode all trees
- #219 (neurocognitive NEXT disorder*):ti,ab,kw
- #220 (psychotic NEAR/2 organic NEAR/2 mental disorders):ti,ab,kw
- #221 (traumatic NEAR/3 psychoses):ti,ab,kw
- #222 (organic NEXT mental NEXT disorder*):ti,ab,kw
- #223 #218 OR #219 OR #220 OR #221 OR #222
- #224 #3 OR #9 OR #13 OR #16 OR #19 OR #22 OR #26 OR #29 OR 34 OR #37
OR #40 OR #44 OR #48 OR #51 OR #55 OR #58 OR #61 OR #64 OR #67
OR #70 OR #73 OR #77 OR #84 OR #87 OR #92 OR #97 OR #101 OR
#105 OR #108 OR #111 OR #114 OR #117 OR #120 OR #123 OR #126 OR
#129 OR #132 OR #136 OR #142 OR #146 OR #149 OR #152 OR #155 OR
#158 OR #161 OR #164 OR #167 OR #170 OR #173 OR #176 OR #180 OR
#183 OR #191 OR #194 OR #198 OR #201 OR #205 OR #208 OR #211 OR
#214 OR #217 OR #223
- #225 MeSH descriptor: [Stress Disorders, Post-Traumatic] explode all trees
- #226 (PTSD):ti,ab,kw
- #227 (post NEXT traumatic NEXT stress NEXT disorder*):ti,ab,kw
- #228 (posttraumatic NEXT stress NEXT disorder*):ti,ab,kw
- #229 (post traumatic NEAR/2 neuros*):ti,ab,kw
- #230 (ptsd NEAR/3 symptom NEAR/3 cluster*):ti,ab,kw
- #231 (re-experiencing):ti,ab,kw
- #232 (avoidance):ti,ab,kw
- #233 (hyperarousal):ti,ab,kw
- #234 ("intrusive symptoms"):ti,ab,kw

- #235 (numbing):ti,ab,kw
- #236 ("sleep disturbance"):ti,ab,kw
- #237 (dizziness):ti,ab,kw
- #238 ("startle response"):ti,ab,kw
- #239 (negative NEAR/4 alterations NEAR/4 mood):ti,ab,kw
- #240 (namc):ti,ab,kw
- #241 #225 OR #226 OR #227 OR #228 OR #229 OR #230 OR #231 OR #232
OR #233 OR #234 OR #235 OR #236 OR #237 OR #238 OR 242
- #242 MeSH descriptor: [Cognitive Dysfunction] explode all trees
- #243 (memory):ti,ab,kw
- #244 ("cognitive impairment"):ti,ab,kw
- #245 (memory NEAR/3 deteriora*):ti,ab,kw
- #246 cognitive NEAR/2 deterioration
- #247 (memory NEAR/4 change*):ti,ab,kw
- #248 cognitive NEAR/3 change*
- #249 (cognitive NEAR/4 deficit*):ti,ab,kw
- #250 (memory NEAR/3 complaint*):ti,ab,kw
- #251 cognitive NEAR/3 complaint*
- #252 memory NEAR/3 deficit*
- #253 ("Alzheimer disease"):ti,ab,kw
- #254 (alzheimer*):ti,ab,kw
- #255 (dementia):ti,ab,kw
- #256 MeSH descriptor: [Cognition Disorders] this term only
- #257 #242 OR #243 OR #244 OR #245 OR #246 OR #247 OR #248 OR #249 OR
#250 OR #251 OR #252 OR #253 OR #254 OR #255 OR #256
- #258 #224 AND #241 AND #257
- #259 MeSH descriptor: [Animals] explode all trees
- #260 MeSH descriptor: [Humanism] explode all trees
- #261 #259 NOT #260
- #262 #258 NOT #261

Clinical vignette: Jan [part 4]

The potentially traumatic events (PTEs)

After noticing the neuropsychiatric symptoms and behaviors, the psychologist decided to gather more detailed information about Jan's life history. The psychologist considered the possibility of PTEs as a contributing factor due to the nature of Jan's agitation, hallucinations and anxiety, which seemed disproportionate to his immediate environment and care routine. Additionally, it appeared that certain behaviors, such as episodes of severe agitation, were triggered by specific stimuli, such as loud noises or particular smells, suggesting a potential link to past PTEs.

Opening the topic of PTEs is often perceived as a barrier in care settings, as caregivers may fear causing distress or not knowing how to respond. However, exploring PTE history can be essential for understanding the complete picture of someone's symptoms and behavior and offering more tailored and compassionate care. In Jan's case, these conversations proved invaluable. His family was consulted to provide additional context and assess whether PTEs might be contributing to his symptoms and behavior. Through these conversations, the psychologist learned that Jan had experienced significant hardships as a child during World War II.

At around 8 years old in 1943, he was exposed to the constant fear and disruption caused by World War II. Coming from a Jewish family, the threat was even more immediate and personal, as Jewish individuals faced persecution, deportation, and violence under the Nazi regime. Jan's brother had been taken to a concentration camp and later murdered, a tragedy Jan learned about from a family acquaintance at a young age. Although he had not witnessed his brother's capture or death firsthand, the loss deeply affected him. Additionally, Jan endured the terror of frequent bombings, often seeking shelter in basements or designated bunkers. On one particularly harrowing occasion, he was caught in an air raid while playing outside with a friend. Unable to reach a nearby shelter, they hid in a roadside ditch, listening to the deafening blasts and feeling the ground shake beneath them.

Although Jan rarely spoke about these experiences as an adult, his family noted that he had always been wary of loud noises and large crowds. He often avoided social gatherings and would flinch at sudden sounds, behaviors that were dismissed over the years as personality traits. However, as Jan's dementia progressed, these past experiences appeared to resurface in fragmented and distressing ways. This pattern aligns with known presentations of delayed expression of PTSD in older adults, where PTE memories may re-emerge due to aging, cognitive decline, or situational triggers. With this new understanding, the psychologist began to suspect that Jan's distress and behavioral changes might not stem solely from dementia, but could also reflect psychological symptoms related to PTEs.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.



Chapter 5

Posttraumatic stress disorder in people with dementia: study protocol

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Mariëlle A.M.J. Daamen, Sebastiaan P.J. van Alphen, Maaïke van Kordenoordt,
Jos M.G.A. Schols, Koen R.J. Schruers, Sjacko Sobczak.

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DOI: 10.1080/20008066.2024.2320040

Abstract

Background

Posttraumatic stress disorder (PTSD) is considered an independent risk factor for dementia. Despite the (clinical) evidence that PTSD is associated with neuropsychiatric symptoms in people with dementia, studies on its prevalence and clinical manifestation are limited, and their quality is affected by the lack of a structured method to diagnose PTSD in this population. The primary aim of the current study is to validate the 'TRAuma and DEmentia' interview as a diagnostic tool for PTSD in people with dementia and to test feasibility of EMDR treatment for people with PTSD and dementia.

Methods

This prospective multi-centre study is divided into two parts. In study A, 90 participants with dementia will be included to test the criterion validity, inter-rater reliability and feasibility of the 'TRAuma and DEmentia' interview. In study B, 29 participants with dementia and PTSD will receive eye movement desensitisation and reprocessing therapy by a trained psychologist, and 29 participants with dementia and PTSD will be placed on the waiting list control group.

Conclusion

This study aims to improve the diagnostic process of PTSD and to assess the effects of eye movement desensitisation and reprocessing treatment in people with dementia living in Dutch care facilities.

Background

Traumatic life events can result in severe psychiatric symptoms, of which posttraumatic stress disorder (PTSD) is the most prevalent. The lifetime prevalence of PTSD in the general population is 7%-8% [1]. However, in older adults, the diagnosis of PTSD is less frequent (1%-3%), compared with younger adults [2, 3].

The main feature of PTSD in the general population is intrusive symptoms after a traumatic event. Additionally, symptoms such as hyperarousal, changes in mood or cognition and avoidance of trauma-associated triggers are seen in people with PTSD [4]. Older adults with PTSD experience a high disease burden, higher risk of suicide attempts, and higher risk of anxiety, compared with older adults without PTSD [5]. In addition, PTSD has a negative effect on quality of life [6]. There is also a high caregiver burden related to the increased symptom severity in PTSD [7]. PTSD is associated with chronic stress and cognitive dysfunctions, and it has been described as an independent risk factor for cognitive decline and dementia [8]. Eye movement desensitisation and reprocessing (EMDR) is a validated treatment modality for PTSD in the general population [9]. It is a protocolised psychological treatment method to reduce the distress related to an experienced traumatic life event. Recent studies have shown that it is also effective in the older population without dementia [10]. Moreover, treatment of PTSD reduces the level of frailty in older people without dementia [10]. Existing case reports show that EMDR may be a feasible treatment modality for people with dementia and PTSD, with the differing case reports describing the dementia severity as anywhere from mild – severe [11-14]. To the best of our knowledge, there are no prospective studies on EMDR for people with PTSD and dementia.

To indicate the appropriate treatment of PTSD, it is important to recognise PTSD in people with dementia. Older adults more frequently present with a sub-threshold diagnosis of PTSD (a 6-month prevalence of 13.1%), compared with a predominantly younger population (a 6-month prevalence of 6.6%) [15, 16]. In a sub-threshold diagnosis of PTSD, a person meets two or three of the *Diagnostic and Statistical Manual of Mental Disorders* (5th edition, DSM-5) criteria [16]. Van Dongen et al. [17], suggest that people with dementia and PTSD might also exhibit different symptoms, compared with healthy adults. For example, avoidance is absent in most cases. Hence, the diagnosis is often 'sub-threshold' [17].

Following the previously highlighted studies describing feasibility and effectivity of EMDR in older people, the need to analyse feasibility of EMDR in people

with dementia arises [10]. An international delphi study finds importance in developing a diagnostic tool for PTSD in people with dementia, due to the different clinical presentation [18]. The TRAuma and DEmentia (TRADE) interview aiming to diagnose PTSD in people with dementia, is developed together with experts in the field but it is not yet validated [19]. The TRADE-interview combines anamnestic information, informant information (of someone that knows the person well) and clinical observations from formal caregivers to determine whether PTSD is present and its severity (https://maastrichtuniversity.eu.qualtrics.com/jfe/form/SV_0AOLXSjGHsmEVVA). The TRADE-interview in its current form does not specifically diagnose sub-threshold PTSD because this term is based on the DSM-5 criteria. As described above we hypothesize these criteria are not suitable for people with dementia. The aim of part A of the current study is to test the validity of the TRADE-interview in people with dementia in clinical practice. The criterion validity will be tested using clinical examination as a comparison standard.

In this article we describe the protocol for a study that aims to (A) test the criterion validity, inter-rater reliability and feasibility of the TRADE-interview; and (B) measure the feasibility of EMDR treatment in people with PTSD and dementia in nursing homes and a mental health care facility, referred to as Dutch care facilities.

Methods/Design

This study follows a multi-centre cross-sectional approach and is divided into two parts. The first part (study A) will assess the diagnostic process (TRADE-interview). The second part will evaluate treatment of PTSD using EMDR (figure 1).

Setting

The study will include participants from five nursing home organisations providing long-term care for people with dementia as well as one regional mental health care facility. Together, these places are referred to as Dutch care facilities. We have chosen these organisations based on their location. These are 6 important stakeholders in the care for residents with dementia in the Netherlands. By including two kinds of facilities, we hope to increase generalizability of the results. These organisations all have multiple locations in the southern part of the Netherlands. People with dementia receive day-to-day care from a team of caregivers and nurses and are supported, where necessary, by (para)medical professionals, such as physiotherapists, psychologists and physicians.

Study population and sample

The inclusion criteria for studies A and B are: (1) people with a DSM-5 diagnosis of dementia and (2) people with an informant, or someone who has known the participant since before their diagnosis of dementia and can assist in insights of the past, available for data collection. The exclusion criteria for studies A and B are: (1) people with an advanced form of dementia, referred to as stadium 3 or 4 according to the scale of Verdult and Van der Kooij [20], meaning a person can be disoriented at times, but also has moments in time where they are oriented in person and place; (2) people or informants who do not speak the Dutch language; (3) people with resistance behaviour possibly indicating they do not wish to participate regardless if they say otherwise; and (4) major medical or psychiatric comorbidities. For study B, an additional inclusion criterion is a diagnosis of PTSD and an additional exclusion criterion is substance abuse disorders.

Sample size calculation

To test the inter-rater reliability of the TRADE-interview in study A, 20 measurements (based on a rule of thumb) are used and independently co-rated by two raters. This rule of thumb is based on a calculation with an intraclass correlation coefficient (ICC) of 0.60 and a power of 80% [21]. Based on this, at least 15 measurements are sufficient [22]. Figure 1 gives an overview of the design for studies A and B.

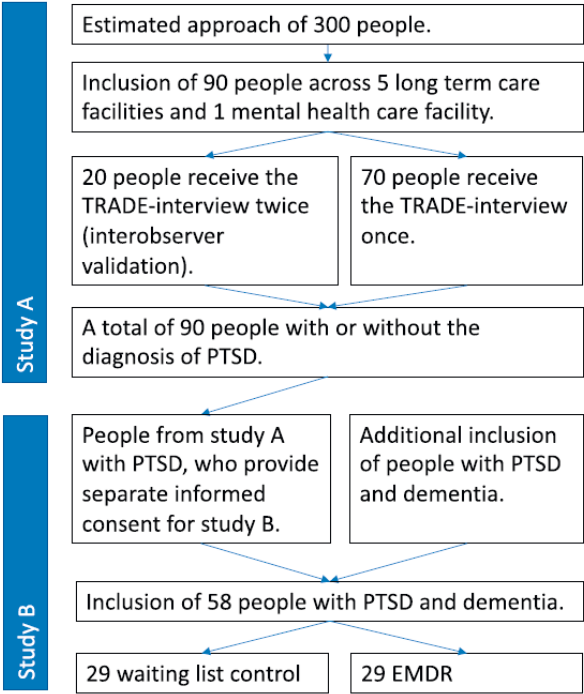


Figure 1. Overview of the design for study A and B. EMDR: Eye movement desensitisation and reprocessing, PTSD: Posttraumatic stress disorder

For criterion validity and feasibility of the TRADE-interview in clinical practice, an additional 70 participants will be included. MedCalc® was used for the power calculation [23]. This software uses the method described by Hanley et al. [24] for the power calculation based on receiver operating characteristic (ROC) curve analysis [24]. Given an α value of 0.05, power of 0.8 and an area under the curve (AUC) of ≥ 0.60 (an AUC of 0.60 can be regarded as sufficient diagnostic accuracy) [25], the necessary sample size for the current study is 90.

For study B, a total of 58 participants will be included. 29 people will receive EMDR, and 29 people will be part of the waiting list control group (WLC). The amount of people included is based on a meta-analysis of the efficacy of EMDR for people with PTSD (with PTSD symptom rating as the outcome variable), in which the average Hedges' g effect size is 1.01 [26]. Large effect sizes have also been reported by Wagenmans et al. [27] (Cohen's $d = 1.52$ - 2.09) and by Van Woudenberg et al. [28] (Cohen's $d = 1.87$). Gielkens et al. [10] proved that these large effect sizes are also seen in older adults. G*power was used to calculate the required sample size, using PTSD symptoms (based on the TRADE-interview) as the major outcome. Considering the parameters, a t-test was used

to determine the difference between two independent means with an effect size of 1.01 [26], an α value of 0.05 and a power of 0.95. Each treatment arm (the EMDR and WLC groups) would have to have at least 29 participants (a total of 58 participants). In addition, two-tailed t-tests to determine the difference between two dependent means will have an effect size of 0.30, an α value of 0.05 and power of 0.80 [29].

Participant selection

The care organisations will provide different locations. The research team will advise the research representatives of the different care organisations to choose a location with multiple residential wards. At the location, the participants will be included via convenience sampling. The participants and their legal representatives will be asked to provide informed consent. If the legal representative and participants feel another person would be best suited as informant in the study, the informant shall also be asked to sign informed consent.

Study protocol

Study A

Study A aims to test the criterion validity, inter-rater reliability and feasibility of the TRADE-interview and to describe the target population for this study. Data will be collected from the participants enrolled in study A over the course of maximum 4 days, within a period of 3 weeks. The clinical diagnoses (PTSD present or absent) of the practitioner will be compared with the results of the TRADE-interviews (measure procedure is further clarified below). The investigators will be blinded, regarding the clinical diagnosis of the participants at the time of the TRADE-interview.

Measurements in Study A

The different measurements that will be done in study A are described below. Tables 1 and 2 present an overview of the instruments that will be applied during the course of the study.

Table 1. Overview of the measurements during the course of study A

Four-week period					
	Conducted by	Day 1	Day 2	Day 3	Day 4*
Patient					
TRADE-interview	Researcher	X			X
Clinical psychiatric investigation	Psychologist or psychiatrist			X	
Demographic variables	Location coordinator	X			
Informal caregiver					
TRADE-interview	Researcher	X			X
Formal caregiver					
TRADE-interview	Researcher	X			X

Note: TRAuma and Dementia (TRADE).

*Day 4 is only done in the first 20 inclusions.

PTSD symptoms

Using the TRADE-interview, the presence of PTSD symptoms and its severity will be assessed (https://maastrichtuniversity.eu.qualtrics.com/jfe/form/SV_0AOLXSjGHsmEVVA). [19]. The semi-structured interview consists of an interview with the participant, informant information and a clinical observation on the presence of PTSD symptoms and their severity in the past month. In the clinical observation the formal caregiver is asked if and to what extent the following symptoms are present: intrusive symptoms (nightmares, flashbacks) avoidance, negative feelings, and changes in arousal (irritability, aggression, reckless or self-destructive behaviour, overly vigilant, heightened startle response and insomnia). The outcomes are combined to form a total score indicating the presence or absence of PTSD in the person with dementia. A patient is considered positive for PTSD when at least one sub-criterion of the main criteria A, B and E is met in one of the elements (anamnestic, informant or observational information). In addition, the duration of the disorder must be longer than 1 month and cannot be explained in any other way (criteria F, G and H; [4]). In 20 participants, the TRADE-interview will be repeated by a second researcher to test inter-rater reliability. This will happen within the 3-week period of data collection and not on the same day as the initial TRADE-interview.

Clinical psychiatric investigation

For the convergent criterion validation of the TRADE-interview, a clinical psychiatric investigation will be used as the comparison standard. This is to increase transferability to current clinical practice in nursing homes. The presence of a clinical diagnosis of PTSD will be assessed by a psychiatrist or psychologist, who will use the standardised clinical investigation that they use in daily practice. The professional will indicate the presence or absence of each DSM-5 criteria, the final diagnosis and an EMDR indication. Tools such as the CAPS-5 or SCID are not applied in this study, as these tools are not validated in people with dementia and the staff in nursing homes is not trained in the application of these tools [18].

Demographic variables

Demographic variables will be collected to describe the population. Data concerning ethnicity, age, gender, (neuro)psychiatric history (including comorbid disorders), somatic disorders, marital status, children, education and employment history, social network, weight (loss), height, use of alcohol and smoking will be collected. Besides, the indication for residency in a long-term care facility, according to the Dutch indication system for long-term institutional care (Residency due to longstanding somatic, cognitive or psychiatric diagnosis), and the use of involuntary care, according to the Compulsory Mental Healthcare Act, will be registered [30]. Involuntary care includes care in which the person's freedom is restricted (such as locked doors, limited use of communicatory devices, or psychopharmacological medication outside of protocol).

Statistical analysis

First, a quantitative analysis will be performed. The results of the TRADE-interview will be compared with the results of the clinical diagnosis to assess the criterion validity of the TRADE-interview. The cut-off score, sensitivity and specificity of the TRADE-interview will be calculated based on receiver operating characteristic (ROC) curve analyses. The ROC curve that best fits the data will determine the sensitivity and specificity. Significance will be set at 0.05 (two tailed). Analyses will be performed with SPSS Statistics (IBM Corp., Armonk, NY, USA). Attrition is expected to be low in section A as the inclusion takes place over a short period of time. Demographic statistics of continuous outcomes will be presented by disorder category (PTSD vs non-PTSD in study A) and include sample size, mean, median, standard deviation, minimum and maximum.

Study B

Study B will investigate the feasibility of EMDR treatment in people with dementia and PTSD. Data will be collected over a period of 4 months. The methods and design are based on a previous study on the feasibility of EMDR in older adults carried out by our research group [10]. Measurements taken during and after EMDR treatment in people with dementia will be compared with measurements from the WLC group (Table 2). To test treatment fidelity, a total of three EMDR treatments will be recorded and evaluated by other EMDR practitioners. There is a guideline available for EMDR therapists. Once every 3 weeks, the EMDR therapists will have an intervision session to guarantee treatment quality and progress. The participants and their caregivers will be asked to provide their permission.

Table 2. Overview of the measurements during the course of study B

Four-months							
	Conducted by	Screening	Start	1 month	2 months	3 months	4 months
Patient							
TRADE-interview	Researcher	X	X	X	X	X	X
Clinical psychiatric investigation	Psychologist or psychiatrist	X					
Demographic variables	Location coordinator	X					
Informal caregiver							
TRADE-interview	Researcher	X	X	X	X	X	X
Formal caregiver							
TRADE-interview	Researcher	X	X	X	X	X	X

Treatment with EMDR

EMDR will be conducted by health care practitioners who are trained in administering this therapy. EMDR is a validated psychological treatment for PTSD and is part of a standardised treatment algorithm [31, 32]. EMDR is a psychotherapeutic approach that aims to resolve symptoms resulting from disturbing life events [33]. This study will use the Dutch translation of the EMDR

(standard) protocol developed for children and adolescents, with cognitive age-appropriate modifications. Clinical experience indicates it may represent a better fit for people with dementia as the explanations are shorter and less complex [34, 35]. Bilateral visual or sensory stimulation will be used. As not all older adults can complete a 90-minute session, the sessions will be reduced to 30-60 minutes, with the aim of one session per week. The first two sessions will also consist of psychoeducation for patients, caregivers and the formal caregivers about the relation between trauma and the symptoms seen in the person included; trauma effects; a rationale for the EMDR treatment; gathering information; and treatment preparation. The psychoeducation to the formal caregivers is done as deemed fit for the EMDR therapist and no guideline is provided. There is no pre-determined minimum number of sessions [36]. The number of sessions is adapted to each individual, according to the number of traumatic events being processed, the individual's capacity and clinical feasibility. A maximum of 10 sessions is set. This is based on clinical feasibility in this population, counting an average of one session per week for the three-month study period. The number of EMDR sessions will be registered. All assessments will be conducted by independent researchers who will not be responsible for the EMDR treatment.

Measurements in Study B

PTSD symptoms

Using the TRADE-interview, the presence of PTSD and its symptoms will be assessed [19]. In the interview the presence and absence of PTSD symptoms will be questioned in the person, their informant and a formal caregiver, including the observed severity of these symptoms. The TRADE-interview will be administered before the start of the EMDR sessions, and during the course of the EMDR sessions the interview will be repeated every month to monitor the effects of the EMDR treatment.

Statistical analysis

For study B, the general linear model (GLM) repeated measures procedure will be used. The between-subject factors will be grouped based on whether the participants received EMDR. The within-subject factor is time. The relationship between the scores for the TRADE-interview and the scores for the main outcome variables will be investigated by using Pearson's product moment and regression analyses. Significance will be set at 0.05 (two-tailed). Analyses will be performed with SPSS Statistics (IBM Corp.).

As study B takes place over the course of 4 months, attrition is expected to be higher compared to section A. As the main outcome is feasibility, we will keep track of drop out rates including the cause of drop out. 'Missing completely at random' data will be handled using random forest plot method.

Demographic statistics of continuous outcomes will be presented by treatment category in study B (EMDR vs WLC) and will include sample size, mean, median, standard deviation, minimum and maximum.

Data management for studies A and B

A data safety management board will be appointed from the Clinical Trial Centre Maastricht (CTCM). A data management plan will be created and the data will become available according to the FAIR principles [37]. The data collected during the study period will be entered into Castor. All adverse events reported spontaneously by the person, observed by the investigator or observed by his staff will be recorded in Castor. The investigator site files will be kept at the study locations in a locked cabinet only accessible by the research team.

Ethical considerations for studies A and B

The study protocol complies with the Declaration of Helsinki and has been granted approval from the Medical Ethics Committee of Maastricht University/Academic Hospital Maastricht (NL70479.068.20 / METC 20-063). The study is registered in the Open Science Framework (OSF) trial register.

Discussion

This study will provide insight into the diagnosis and treatment of PTSD in people with dementia in Dutch care facilities. Study A will analyse validity of the TRADE-interview as a diagnostic tool for PTSD in people with dementia living in Dutch care facilities. This validation would help health care professionals working with people with dementia to talk about traumas and the effect on the patient, and it would open the door to trauma-focused treatment. We expect study B to provide insight into the feasibility of EMDR in people with mild-to-moderate dementia in Dutch care facilities.

Prospective research on the diagnosis and treatment of PTSD has not been performed in people with dementia, possibly due to the challenges of research

in this population, such as achieving (informant) information about the past, the role of cognitive decline in this population and the challenges associated with obtaining informed consent. The limitations of the current study are the high dependence on informant data (via treatment effect measurement using TRADE-interview) to determine the treatment effects and the recruitment of participants in different care settings with different levels of care burden. Selection bias may occur by only recruiting people with mild-to-moderate dementia in whom no resistance behaviour is expected. We aim to validate the TRADE-interview using clinical examination as a comparison standard supported by the DSM-5. We believe that the sensitivity of the DSM-5 criteria in people with PTSD and dementia is not high enough due to different symptom presentation [17] and the clinical examination is not protocolized. Thus, the results should be interpreted with caution, considering this context. The study of van Dongen et al. [17] showed that avoidance seems to be a rarely present symptom (only 3/30 cases), possibly because it is not recognized, not needed in the structured and protected environment or people do not have the cognitive ability to avoid a trauma related thought. Because of this, most people with dementia will not be diagnosed with PTSD when assessed with the DSM-5 criteria of PTSD, as they do not meet all the main DSM-5 criteria.

5

Regarding the treatment with EMDR, there is a high level of independence for the psychologists performing the EMDR. We have not set lower limits of treatment sessions to stay as close to 'practice as usual' as possible, and this must be considered when interpreting the results. Nevertheless, the results of this study will hopefully provide tools for diagnostics and treatment.

This study differs from other studies due to the chosen population: other studies have not included people with dementia living in nursing homes and mental health care facilities. This population is provided with full-time care, giving us unique insight into the effects of the treatment from the formal caregiver's perspective. Additionally, this project forms a bridge between mental health care and long-term care facilities for older adults by building a transmutal academic workplace.

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Clinical vignette: Jan [part 5]

The diagnostic process

Recognizing the possibility of underlying consequences of PTE, the psychologist conducted an assessment using the TRAuma and Dementia (TRADE)-interview. The TRADE-interview integrated observations from caregivers, insights from Jan's family, and direct input from Jan himself to provide a comprehensive picture of his symptoms. Although avoidance behaviors—typically associated with PTSD—were not prominently observed in Jan's daily routines, retrospective information and behavioral patterns suggested subtle signs of avoidance, such as his long-standing reluctance to speak about the war or engage in large crowds. The TRADE-interview nonetheless provided valuable insights into how past PTEs may help explain the presence of his hallucinations, screaming, agitation, sleep disturbances, and wandering.

The gathered information, particularly details about Jan's childhood experiences during the war, clarified that his symptoms and behavior were likely manifestations of undiagnosed PTSD. What initially appeared to be typical dementia-related behaviors or neuropsychiatric symptoms, such as wandering and hallucinations, were reinterpreted as 'PTE-related neuropsychiatric symptoms'. His sleep disturbances were identified as nightmares, often centered around the traumatic loss of his brother. At the same time, his screaming and hallucinations were likely flashbacks triggered by perceived threats rooted in his past experiences of bombings.

Jan's dementia compounded these symptoms and behaviors, making it increasingly difficult for him to differentiate between past and present. This confusion caused his PTSD symptoms to resurface in heightened and fragmented ways. In his mind, ordinary events in the nursing home—such as a loud noise—could evoke panic responses, as though he were back in a war zone again.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.



Chapter 6

A first insight into the clinical manifestation
of posttraumatic stress disorder in dementia:
a systematic literature review

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Abstract

Posttraumatic stress disorder (PTSD) is a prevalent disorder worldwide and often co-occurs in dementia. Both have a major impact on disease burden and quality of life. PTSD may be difficult to recognize in dementia and a structured diagnostic method is lacking. In order to get insight into the clinical diagnostics of PTSD in dementia, this systematic literature review evaluates the clinical presentation of PTSD and other relevant symptoms in people with dementia. PubMed, PsycINFO, Embase, and CINAHL were searched for all publications through 30 December 2021. Articles were included which met the following criteria: (i) description of at least one case with a current diagnosis of dementia and co-morbid PTSD; (ii) clinical presentation of symptoms being adequately described; (iii) no difference being made between chronic PTSD, PTSD with re-activation, and delayed onset PTSD. Of the 947 identified abstracts, 13 papers met the inclusion criteria and were included (describing 30 cases). Based on our rating, only one case completely fulfilled the DSM-5 criteria of PTSD. Avoidance was only described in three cases. Most commonly described symptoms were irritability and anger (E1, 9%), persistent negative emotional state (D4, 9%), and sleep disturbances (E6, 8%). In 93% of the case reports, other symptoms were also described, i.e. memory problems (58%), screaming (33.3%), and wandering (22.2%). People with dementia who have experienced a traumatic event seem to present, based on our rating method, with insufficient symptoms to meet all criteria for a PTSD DSM-5 diagnosis. The DSM-5 core symptom of avoidance was absent in most of the cases. Clinical presentation consists mainly of symptoms of irritability, anger, persistent negative emotional state, and sleep disturbances, often accompanied by other symptoms. These findings suggest that older people with dementia may have other symptom presentations than people without dementia.

Introduction

Posttraumatic stress disorder (PTSD) is a prevalent disorder worldwide and has been reported as an independent risk factor for cognitive decline and dementia [1-6]. Veterans with PTSD are twice as likely to develop dementia than veterans without PTSD [4, 7, 8], with a 7-year cumulative dementia incidence of 10.6% [9].

The estimated comorbidity rate of PTSD in dementia, based on only three studies in veterans [10-12], varies between 4.7% and 7.8%. However, PTSD may be difficult to recognize in people with dementia due to cohort properties such as underreporting of psychological symptoms, memory dysfunctions, and difficulties in self-report of symptoms [13]. Besides PTSD, depression and fear [14] are also difficult to recognize and consequently go undertreated in people with dementia.

Presentation of PTSD in dementia may be masked by other psychological and possible behavioural disorders, described as behavioural and psychological symptoms of dementia (BPSD) [11]. Reported BPSD are anxiety, irritability [15], sleep disturbances, and nightmares [16]. As PTSD is potentially a treatable condition, also in dementia, recognition is essential for personalized treatment interventions [17].

PTSD symptoms can appear with delayed onset or in chronic form with fluctuating course. The prevalence of PTSD declines with age [1, 18-20]. In addition, three distinct clinical courses of PTSD have been described, namely: (i) chronic PTSD in which patients continuously suffer from PTSD [21, 22]; (ii) PTSD with reactivation whereby PTSD is provoked, e.g. by loss of loved ones, after retirement, and other re-activation of feelings experienced during early life trauma [23]; and (iii) delayed onset PTSD in which people functioned normally after the traumatic event but develop symptoms of PTSD after decades [12, 24]. Delayed onset PTSD may be easily missed especially in dementia because of lack of a valid life history. Associated behavioural problems may then be easily interpreted as BPSD.

In the general population, PTSD may go along with a lower quality of life which is even more compromised in people with dementia [25-27]. Accordingly, several studies have shown that PTSD is associated with physical and psychological comorbidities which may lower the quality of life even more [12, 28].

There is no clear overview of the clinical presentation of PTSD in people with dementia. In order to improve recognition of PTSD symptoms in these individuals, the current systematic literature review was designed to summarize

the available literature with regard to the clinical presentation of PTSD symptoms (according to the Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM-5)) in people with dementia [29].

Methods

Data sources and searches

The literature search was conducted in PubMed, PsycINFO, Embase, and CINAHL on 30 December 2021. The search strategy consisted of terms related to PTSD and terms related to dementia, as well as specific limitations (see Appendix S1 in the Supporting Information). In particular, the search was made for the umbrella term dementia and not each subtype of dementia separately. Subsequently, a reference list of publications and secondary literature was hand-searched for possible missing publications. See Sobczak et al. [6] for more details.

Study selection

As the goal of this study is to investigate the clinical presentation of PTSD in people with a current diagnosis of dementia, we included all papers in which current post-traumatic stress symptoms in dementia cases were described. We used the following inclusion criteria: (i) description of at least one case of a patient with a current diagnosis of dementia with comorbid PTSD symptoms [21, 22]; (ii) clinical presentation of symptoms being adequately described [23]; (iii) no difference being made between chronic PTSD, PTSD with re-activation, and delayed onset PTSD [12, 24]. The search was limited to English language publications. Publications were excluded when the described PTSD symptoms predated the onset of dementia.

Data extraction and description of data

The selection process of this exploratory study followed the PRISMA (Preferred reporting items for systematic reviews and meta-analyses) guidelines [30]. Titles and abstract were screened for broad suitability and the above-mentioned eligibility criteria. Next, selection took place after reviewing the full-text papers by two independent authors (S.S. and D.v.D.). In order to describe the clinical presentation of PTSD in dementia, included papers were checked for PTSD symptoms according to the DSM-5 [29] using the following steps: (i) For the first DSM-5 criteria, traumatic life events were checked using the Life Event Checklist-5 (LEC-5) and were rated using DSM-5 criteria A (1–4), trauma exposure [31]; and (ii) psychiatric symptoms described in the case were rated using PTSD DSM-5 criteria (the number of items required for a PTSD diagnosis indicated in brackets for each symptom group): B (1–5) intrusion symptoms (≥ 1), C (1, 2)

avoidance symptoms (≥ 1), D (1–7) negative cognition and mood symptoms (≥ 2), E (1–6) marked alterations in trauma related arousal and reactivity (≥ 2).

DSM-5 criteria F (duration >1 month), G (distress/ impairment), and H (not attributable to another disorder) were not used in the symptom rating as these are regarded as difficult to check in the literature and less relevant for our specific research question. A standardized data collection form was used to extract information (see Appendix S1). We rated all described symptoms in the cases. If symptoms could not be classified as PTSD symptoms according to DSM-5, these were rated as 'other symptoms'. These other symptoms are relevant as they may give hints for a possible alternative symptom presentation of PTSD in dementia.

We give here as an example case 2 from van Achterberg et al. (2001, p. 206; see also Appendix S2):

Mr. B became progressively more anxious and began to startle more easily. Car horns caused him to jump dramatically, making it difficult for him to drive. He awaked from sleep physically fighting, and his wife described 'rage attacks', during which Mr B yelled, threw objects, and slammed doors.

The rated symptoms were anxiety (D4), easily startled (E4), disturbed sleep (E6), physical aggression (E1), rage attacks (E1), and screaming (other symptoms).

Next, operationalization of the search and selection criteria, data extraction, and subsequent rating of PTSD symptoms (using DSM-5) were done by two authors (D.v.D. and S.S.) independently. Possible discrepancies were discussed by the study team.

Assessment of risks of bias

Since this is an exploratory study of a qualitative character, the empirical quality of the included studies is not expected to affect results. To check the impact of quality on our findings, quality assessment of the included papers was done using the method of Murad et al. [30]. This method is based on the Newcastle Ottawa Scale (NOS) reports [32]. We applied this method (performed by D.v.D.) to the reviewed papers (see Appendix S2).

Results

The literature search resulted in 947 abstracts of which 33 (3.5%) were included for full-text screening. Two additional studies were found by checking reference lists [17, 33] and were included after full-text screening. Finally, of the 33 full-texts, 13 studies (1.1%) met the eligibility criteria and were included (Fig. 1).

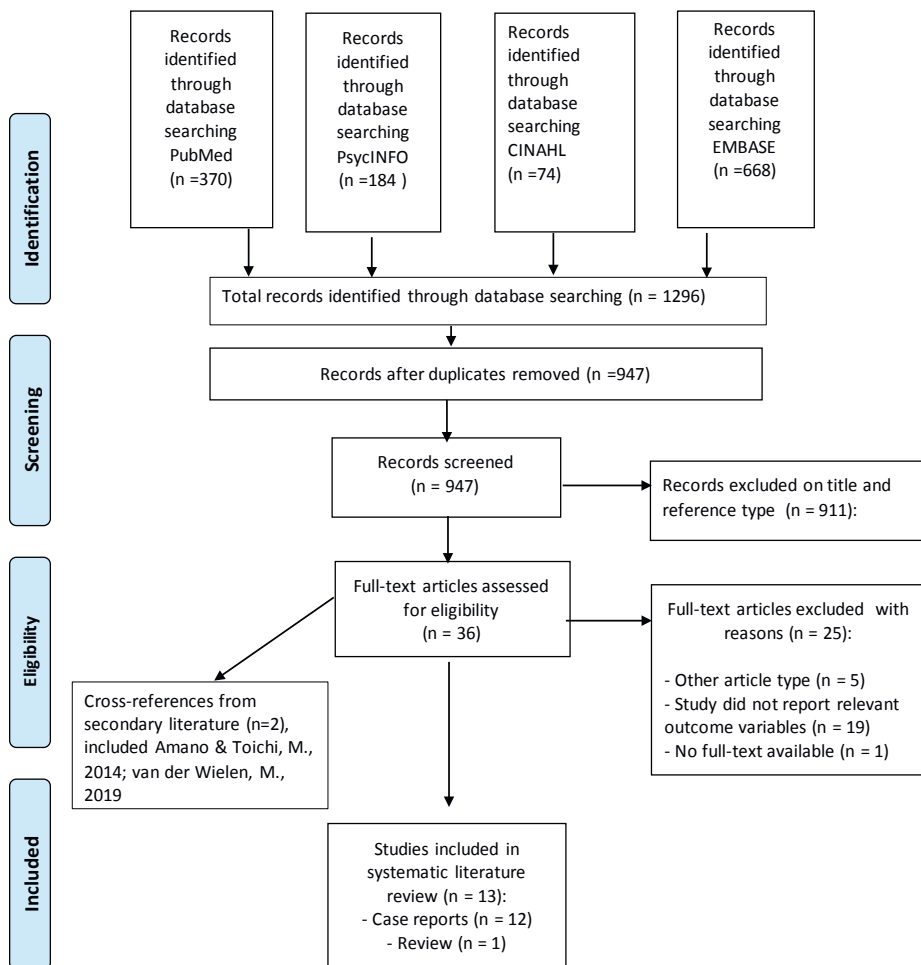


Figure 1. PRISMA flow chart documenting the search and screening process

Of the 13 papers included in the review, 12 consisted of case reports [16, 17, 22, 33–41] and one paper was a review which included three case reports [23]. In total, this review includes 30 cases. The most common trauma was combat or exposure to a war zone (21/30 = 70%). The PTSD diagnosis in the described cases was mainly established by a clinical psychiatric investigation (25/30 = 83%)

[16, 17, 23, 33–38, 40]. Only in one case ($1/30 = 3.3\%$) were diagnostic tools applied (an adapted version of the Clinician-administrated PTSD scale for DSM-IV (CAPS), Mini international neuropsychiatric interview (MINI) and PTSD Checklistcivilian version (PCL-C)) [22]. Two studies did not give information about how PTSD was diagnosed [35, 40].

DSM-5 symptom rating

Table 1 shows the characteristics of the 13 papers and 30 cases that were included in this review. According to the LEC-5, all cases met the first DSM-5 criterion for PTSD (A1). Only one case of the 30 included (3.3%) fulfilled, using our rating method, all necessary DSM-5 criteria of PTSD [39]. The total number of rated PTSD symptoms varied per case between two and five. Avoidance, as a main symptom of PTSD, was not rated in 27 of 30 cases (90%). A more extensive version of Table 1 is shown in Appendix S2. Appendix S2 shows that the mean age was 74.9 years (range 57–95 years), most cases were men (22 male/8 female, 73%) and most people were veterans and have the trauma type of combat or exposure to a war zone ($n = 21$, 70%).

The total rated DSM-5 PTSD symptoms of the included cases are presented in Table 2.

Table 1. Characteristics of included studies, Lec-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria

Authors (year)	Lec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Review			
Martinez-Clavera et al. 2017 [22]	Case 1: Combat or exposure to a war-zone	Anxiety(D4), flashbacks(B3), sleeping disturbances (E6), distractibility(E5), memory problems (o)	Three
	Case 2: Combat or exposure to a war-zone	Physical aggression (E1), anxiety (D4), sleeping disturbances (E6), paranoid ideas (B3), agitation (E1), Disliking seeing other residents in distress (o), memory problems (o)	Three
	Case 3: Severe human suffering	Anxiety (D4), flashbacks (B3), nightmares(B2), sleeping disturbances(E6), screaming (o) Dislike physical touch (o), easily startle (E3), memory problems (o)	Three
Case report			
van Achterberg et al. 2001 [34]	Case 4: Transportation accident	Flashbacks (B3), agitation(E1), distress (D4) psychomotor agitation (E1), memory problems (o)	Three
	Case 5: Combat or exposure to a war-zone	Physical and verbal aggression (E1), anxiety(D4), nightmares(B2), sleeping disturbances(E6), easily alarmed/easily startle (E3), screaming (o), Negative beliefs (D2), memory problems (o)	Four
	Case 6: Combat or exposure to a war-zone	Agitation (E1), anxiety(D4), flashbacks (B3), Intrusive memories (B3) nightmares (B2), easily alarmed/ easily startle (E3), suspiciousness (o), memory problems (o)	Three
Ahmed. 2018 [39]	Case 7: Sexual assault, stressful event	Depressive symptoms (D7), anxiety (D4), sleep disturbances (E6), visual hallucinations (o)	Two

Table 1. Characteristics of included studies, Lec-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria (continued)

Authors (year)	Lec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Amano et al. 2014 [16]	Case 8: Childhood trauma	Physical and verbal aggression(E1), agitation (E1), hallucination (B1), wandering (o), screaming (o), memory problems (o)	Three
	Case 9: Combat or exposure to a war-zone	Sleeping disturbances (E6), resistance against caregivers (o), screaming(o), wandering(o), restlessness (E6), delirium(o), hallucination (o), agitation (E1), memory problems (o)	Two
	Case 10: Combat or exposure to a war-zone	Sleeping disturbances(E6), physical aggression (E1), screaming(o), wandering(o), delirium(o), resistance against caregivers (o), bizarre eating habits(o), inappropriate dressing and undressing (o), frequently calling a caregiver (o), psychomotor acceleration (o), memory problems (o)	Two

Table 1. Characteristics of included studies, IEC-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria (continued)

Authors (year)	Lec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Bruneau et al. 2020 [32]	Case 11: Combat or exposure to a war- zone	Visual hallucination (o), physical aggression (E1) suicidal ideation (o), nightmares (B2), Depressive symptoms (D7), screaming (o), memory problems (o)	Two
	Case 12: Combat or exposure to a war-zone	physical aggression (E1), emotional lability (D4), visual and auditory hallucination (o), sleeping disorder (E6), memory problems (o), vivid intrusive memories of war (B1), wandering (o), inside talking (o), dissociative trauma flashback (B3)	Three
	Case 13: Imprison	physical aggression (E1), screaming (o), depressive (D7), physical and psychological distress (B4 and B5), memory problems (o)	Two
	Case 14: Drugged and robbery	aggression (E1), agitation (E1), Anxious (D4), memory problems (o),	Two
	Case 15: Imprison during Pinochet regime	agitation (E1), resistance against caregivers (o), sleeping disorders (E6), avoidance (C1), aggression (E1), psychomotor restlessness (o), memory problems (o)	Three
Chopra et al. 2011 [40]	Case 16: Combat or exposure to a war-zone	Nightmares (B2), sleeping disturbances (E6), flashbacks (B3) , easily startle (E3) , depressive symptoms (D7)	Three

Table 1. Characteristics of included studies, Lec-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria (continued)

Authors (year)	Lec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Duax et al. 2021 [21]	Case 17: Combat or exposure to a war-zone	Physical aggression (E1), nightmares(B2), memory problems(o), sleeping disturbances(E6), irritability(E1), apathy (D5), suspiciousness (o), Anxiety (D4), depression (D7)	Four
Hamilton et al. 1998 [35]	Case 18: Combat or exposure to a war-zone	Nightmares(B2), sleeping disturbances(E6), psychomotor retardation(o) , agitation(E1), disorientation (D6), screaming (o), delusion of beliefs (o), memory problems (o), delirium (o), re-experiences (B1), easily startle (E3)	Three
Iacono et al. 2020 [33]	Case 19: Combat or exposure to a war-zone	memory problems (o), irritability (E1), depression (D7), agitation (E1), physical aggression (E1),	Two
	Case 20: Combat or exposure to a war-zone	Nightmares (B2), suicide (o), memory problems (o) beliefs (D3), sleeping disturbances (E6)	Two
	Case 21: Combat or exposure to a war-zone	memory problems (o), attention (E5), dissociative episodes (B3), guilt and shame (D3), distressing memories (B1, B4), irritability (E1), Physical aggression (E1), wandering (o), paranoia (o)	Three
	Case 22: Combat or exposure to a war-zone	suicidal ideations (o), memory problems (o),	One

Table 1. Characteristics of included studies, LEC-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria (continued)

Authors (year)	Lec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Johnston. 2000 [15]	Case 23: Combat or exposure to a war-zone	Flashback (B3), nightmares(B2), memory problems(o), sleeping disturbances(E6), dissociation(B3), irritability(E1), agitation(E1), easily alarmed/easily startle(E3), disorientation(D6), wandering(o), screaming (o), aggression (E1), paranoid ideas (o), social withdrawn (D5)	Four
	Case 24: Combat or exposure to a war-zone	Physical aggression (E1), depression/ depressive symptoms(D7), nightmares(B2), memory problems(o), concentration problems(E5), sleeping disturbances(E6), Physiological distress on trauma (B4 and B5)	Three
	Case 25: Combat or exposure to a war-zone	Physical aggression(E1), anxiety(D4), nightmares(B2), memory problems(o), sleeping disturbances(E6), paranoid ideas(o), delusion (D3), agitation(E1)	Four
Mc Cartney et al. 1997 [36]	Case 26: Sexual assault	Anxiety (D4), concentration problems (E5), agitation (E1), easily alarmed/ easily startle (E3), psychomotor restlessness (o), memory problems (o), physiological distress (B4), avoidance (c2), intrusions (B1)	Four

Table 1. Characteristics of included studies, IEC-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria (continued)

Authors (year)	Iec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Mittal et al. 2000 [37]	Case 27: Combat or exposure to a war-zone	Suicidal ideations (not attempt) (o), depression/depressive symptoms, anxiety (D7), flashbacks (B3), memory problems (o), impaired abstract reasoning (E5), anxiety (D4), concentration problems (E5)	Four
	Case 28: Combat or exposure to a war-zone	Suicidal ideations (no attempt) (o), restricted affect (D4), depression/ depressive symptoms (D7), flashback (B3), nightmares (B2), memory problems (o), concentration problems (E5), sleeping disturbances (E6), psychomotor retardation (o), hopelessness (D3), negative beliefs (D4), avoidance (C2)	Five
	Case 29: Combat or exposure to a war- zone	Depression/depressive symptoms (D7), anxiety (D4), nightmares (B2), memory problems (o), sleeping disturbances (E6), psychomotor acceleration (o), impaired attention (E5), impaired abstract reasoning (E5), recall (B1)	Four

Table 1. Characteristics of included studies, LEC-5 trauma, psychiatric symptoms, and total rated PTSD. The psychiatric symptoms are those described in the 30 cases. The PTSD symptoms are rated based on DSM-5 criteria (continued)

Authors (year)	Lec-5 trauma	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Van der Wielen. 2019 [32]	Case 30 : stressful experience	Memory problems (o), flashbacks (B3)	Two

Psychiatric symptoms: symptoms described in cases. A, Exposure via any of the following: A1, Directly exposed to trauma; A2, Eyewitness to others directly exposed to trauma; A3, Learning of direct exposure to trauma of a close family member or close friend; A4, Repeated or extreme exposure to aversive details of traumatic event, in person or via work-related electronic media. B, Intrusion, including the following: B1, Recurrent, involuntary, distressing, trauma-related dreams; B3, Dissociative reactions/flashbacks related to trauma; B4, Intense or prolonged psychological distress to trauma reminders; B5, Marked, physiological reactions to trauma reminders. C, Avoidance, including: C1, Avoidance/efforts to avoid distressing internal trauma reminders; C2, Avoidance or efforts to avoid distressing external trauma reminders. D, Negative cognition and mood, including: D1, Amnesia for important parts of trauma exposure; D2, Persistent, exaggerated negative beliefs about self, others, or the world; D3, Persistent, distorted trauma-related cognitions leading to inappropriate blame of self/others; D4, Persistent negative emotional state; D5, Loss of interest or participation in significant activities; D6, Detached/estranged feelings from others; D7, Persistent loss of positive emotions. E, Hyperarousal, including: E1, Irritability and angry outburst with little/no provocation; E2, Reckless or self-destructive behaviour; E3, Hypervigilance; E4, Exaggerated startle; E5, Concentration problems; E6, Sleep disturbance. G, Distress/impairment. H, Not attributable to another disorder. O, Other symptoms. DSM-5, Diagnostic and Statistical Manual of Mental Disorders, fifth edition; LEC-5, Life Event Checklist-5; PTSD, posttraumatic stress disorder.

Frequencies of rated PTSD symptoms

Table 2 shows that irritability and anger (E1) is the most frequently described PTSD symptom in people with dementia (9%) [16, 17, 22, 23, 34–36, 38]. Symptoms of irritability and anger (E1) were physical and verbal aggression, agitation, and irritability. Next, persistent negative emotional state (D4) is as often (9%) described. Symptoms of a persistent negative emotional state (D4) were anxiety, depression/depressive symptoms, unstable mood, and suicidal ideations [16, 22, 23, 34–40]. Sleep disturbances (E6) (8%) were described, often in co-occurrence with vivid nightmares (10 out of 16 cases) and nightly wandering (4 out of 13 cases) [16, 17, 22, 23, 34–37, 39–41]. Avoidance (C) was only described in three cases [33,37,38].

Items in the category of ‘other symptoms’ were described in 29/30 cases (97%) (see Appendix S2). Most frequent were memory problems (in 16/30 cases, 53%) [16, 17, 22, 23, 33–39], screaming (9/30 cases, 30%) [16, 17, 23, 34, 36, 37], and wandering (6/30 cases, 20%) [1, 7, 17, 34–36]. Less frequently described other symptoms were suicidal ideation (4/30 cases, 13.3%) [22, 35, 37, 39], paranoid ideas (3/30 cases, 10%) [34, 39], hallucinations (3/30 cases, 10%) [17, 35], delirium (3/30 cases, 10%) [17, 34], resistance against caregivers (3/30 cases, 10%) [16, 17], and psychomotor agitation/acceleration (3/30 cases, 10%) [17, 35, 36].

Table 2. Percentages of reported PTSD symptoms (using DSM-5 criteria) of reviewed cases (n=30)

DSM-5 Criteria for PTSD	
A: Exposure via any of the following	
1. Directly exposed to trauma	100%
2. Eyewitness (in person) to others directly exposed to trauma	0
3. Learning of direct exposure to trauma of a close family member or close friend	0
4. Repeated or extreme exposure to aversive details of traumatic event, in person or via work-related electronic media	0
B: Intrusion	
1. Recurrent, involuntary, distressing trauma memories	6%
2. Recurrent, distressing, trauma-related dreams	7%
3. Dissociative reactions/flashbacks related to trauma	5%
4. Intense or prolonged psychological distress to trauma reminders	2%
5. Marked physiological reactions to trauma reminders	1%

Table 2. Percentages of reported PTSD symptoms (using DSM-5 criteria) of reviewed cases (n=30) (continued)

DSM-5 Criteria for PTSD	
C: Avoidance	
1. Avoidance/efforts to avoid distressing internal trauma reminders	1%
2. Avoidance or efforts to avoid distressing external trauma reminders	1%
D: Negative cognition and mood	
1. Amnesia for important parts of trauma exposure	0
2. Persistent, exaggerated negative beliefs about self, others, or the world	1%
3. Persistent, distorted trauma-related cognitions leading to inappropriate blame of self/others	2%
4. Persistent negative emotional state	9%
5. Loss of interest or participation in significant activities	1%
6. Detached/estranged feelings from others	1%
7. Persistent loss of positive emotions	5%
E: Hyperarousal	
1. Irritability and angry outbursts with little/no provocation	9%
2. Reckless or self-destructive behaviour	0
3. Hypervigilance	3%
4. Exaggerated startle	0
5. Concentration problems	3%
6. Sleep disturbance	8%%
Additional criteria	
F: Duration >1 month	
G: Distress/impairment, clinically significant distress, social/occupational/other important functioning impairment	

PTSD: Posttraumatic Stress Disorder, DSM: Diagnostic and Statistical Manual of Mental Disorders

Discussion

In this systematic literature review we examined the clinical presentation of PTSD in people with dementia. Symptoms of PTSD in dementia were described in 13 papers (1.4% of total found literature) from which 30 cases were included in this review.

PTSD diagnosis in dementia

Of the 30 reviewed cases 24 were clinically diagnosed with PTSD, but using our rating method only one completely fulfilled the DSM-5 criteria for PTSD. A side note in these findings should be that if symptoms were not described, this does not mean that they were not present. Previously, altered clinical presentations of PTSD in different age-groups has been reported [42]. For example, PTSD may be accompanied by more arousal symptoms and lower intrusive symptoms in older adults [42]. Such different clinical presentations may hamper diagnosing PTSD in older age groups. Consequently, differences in reported comorbidity rates between age groups may possibly be attributed to unrecognized PTSD symptoms. For example, in the general population, the 3-month prevalence of PTSD is 7–8%, and it is even lower in older adults [18, 43].

The concept of sub-threshold PTSD has been suggested by McLaughlin et al. [44], defined as meeting two or three of the DSM-5 criteria for PTSD (among the symptom groups B, intrusion; C, avoidance; D, negative cognition and mood; and E, hyperarousal) [44]. In older adults, the 6-month prevalence of subthreshold PTSD is 13.1% [45]. Compared to the 6-months prevalence rate of 0.9% in adults this is relatively high, suggesting a blunted expression of PTSD in older adults. In adults, the prevalence of sub-threshold PTSD is 4.6% [44]. Possibly, the prevalence of PTSD is lower in older adults because of inadequate recognition of PTSD symptoms, resulting in relatively more frequent diagnosis of sub-clinical PTSD. We suggest that in people with dementia inadequate recognition of PTSD symptoms may also be reflected in relatively more sub-threshold PTSD diagnoses. However, even sub-threshold PTSD in older adults may cause mental suffering and be clinically relevant, as trauma-focused treatment can improve PTSD, general well-being and quality of life in older adults with sub-threshold PTSD [46–49]. As Eye Movement Desensitization and Reprocessing (EMDR) has been shown to relieve neuropsychiatric symptoms in three cases with severe dementia [17], we suggest that in clinical practice diagnosing sub-threshold PTSD in people with dementia is also relevant.

People with dementia constitute a population in which the expression of several diagnostic DSM-5 symptoms may be challenging. The DSM-5 criteria are primarily designed for the younger and healthier population. Besides PTSD,

symptoms of depression [13] and fear [14] are also difficult to recognize and consequently undertreated in people with dementia. For example, Olin et al. [13] proposed adapted diagnostic criteria for depressive disorder in Alzheimer's disease. We suggest that adapted diagnostic criteria for PTSD in people with dementia may also be relevant.

Furthermore, the underlying aetiology of dementia can affect the clinical manifestation of PTSD. For example, people with Lewy body dementia more often have hallucinations and flashbacks compared to people with Alzheimer disease [14]. In addition, the presentation of PTSD in people with dementia may also differ depending on the type of trauma [34]. It is unknown whether or not some manifestations are more likely to relapse or exacerbate with the onset of dementia.

Avoidance is a key symptom in PTSD. However, in our reviewed cases we only found avoidance symptoms (C1-2) in three cases [34, 38, 39]. We suggest that avoidance is difficult to signal when patients stay in nursing homes or other closed clinical settings, possibly due to the following factors: (i) older adults are physically less mobile; (ii) older adults living in nursing homes or other closed clinical settings live in an environment where the door is often closed;

(iii) avoidance includes thought, memories, and feelings which are difficult to assess in people with dementia; and (iv) older adults with cognitive problems are often impaired in planning their activities, and thus in avoiding. Therefore, as avoidance may be difficult to recognize, and difficult for patients to realize themselves, caregivers and family members should be asked for avoidance symptoms. Possibly, the wandering seen in 22.2% of our reviewed cases can be taken as a sign of avoidance. Avoidance symptoms of PTSD are more often reported as absent in PTSD subpopulations, such as Mexican hurricane victims [50], women living in South African townships [51], and Palestinian survivors of war of mass violence [52]. Not only do PTSD patients have an inconsistent avoidance symptom presentation, in anxiety disorders, avoidance may also often be difficult to recognize, especially in older adults [53]. Besides, many older adults have been exhibiting coping behaviour for years and may, therefore, be not aware of their avoidance behaviour [23].

Clinical presentation of PTSD in dementia

The most frequently described DSM-5 symptoms of PTSD in dementia were irritability and anger (E1, 9%), persistent negative emotional state (D4, 9%) and sleep disturbances (E6, 8%). There is evidence for increased BPSD in people with dementia and PTSD in some reports [9] but not in others [10, 12]. As specific BPSD symptoms can reflect an expression of delayed onset PTSD, but may be

often not recognized as such [23], we suggest that PTSD is frequently treated as BPSD [23, 24]. Next, a persistent negative emotional state (mainly anxiety) is often seen. We suggest that anxiety is a relatively easy PTSD symptom to recognize in people with dementia, as anxiety seems to be often related to re-experiencing of trauma as a cause of problem behaviour [54]. Sleep disturbances in our cases were often accompanied with dissociative reactions and flashbacks during the night. We cannot be certain that reported sleep disturbances were all PTSD symptoms, as sleep disturbances are a widely known problem in older adults in general [55]. More specifically, 60%–70% of people with cognitive impairment or dementia have sleep disturbances [53]. In conclusion, it can be difficult to differentiate between PTSD symptoms and BPSD symptoms because symptoms such as anger and irritability may be related to both [10, 30].

Other symptoms

Other symptoms were rated in 29/30 of the reviewed cases. In addition to memory problems (53%), screaming (30%) and wandering (20%) were most frequently described.

For example, screaming was accompanied with re-experiences of traumatic events [23, 36] in case 4 (see Table1). She was a woman who survived the sinking of the Titanic. Every time she was distressed, she screamed 'The water is coming up! Go to the lifeboats! Save the children! We'll all be dead!' [36]. However, in some cases patients scream frequently during the day without a specific trigger [23]. Screaming in dementia is a BPSD seriously impacting on the quality of life of both patients and those involved (bystanders and care-givers). For example, a whole department may suffer when a patient is screaming throughout the entire day [56]. Treatment of screaming in dementia is difficult; the challenge is to find which emotional or physiological discomfort causes the screaming [57]. We suggest that screaming may provide a hint to possible previous traumatic events. Diagnosing PTSD may support the clinician in his considerations to start trauma-focused therapy.

During the disease course of dementia, about 60% of patients are considered to exhibit wandering behaviour [13]. It has major health consequences, e.g. getting lost, leading to injury or even death [58]. It also impacts on caregivers [59], e.g. by causing distress due to consequent worries or by being confronted with aggression [15]. Aimless wandering should be differentiated from trauma-related avoidance behaviour in order to diagnose PTSD in dementia.

Though cognitive dysfunctions, e.g. impaired memory performance, are described in PTSD [59], the reported memory problems are probably inherent to the studied dementia population.

Methodological considerations

The scientific evidence of this exploratory study is mainly restricted by: (i) using a small number of papers ($n = 13$); and (ii) using only case reports, which have very limited scientific evidence. Most of the articles have a sufficient quality (NOS 2–3 out of 4, 96%). The lower quality article (case 1) had symptoms conforming to the major findings in our article. Thus it is assumed that there is no interference with the main findings. Next, information bias may be present due to our applied rating method of PTSD symptoms in which we rated symptoms using the DSM-5 as a reference. In addition, there is limited translatability of the results to the general population, because the case reports include a limited group of patients, for instance we included a relatively low number of women and the most common trauma was combat or exposure to a war zone. We did not check psychiatric comorbidities, therefore our rated symptoms were either rated as PTSD symptoms or as other symptoms. Misinterpretation of symptoms may therefore not be fully excluded. In addition, cases were all described in different ways, with different aims of the reports, and differences in the extent of case descriptions. Another limitation is associated with our rating procedure. As we only rated the described symptoms it cannot be ruled out that we overlooked symptoms that were present in the cases but were not described. Thus the findings of our paper give information about clinical symptoms of PTSD that were at least present. Furthermore, this implies that reported symptoms may be skewed toward symptoms that are more observable and therefore more described in the cases. This may explain the low rate of symptoms such as irritability/ anger and persistent negative emotional state.

As, except one, all papers did not use a diagnostic tool for PTSD, descriptions of PTSD symptoms in the reviewed cases may have been incomplete and hence symptoms were missed [22]. The methodological quality (range 2–3 on a scale of 4) [30] between the cases are mainly of low but sufficient and equal quality. Our findings must therefore be regarded as a first exploration of the clinical presentation of PTSD in people with dementia.

Conclusion and recommendations

Overall, a first insight into PTSD in people with dementia shows that, based on our rating method, subjects present mainly with insufficient criteria to fulfil the DSM-5 diagnostic criteria for PTSD. Avoidance seems to be a rarely present symptom, possibly because it is not recognized. Next, the clinical presentation of PTSD in dementia seems to be mainly with irritability and anger symptoms (E1), persistent negative emotional state (anxiety, D4), and sleep disturbances (E6). Furthermore, it could be suggested that PTSD in dementia is accompanied

by other symptoms, e.g. screaming and wandering. We suggest that all these symptoms may be indicative of possible PTSD. Based on this, in dementia, PTSD may have an alternative clinical presentation. In clinical practice, PTSD may then be easily interpreted as BPSD. Therefore, the use of diagnostic tools to diagnose PTSD (e.g. TRADE-interview, LEC of Clinician Administered PTSD scale) is recommended in care and research. This will improve diagnosing PTSD in people with dementia, the quality of research, and comparison of studies.

We suggest conducting a life review of traumatic events and consider PTSD in people with dementia who present with symptoms of irritability and anger, anxiety, and sleep disorders, especially when there is concurrent screaming or wandering.

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Supplemental material

Appendix 1. Complete search strategy

PubMed

S1: (dement* OR Alzheimer*).af
S2: (PTSD OR Post Traumatic Stress Disorder).af
S3: S1 AND S2
30/12/2021 → 370 hits

PsycINFO

S1: dement# OR alzheimer
S2: PTSD OR Post Traumatic Stress Disorder
S3: S1 AND S2
S4: limit S3 to 'Human' and 'English language' (limit to)
30/12/2021 → 1840 hits

CINAHL

S1: dement# OR alzheimer
S2: PTSD OR Post Traumatic Stress Disorder
S3: S1 AND S2
S4: limit S3 to 'English language'
30/12/2021 → 74 hits

Embase

S1: dement* OR Alzheimer*
S2: PTSD OR Post Traumatic Stress Disorder
S3: S1 AND S2
S4: limit S3 to 'Human' and 'English language'
30/12/2021 → 668 hits

Appendix 2. Characteristics of included studies

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD.

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Review							
Martinez- Clavera et al, 2017 (22)	Patients with dementia and PTSD (N=3)	Nursing home	>70	Male	No information	Clinical assessment	No information
			77	Male			
			90	Female			

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	1 (selection)	Case 1: Combat or exposure to a war-zone	Not described	Anxiety(D4), flashbacks(B3), sleeping disturbances (E6), distractibility(E5), memory problems (o)	3
	2(selection and ascertainment)	Case 2: Combat or exposure to a war-zone	Not described	Physical aggression (E1), anxiety (D4), sleeping disturbances (E6), paranoid ideas (B3), agitation (E1) Disliking seeing other residents in distress (o), memory problems (o)	3
	2(selection and ascertainment)	Case 3: Severe human suffering	Not described	Anxiety (D4), flashbacks (B3), nightmares(B2), sleeping disturbances(E6), screaming (o) Dislike physical touch (o), easily startle (E3), memory problems (o)	3

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Case reports							
van Achterberg et al, 2001 (34)	Patients with dementia and PTSD (N=3)	Nursing home	95	Female	No information	Clinical assessment MMSE	No information
			75	Male			
			83	Female			
Ahmad, 2018 (39)	Patient with demented and PTSD	Nursing home	83	Female	No information	Addenbrooke's Cognitive Examination	No information

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	2(selection and ascertainment)	Case 4: Transportation accident	Not described	Flashbacks (B3), agitation(E1) , Distress (D4) psychomotor agitation (E1), memory problems (o)	3
	2(selection and ascertainment)	Case 5: Combat or exposure to a war-zone	Not described	Physical and verbal aggression (E1), anxiety(D4), nightmares(B2), sleeping disturbances(E6), easily alarmed/easily startle (E3), screaming (o), Negative beliefs (D2), memory problems (o)	4
	2(selection and ascertainment)	Case 6: Combat or exposure to a war-zone	Not described	Agitation (E1), anxiety(D4), flashbacks (B3), Intrusive memories (B3) nightmares (B2), easily alarmed/ easily startle (E3), suspiciousness (o), memory problems (o)	3
No information	2(selection and ascertainment)	Case 7: Sexual assault, stressful event	Not described	Low mood, anxious, sleep disturbances, visual hallucinations	2

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Amano et al, 2014 (16)	Patients with mild and moderate dementia and PTSD (N=3)	Nursing home: residential facility	67	Female	No information	Clinical assessment MMSE WAIS	No information
			85	Male			
			83	Male			
.....							

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	3(selection, ascertainment and reporting)	Case 8: Childhood trauma	0/30	Physical and verbal aggression(E1), agitation (E1), hallucination (B1), wandering (o), screaming (o), memory problems (o)	3
	3(selection, ascertainment and reporting)	Case 9: Combat or exposure to a war-zone	7/30	Sleeping disturbances (E6), resistance against caregivers (o), screaming(o), wandering(o), restlessness (E6), delirium(o), hallucination (o), agitation (E1), memory problems (o)	2
	3(selection, ascertainment and reporting)	Case 10: Combat or exposure to a war-zone	0/30	Sleeping disturbances(E6), physical aggression (E1), screaming(o), wandering(o), delirium(o), resistance against caregivers (o), bizarre eating habits(o), inappropriate dressing and undressing (o), frequently calling a caregiver (o), psychomotor acceleration (o), memory problems (o)	2

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Bruneau et al, 2020 (32)	Patients with dementia and PTSD (N=5)	No information	86	Male	No information	No information	No information
			89	Female			
			65	Male			
			78	Male			
			66	Male			

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	2(selection and ascertainment)	Case 11: Combat or exposure to a war-zone	Not described	Visual hallucination (o), physical aggression (E1) suicidal ideation (o), nightmares (B2), Depressive symptoms (D7), screaming (o), memory problems (o)	2
	2(selection and ascertainment)	Case 12: Combat or exposure to a war-zone	Not described	physical aggression (E1), emotional lability (D4), visual and auditory hallucination (o), sleeping disorder (E6), memory problems (o), vivid intrusive memories of war (B1), wandering (o), inside talking (o), dissociative trauma flashback (B3)	3
	2(selection and ascertainment)	Case 13: Imprison	Not described	physical aggression (E1), screaming (o), depressive (D7), physical and psychological distress (B4 and B5), memory problems (o)	2
	2(selection and ascertainment)	Case 14: Drugged and robbery	Not described	aggression (E1), agitation (E1), Anxious (D4), memory problems (o)	2
	2(selection and ascertainment)	Case 15: Imprison during Pinochet regime	Not described	agitation (E1), resistance against caregivers (o), sleeping disorders (E6), avoidance (C1), aggression (E1), psychomotor restlessness (o), memory problems (o)	3

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Chopra et al,2011 (40)	Veteran with PTSD and mild-to-moderate dementia	Home	85	Male	No information	MMSE	PTSS-CI
Duax et al, 20212 (21)	Veteran with PTSD and early stage dementia (N=1)	Psychiatric hospital: PTSD clinic	65	Male	No information	Clinical assessment MMSE RBANS TMT BNT NIT	DSM-IV
Hamilton et al, 1998 (35)	Man with Alzheimer dementia and superimposed delirium (N=1)	Medical Center geropsychiatric inpatient unit	94	Male	DSM-IV	Clinical assessment, MMSE not possible due to blindness	No information

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
MMSE	2(selection and ascertainment)	Case 16 : Combat or exposure to a war zone	17/30	Nightmares (B2), sleeping disorders (E6), reexperiencing , easily startle /hyperarousal	3
CAPS MINI PCL-C (SUDS-hetero anamnestic)	3(selection, ascertainment and reporting)	Case 17: Combat or exposure to a war-zone	24/30	Physical aggression (E1), nightmares(B2), memory problems(o), sleeping disturbances(E6), irritability(E1), apathy (D5), suspiciousness (o), Anxiety (D4), depression (D7)	4
Clinical assessment	3(selection, ascertainment and reporting)	Case 18: Combat or exposure to a war-zone	Not possible due to blindness	Nightmares(B2), sleeping disturbances(E6), psychomotor retardation(o), , agitation(E1), disorientation (D6), screaming (o), delusion of beliefs (o), memory problems (o), delirium (o), re-experiences (B1), easily startle (E3)	3

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Iacono et al, 2020 (33)	Patients with dementia and PTSD (N=4)	No information	72	Male	No information	Clinical assessment MMSE	Clinical assessment
			66	Male			
			64	Male			
			63	Male			

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
No information	2(selection and ascertainment)	Case 19:Combat or exposure to a war-zone	20/30 at age 63, 11/30 at age 67	memory problems (o), irritability (E1), depression (D7), agitation (E1), physical aggression (E1),	2
	2(selection and ascertainment)	Case 20: Combat or exposure to a war-zone	Not described	Nightmares (B2), suicide (o), memory problems (o) beliefs (D3), sleeping disturbances (E6)	2
	2(selection and ascertainment)	Case 21: Combat or exposure to a war-zone	Not described	memory problems (o), attention (E5), dissociative episodes (B3), guilt and shame (D3), distressing memories (B1, B4), irritability (E1), Physical aggression (E1), wandering (o), paranoia (o)	3
	2(selection and ascertainment)	Case 22: Combat or exposure to a war-zone	Not described	suicidal ideations (o), memory problems (o),	1

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Johnston, 2000 (15)	Patients with dementia and PTSD (N=3)	Veterans administration Medical Center	68	Male	No information	Clinical assessment MMSE	No information
			77	Male			
			78	Male			

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	2(selection and ascertainment)	Case 23: Combat or exposure to a war-zone	23/30	Flashback (B3), nightmares(B2), memory problems(o), sleeping disturbances(E6), dissociation(B3), irritability(E1), agitation(E1), easily alarmed/ easily startle(E3), disorientation(D6), wandering(o), screaming (o), aggression (E1), paranoid ideas (o), social withdrawn (D5)	4
	2(selection and ascertainment)	Case 24: Combat or exposure to a war-zone	26/30	Physical aggression (E1), depression/depressive symptoms(D7), nightmares(B2), memory problems(o), concentration problems(E5), sleeping disturbances(E6),	3
	2(selection and ascertainment)	Case 25: Combat or exposure to a war-zone	19/30	Physiological distress on trauma (B4 and B5) Physical aggression(E1), anxiety(D4), nightmares(B2), memory problems(o), sleeping disturbances(E6), paranoid ideas(o), delusion (D3), agitation(E1),	4

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Mc Cartney et al, 1997 (36)	Woman with Alzheimer dementia and PTSD (N=1)	Assisted living facility	82	Female	No information	Clinical assessment CCSE	No information

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	3(selection, ascertainment and reporting)	Case 26: Sexual assault	8/30	Anxiety (D4), concentration problems (E5), agitation (E1), easily alarmed/easily startle (E3), psychomotor restlessness (o), memory problems (o), physiological distress (B4), avoidance (c2), intrusions (B1)	4

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Mittal et al, 2000 (37)	Patients with dementia and PTSD (N=3)	No information	59	Male	No information	Clinical assessment MMSE VLT WAIS Clock Trails	No information
			57	Male			
			74	Male			

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
Clinical assessment	2(selection and ascertainment)	Case 27: Combat or exposure to a war-zone	Not described (mild to moderate memory deficit)	Suicidal ideations (not attempt) (o), depression/depressive symptoms, anxiety (D7), flashbacks (B3), memory problems (o), impaired abstract reasoning (E5), anxiety (D4), concentration problems (E5)	4
	2(selection and ascertainment)	Case 28: Combat or exposure to a war-zone	Not described	Suicidal ideations (no attempt) (o), restricted affect (D4), depression/depressive symptoms (D7), flashback (B3), nightmares (B2), memory problems (o), concentration problems (E5), sleeping disturbances (E6), psychomotor retardation (o), hopelessness (D3), negative beliefs (D4), avoidance (C2)	5
	2(selection and ascertainment)	Case 29: Combat or exposure to a war-zone	Not described	Depression/depressive symptoms (D7), anxiety (D4), nightmares (B2), memory problems (o), sleeping disturbances (E6), psychomotor acceleration (o), impaired attention (E5), impaired abstract reasoning (E5), recall (B1)	4

Supplementary 2: Subjects, number of cases, setting, age, dementia measure, neuropsychological scales, PTSD measure, PTSD scales, quality case description, Lec-5 trauma, gender, MMSE, psychiatric symptoms, total rated PTSD symptoms. The psychiatric symptoms are the symptoms described in the 27 cases. The PTSD symptoms are the rated PTSD symptoms based on the DSM-criteria of PTSD. (continued)

Authors (year)	Subjects (N)	Setting	Age	Gender	Dementia measure	Neuropsychological scales	PTSD measure
Van der Wielen, 2019 (32)	Patient with mild stage Alzheimer disease (N=1)		69	Female	No information	Clinical assesment	No information

* Study quality was assessed with an adapted version of the Newcastle Ottawa Scale (Murad, 2018).

BNT= Boston Naming Test; Clock= Clock Drawing Test; CAPS(IV-TR)= Clinician-Administrated PTSD Scale for DSM-IV; CCSE= Cognitive Capacity Screening Exam; MINI= Mini International Neuropsychiatric Interview; MMSE= Mini Mental State Examination; MSE= Mental State Examination; NIT= Number Information Test; PCL-C= PTSD Checklist-Civilian Version; PTSD = Post Traumatic Stress Disorder; RBANS= Repeatable Battery for the Assessment of Neuropsychological Status; SUD= Subjective Unit of Distress scale; TMT= Trail Making Test; VLT= Verbal Learning Test; WAIS= Wechsler Adult Intelligence Scale

Psychiatric symptoms: symptoms described in cases. A=Exposure via any of the following; A1= Directly exposed to trauma; A2=Eyewitness to others directly exposed to trauma; A3= Learning of direct exposure to trauma of a close family member or close friend; A4= Repeated or extreme exposure to aversive details of traumatic event, in person or via work-related electronic media; B= Intrusion; B1= Recurrent, involuntary, distressing, trauma, related dreams; B3= Dissociative reactions/flashbacks related to trauma; B4= Intense or prolonged psychological distress to trauma reminders; B5= Marked, physiological reactions to trauma reminders; C= Avoidance; C1= Avoidance/efforts to avoid distressing internal trauma reminders; C2= Avoidance or efforts to avoid distressing external trauma reminders; D= Negative cognition and mood; D1= Amnesia for important parts of trauma exposure; D2= Persistent, exaggerated negative beliefs about self, others, or the world; D3= Persistent, distorted trauma-related cognitions leading to inappropriate blame of self/others; D4= Persistent negative emotional state; D5= Loss of interest or participation in significant activities; D6= Detached/estranged feelings from others; D7= Persistent loss of positive emotions; E= hyperarousal; E1= irritability and angry outburst with little/no provocation; E2= Reckless or self-destructive behavior; E3= Hypervigilance; E4= Exaggerated startle; E5= Concentration problems; E6= Sleep disturbance; G = Distress/impairment; H = Not attributable to another disorder; O= other symptoms

PTSD scales	Quality case description*	Lec-5 trauma	MMSE	Psychiatric symptoms	Total rated PTSD symptoms (DSM-5)
	2(selection and ascertainment)	Case 30: Mother with dementia in nursing home		Memory problems, flashbacks	2

Clinical vignette: Jan [part 6]

Care approaches

This understanding allowed the care team to see the complete picture of Jan's condition and informed a more targeted approach to his care. Jan's care plan was revised using a trauma-sensitive approach, building on the behavioral recommendations already in place. Drawing on principles such as promoting safety, trust, and empowerment, the team created a supportive environment that acknowledged the potential impact of PTEs alongside his dementia. The goal was to create a supportive environment that addressed both his PTSD and dementia.

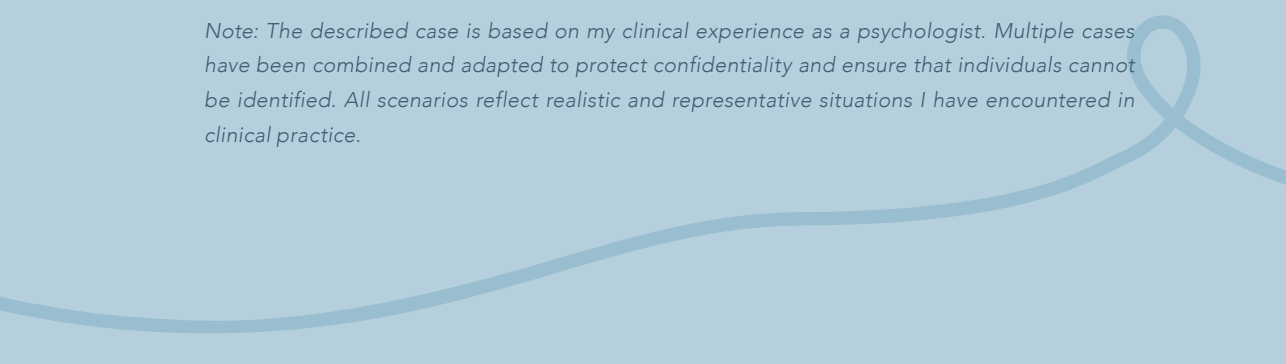
Safety: The staff minimized triggers such as loud noises and sudden changes, creating a structured routine and personalizing his room with familiar objects to reduce anxiety. Physical spaces were designed to prevent feelings of confinement, ensuring Jan felt secure.

Trust and Transparency: Caregivers used consistent, clear communication, explaining actions to avoid startling him. Predictable routines and early communication about changes further built trust and reduced uncertainty.

Family Involvement and Peer Support: Jan's family actively participated in his care, providing comforting interactions and insights into his needs. Group activities were carefully selected to avoid overwhelming him, focusing on safe and positive engagement.

Collaboration and Empowerment: A multidisciplinary approach ensured Jan's care was personalized, involving him in decisions where possible. Regular meetings with his family and the psychologist helped adapt strategies to his evolving needs.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.





Chapter 7

The Need for a Diagnostic Instrument to Assess Post-Traumatic Stress Disorder in People with Dementia: Findings from a Delphi Study

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Abstract

Cognitive and behavioral aspects may mask posttraumatic stress disorder (PTSD) in people with dementia. PTSD severely lowers quality of life in people with dementia. Proper recognition of PTSD is essential to ensure adequate treatment. However, a valid diagnostic tool for PTSD in dementia is lacking. A Delphi study was conducted among 20 Dutch and six international experts in the field of PTSD and dementia care or research. The aim was to reach consensus in three rounds on the added value, form, content, and application for developing such an instrument. The first round confirmed the need for a new diagnostic tool for research and clinical practice. Consensus was reached on 23 statements regarding the support base and 19 related to content of the instrument. In the third round, opinions on several conceptual problems were gathered. Based on the experts' opinions, a draft version of an instrument, the TRAuma and DEmentia-interview (TRADE-interview), was developed. Clinical and research implications of this new measure are discussed.

Objective

Although posttraumatic stress disorder (PTSD) is a common psychiatric diagnosis in the general population (7-8%) [1, 2], PTSD is not often diagnosed in older adults (1-3%) [3, 4]. Evidence has been accumulated for important links between PTSD and dementia [5-8], with comorbidity rates of PTSD in people with dementia at 4.7-7.8% [9]. Globally, the number of patients with dementia is estimated to be 35.6 million in 2010 and will double almost every 20 years to approximately 115.4 million by 2050 [10]. Based on the findings, affected patients with comorbid PTSD could be between 2.5-4.2 million ($53.4 \times 4.7-7.8\%$) in 2020 and increasing to 5.4-9.0 million ($53.4 \times 4.7-7.8\%$) in 2050. However, due to the lack of a structured diagnostic tool for PTSD in these patients, these are probably underestimates [4]. While the nature of the associations between dementia and PTSD is still unclear, several hypotheses about possible underlying mechanisms have been postulated [11-16]. For example, PTSD and dementia share many comorbidities (e.g., impairments in attention and memory, depression, substance abuse, cardiovascular diseases) [17-19].

A decrease in perceived quality of life is known in both dementia and PTSD [20, 21]. It can therefore be assumed that the simultaneous occurrence of PTSD in people with cognitive impairment or dementia may further negatively affect the quality of life in many aspects. Dementia and PTSD are both common and place a significant burden on patients, family members and other caregivers. Pinciotti et al. [22] reported more difficult behavioral symptoms in people with dementia and comorbid PTSD than without PTSD, which also increased the burden on caregivers and, therefore, increase health care costs. Problem behavior can be a real challenge for informal caregivers and, in addition to dementia, has a huge impact on the quality of life of patients, relatives and others involved [20]. Better recognition of PTSD in people with dementia is essential to optimize personalized care to improve the quality of life and reduce problem behavior through less: intensive nursing care, medication, medical consultations, freedom-restricting or other coercive interventions.

Developments in the field are hampered by the current lack of a structured diagnostic tool for PTSD in individuals with dementia, which meets the standards of the classical test theory [23-25]. Clinical assessment, assessing for exposure to potentially traumatic events and current PTSD symptoms, seems to be the most common method [23, 26-30]. Instruments that have been most often used for assessing PTSD symptoms in those with dementia are: Impact of Event Scale-Revised (IES-R) [31], Post Traumatic Stress Screen for the Cognitively Impaired (PTSS-CI) [24], PTSD Checklist-Civilian Version (PCL-C) [32], Clinician-

Administered PTSD Scale for DSM-V (CAPS-V) [32, 33] and the Mini International Neuropsychiatric Interview (MINI) [32].

However, none of these instruments have been validated through the classical test theory in a population with dementia [24]. For example, they are based on self-report and/or anamnestic interviews, which are not conceivable in cognitively impaired populations [34]. Besides, these instruments often use complicated wording and response categories which are too complex for this population. Though the PTSS-CI was specifically developed for those with cognitive impairments, this screening instrument has not been validated through the classical test theory in older adults. The PTSS-CI is furthermore limited as it has been designed as a screening tool, and not a diagnostic instrument (which is the aim of the present study). Another important limitation in diagnosing PTSD in those with dementia is that published case reports show that most people with comorbid PTSD and dementia may not show enough symptoms to meet the criteria for a formal psychiatric diagnosis [23, 26, 30, 32, 35]. For example, avoidance symptoms were in most cases not expressed. Many older adults with dementia may live in long-term care facilities, and thus experience and expression of their avoidance may be different and not endorsed. Also, older adults may also not connect their current symptoms with their past traumatic experiences, or may have modified their lifestyle so that avoidance is automatic rather than effortful (e.g., systematically avoiding interactions with other people or only going out when they are unlikely to confront others) [9]. Furthermore, behavioral expression of PTSD symptoms could be misinterpreted and classified as being part of the dementia syndrome such as Behavioral and Psychological Symptoms of Dementia (BPSD). For instance, re-experience symptoms occurring during the night may induce perception of danger and thereby to nightly wandering and be classified as BPSD [23, 28, 30]. In line with previous suggestions [23], we have postulated that BPSD may also be linked to comorbid (yet undetected) PTSD, and that this link may be especially relevant in those with a delayed onset course [36]. Interestingly, thus far only one study reported higher levels of BPSD in people with dementia with comorbid PTSD compared to those without PTSD [22]. As PTSD, dementia, and BPSD all impact negatively on quality of life [37], the combination may further decrease well-being. Thus, both in clinical practices as in research, there is a need for a structured method to diagnose PTSD in people with dementia. Recognition of PTSD can help health care practitioners give direction to management possibilities [23, 38]. For example, personalized trauma-focused psychotherapy, namely Eye Movement Desensitization (EMDR), has been shown to relieve BPSD in those with severe dementia [30, 39].

In order to improve knowledge on PTSD in dementia, increase treatment possibilities, decrease health care burden, and improve the quality of life in those with dementia, we aimed to investigate the added value of a new instrument to diagnose PTSD in people with dementia among international experts, and to assess the optimal form, content, and application of such a measure. The current Delphi study is the first initiative to develop such a diagnostic tool and its usability by using an international expert team.

Method

The Delphi methodology (i.e., soliciting opinions of experts through a series of questionnaires together with information and opinion feedback with the aim to establish convergence of opinion) was used for the present study. This method is most often employed when there is little to no empirical evidence or clinical consensus on the topic of interest [40, 41]. A Delphi design was used to reach consensus about statements with experts in PTSD and/or dementia. The survey rounds addressed: 1) the need for a structured method to assess PTSD in dementia, and whether current instruments might already be sufficient; 2) which domains and items should be included in the new instrument (TRAuma and DEmentia-interview; the TRADE-interview); and 3) scoring of items, diagnosis criteria, and severity measurement.

The first round specifically evaluated the need for a screener, a diagnostic tool, and a severity measurement (see Table 1). A screening tool is an instrument that can quickly indicate whether a certain disorder is present and distinguishes those who are eligible for a more detailed assessment from those who would not benefit from it. A diagnostic tool is used to check whether the criteria are met to make a certain diagnosis, while the severity measurement is used to investigate how much impact a disorder has on an individual (see below Table 1).

Table 1. Agreement ratings regarding the support base, existing tools, and care settings

Statement: The new instrument should be a:	Screening tool	Diagnostic tool	Severity measurement
Support base and existing tool			
Need in clinical practice	88%	81%	77%
Need in the area of research	96%	92%	88%
Need for improving treatment	96%	92%	Not applicable
Need for understanding behaviour	96%	96%	73%

Table 1. Agreement ratings regarding the support base, existing tools, and care settings (continued)

Statement: The new instrument should be a:	Screening tool	Diagnostic tool	Severity measurement
Need for diagnosing PTSD earlier	88%	85%	Not applicable
LEC-5	42%	Not applicable	Not applicable
GPS	23%	Not applicable	Not applicable
CTES/RTES	27%	Not applicable	Not applicable
CAPS-5	Not applicable	23%	27%
PDS-5	Not applicable	23%	Not applicable
PTSS-CI	Not applicable	65%	Not applicable
PCL	Not applicable	39%	46%
PSS-SR-5	Not applicable	Not applicable	27%
Care settings			
Primary care	73%	65%	54%
Specialist mental health care	96%	92%	96%
Nursing homes	92%	85%	81%
Hospital	77%	65%	50%

Note: consensus; >67%, consensus; 67%, no consensus; <67, not applicable

Recruitment of Experts

The international and national experts were selected through: (1) an online search of relevant peer-reviewed publications on PTSD (i.e., in older adults) and/or BPSD and dementia; (2) consultation of national associations such as 'Nederlandstalige Vereniging voor Psychotrauma' (NtVp) and the Dutch association of specialists in geriatric medicine 'Verenso'; (3) approaching international associations for trauma (see Appendix 1); and (4) asking each expert was asked to nominate other specialists who could serve as participants in the study.

The expert group consisted of psychologists, behavioral scientists, medical doctors all working in the field of psychiatry and/or geriatric care who met the following criteria: (1) had at least five years of clinical, research, educational, diagnostic or treatment experience with PTSD (trauma expert) or in the field of people with dementia (dementia expert); and (2) had an identifiable affinity with diagnostics, older adults and/or dementia when they were trauma expert, or they had an identifiable affinity with stress, PTSD, BPSD when they were dementia expert.

Procedure

The Delphi study's statements were compiled through a literature search and supplemented with the research teams' clinical and academic experiences (D.H., S.S., M.v.d.V., S.v.A., F.V. & B.R.). Each topic was briefly introduced (e.g., elements, main criteria, and sub-criteria), after which the experts were asked to indicate a level of agreement with each statement using a five-point Likert scale (i.e., Strongly agree, Agree, Neither agree nor disagree, Disagree or Strongly disagree). Responses of 'Strongly agree' and 'Agree' were grouped and categorized as agreement. The responses of 'Disagree' and 'Strongly disagree' were grouped and categorized as disagreement. Consensus was achieved when at least 66,7% agreed with a statement (strongly agree and somewhat agree) [42]. Participants were given a chance to elaborate or express their opinion on the free-response comments. The results of the last part of round three were not designed to gain consensus, but rather to increase depth of experts' opinion. After each round, results were analysed and assessed in Microsoft Excel and implemented in the following round. Findings were discussed with the research team. Between the rounds, participants were provided a summary of the panel's responses.

Between May and June 2020, experts received three questionnaires via Qualtrics, an online survey software tool that facilitates design and conducts online questionnaires. Experts were given five working days to reply in each round. If a participant did not respond after five days, they were excluded from the further rounds. The experts were reminded twice during these five working days through e-mail to complete the round. The average length of time between rounds was five to ten days.

Approval for this study was obtained from the Ethics Review Committee Psychology and Neuroscience (ERCPN) of the University of Maastricht. Before starting the study, an information letter was sent to the potential participants regarding the study's aims, purpose, and requirements for participation. The participants were informed that the study was voluntary and that they had the

right to drop out of the study at any time. Completion of the survey was deemed as consent.

Data were collected digitally using Qualtrics research software and were exported to Microsoft Excel for statistical analysis. The consensus was calculated for each statement using frequency, mean, and standard deviation formulas.

Results

A flow chart summarizing each round of the Delphi study and panel characteristics is shown in Figure 1. The appendix contains an extensive table with the results. Based on the experts' opinions, a draft version of the TRADE-interview has been developed.

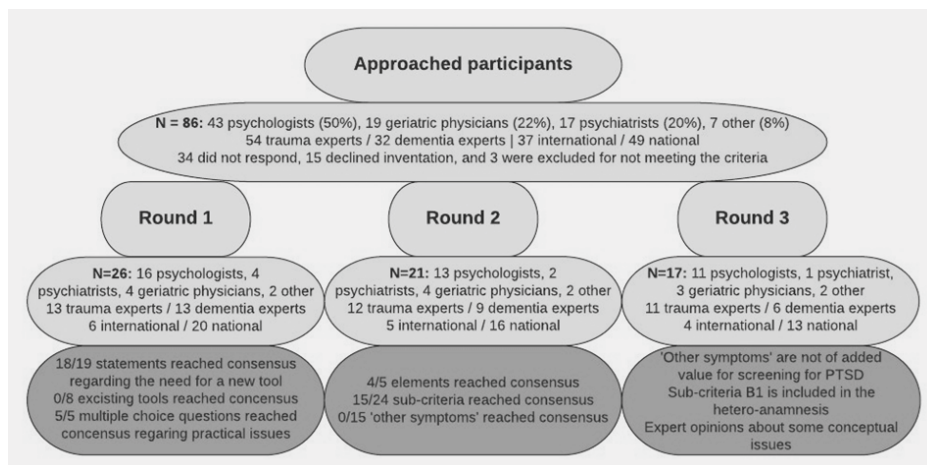


Figure 1. Summary Delphi study and panel characteristics

Support Base

Consensus was reached for developing a new instrument for the screener, the PTSD diagnostic, and the severity measurement of PTSD (see Table 1). No consensus was reached (agreement rating of 58%) on the item 'diagnosing PTSD in people with dementia is sufficiently reliable based on only clinical research', with experts indicating that this item was not relevant and unclear. Given the lack of consensus on this item, it was decided to drop this item. In addition, no consensus was reached on suitability of existing tools to screen and diagnose PTSD in people with dementia (agreement ratings ranging from 23% - 65%, see Table 1). The experts agreed that a new instrument should not be too extensive, use simple language, not use Likert scale, and primarily adhere to the Diagnostic and Statistical Manual for Mental Disorders-Fifth Edition (DSM-5) criteria. All

previously mentioned instruments did not meet these criteria except for the PTSS-CI, which nearly reached consensus (65%). However, the PTSS-CI needs further evidence to establish the reliability and validity in older adults and is only a screening instrument. The experts clearly stated that the PTSS-CI could be used as an example regarding language, length, and the objective part, which all fit with this target group.

The last part of round one was related to which health care disciplines the development of a new tool for screening, diagnosing, and measuring severity could be relevant (see Table 1). Consensus was reached for psychologists and doctors being able to conduct the TRADE-interview (agreement ratings ranging from 81-100%). In addition, the experts agreed that ideally, the instrument should contain both a screener for traumatic life events, diagnostics for PTSD and a severity measurement (agreement ratings ranging from 77-100%). Finally, we posed the question to the expert panel for which clinical picture they think the instrument is no longer useful for. The experts agreed that severe language problems (comprehension problems), severe dementia, and not being able to respond to his/her surroundings are exclusion criteria for using the instrument.

Content of the TRADE-interview

Round two was related to which elements should be included in the new instrument according to the expert panel. Consensus was reached to include the anamnesis, informant information, clinical observation, and file study in the TRADE-interview (agreement ratings ranging from 76%-86%) (see Table 2). No consensus was achieved to include physiological measures to assess increased physiological reactivity for trauma-related signals (e.g., heart rate, blood pressure) (33%) (Table 2). Consensus was reached on including all the DSM-5 main criteria for PTSD (e.g., avoidance symptoms, mood symptoms) [43]. However, consensus was not reached on some of the sub-criteria, as these were regarded as non-specific and could also be symptoms of BPSD or related to ageing (e.g., difficulty concentrating, physical activity after trauma reminder; see Table 3). Fifteen of the 24 sub-criteria from DSM-5 reached consensus and were included in the new instrument. As a result, 12 out of 15 sub-criteria were included in the anamnesis, 14 sub-criteria in the informant information, and nine sub-criteria were selected for the clinical observation. Furthermore, none of the 'other symptoms' (i.e., psychiatric symptoms that often occur in people with PTSD but cannot be classified) achieved consensus. In round three, the experts were asked if the 'other symptoms' would be of added value to screen for PTSD, but it was often commented that these symptoms could also have many other causes and could not definitively be distinguished for PTSD. Therefore, none of the 'other symptoms' were included in the new instrument (e.g., wandering, screaming; see Table 3).

Table 2. Agreement ratings regarding the elements

	Statement	Agree	Neutral	Disagree
	Anamnesis	76%	10%	14%
	Informant information	86%	0%	14%
	Clinical observation	81%	14%	5%
	Physiological measures	33%	19%	48%
	File study	81%	5%	14%

Note: consensus; >67%, consensus; 67%, no consensus; <67, not applicable

Table 3. Agreement ratings regarding the sub-criteria and other symptoms

Statement	Included	Anamnesis	Informant information	Observation	File study
Trauma, actual or threatened violent death, serious injury or accident, or sexual violence					
A1: Direct exposure	100%	85%	80%	-	80%
A2: Witnessing the trauma	80%	75%	75%	-	75%
A3: Learning that a relative or close friend was exposed to a trauma	40%	-	-	-	-
A4: Indirect exposure to aversive details of the trauma, usually in the course of professional duties	75%	67%	80%	-	73%
Intrusion symptoms					
B1: Unwanted upsetting memories	100%	89%	67%	58%	-
B2: Nightmares	100%	74%	79%	68%	-
B3: Flashbacks	95%	83%	83%	67%	-
B4: Emotional distress after exposure to traumatic reminders	60%	-	-	-	-

Table 3. Agreement ratings regarding the sub-criteria and other symptoms (continued)

Statement	Included	Anamnesis	Informant information	Observation	File study
B5: Physical reactivity after exposure to traumatic reminders	55%	-	-	-	-
Avoidance symptoms					
C1: Avoidance of trauma-related thoughts or feelings	60%	-	-	-	-
C2: Avoidance of trauma-related external reminders	80%	73%	73%	80%	-
Negative cognition and mood symptoms					
D1: Inability to recall key features of the trauma	40%	-	-	-	-
D2: Overly negative thoughts and assumptions about oneself or the world	80%	80%	67%	60%	-
D3: Exaggerated blame of self or others for causing the trauma	80%	87%	67%	53%	-
D4: Negative affect	90%	76%	88%	82%	-
D5: Decreased interest in activities	55%	-	-	-	-
D6: Feeling isolated	60%	-	-	-	-
D7: Persistent loss of positive emotions	50%	-	-	-	-
Alterations in arousal and reactivity					
E1: Irritability or aggression	90%	71%	76%	82%	-

Table 3. Agreement ratings regarding the sub-criteria and other symptoms (continued)

Statement	Included	Anamnesis	Informant information	Observation	File study
E2: Reckless or self-destructive behavior	70%	54%	69%	92%	-
E3: Hypervigilance	85%	44%	69%	94%	-
E4: Heightened startle reaction	85%	56%	75%	88%	-
E5: Difficulty concentrating	60%	-	-	-	-
E6: Difficulty sleeping	95%	72%	78%	78%	-
Other symptoms					
Resistance against caregivers	40%	-	-	-	-
Inappropriate dressing and undressing	10%	-	-	-	-
Bizarre eating habits	20%	-	-	-	-
Screaming	60%	-	-	-	-
Impaired problem-solving	0%	-	-	-	-
Impaired visuospatial skills	0%	-	-	-	-
Psychomotor retardation	0%	-	-	-	-
Delirium	10%	-	-	-	-
Memory problems	20%	-	-	-	-
Impaired scanning speed	0%	-	-	-	-
Wandering	30%	-	-	-	-
Disorientation	25%	-	-	-	-
Claiming behavior	30%	-	-	-	-
Addiction problems	40%	-	-	-	-

Table 3. Agreement ratings regarding the sub-criteria and other symptoms (continued)

Statement	Included	Anamnesis	Informant information	Observation	File study
Self-mutilation	40%	-	-	-	-

Note: consensus; >67%, consensus; 67%, no consensus; <67%, not applicable

Conceptual Issues

Round three consisted of several application issues regarding the implementation of the new instrument. For the last part of this round, the aim was to consider experts’ opinions and not necessarily reach consensus. This option was chosen because many options were possible, and a decision can only be made once this new tool has been tested in practice. For this study, we chose the answer with the highest consensus achieved to be reviewed. The first question was about scoring the items. There were various response options (see Table 4). 76% of the experts indicated that an item or sub-criterion is met if one or two of the three elements (anamnesis, informant information, and clinical observation) are scored ‘yes’. When ‘yes’ is scored, this means that the sub-criterion is met for this element (e.g., anamnesis, informant information, clinical observation). It, therefore, makes no difference if there is an overlap between symptoms from the anamnesis, informant information, and/or clinical observation.

The second application issue was about how the new instrument can be used to diagnose PTSD, because in round two the experts indicated that nine sub-criteria of PTSD were excluded. The experts had very different answers to this question. There was no clear majority in any option, but most indicated that the diagnosis should be made based on a certain number of sub-criteria (29%) or chose the option ‘other’ (29%). Most indicated that before such cut-offs should and could be considered, we must await actual testing and observation. The third application issue contained the question of how the severity measurement would be determined at the observation part and at the end of the new instrument. No severity scale is added to the anamnesis and hetero anamnesis because the experts indicated several times that it is complicated for people with dementia and their relatives or friends to indicate severity reliably. Most of the experts chose the ‘other’ option, indicating that the severity should be assessed by determining how the symptoms impair function on a zero to two scale (41%). Moreover, 35% indicated that the severity should be assessed by the interviewer based on frequency and suffering.

Table 4. Conceptual issues regarding the implementation of the new instrument

Statements	Percentage	Remarks
Scoring of the items		
Someone meets a criterion when answering 'yes' to the anamnesis	0%	
Someone meets a criterion when answering 'yes' to the informant information	0%	
Someone meets a criterion when answering 'yes' on the observation	0%	
Someone meets a criterion when 'yes' is answered based on the anamnesis, informant information, and observation	12%	-It depends on the reliability of the patient and the third person
Someone meets a criterion when 'yes' is answered based on the anamnesis and informant information	6%	-Clinicians will not be able to observe most of the items directly
Someone meets a criterion when 'yes' is answered based on the anamnesis and observation	0%	
Someone meets a criterion when 'yes' is answered based on the informant information and observation	6%	-Depends on the stage of dementia. In advances stages you will have to rely on the informant information and observation
Other:	76%	-To be completely sure -All three are equally important -38% indicated that 'yes' needs to be answered on 2 out of the 3 -31% indicated that 'yes' needs to be answered on 1 out of the 3

Table 4. Conceptual issues regarding the implementation of the new instrument (continued)

Statements	Percentage	Remarks
Diagnosing PTSD		
When someone meets the full criteria for DSM-5	18%	-This must be more feasible in the TRADE-interview because the criteria will be measured through anamnesis, informant information, and observation -Do not give a diagnosis when less than full criteria are met. That is what the anxiety nos/ subthreshold PTSD diagnosis is for
When someone meets 1-3 criteria following DSM-5	24%	-Criteria A,B,E most clear criteria for cognitively impaired patients
When someone meets a number of sub-criteria	29%	-At least 1 sub-criterion of each of the three main criteria (trauma, intrusion, and arousal) -1 sub-criterion for each main criterion, because the threshold should be low. -3 or more sub-criteria
Other:	29%	-Orient the diagnosis to ICD-11 -Before such cut-offs should/ could be considered, we must await actual testing and observation -Subsyndromal PTSD is clinically significant, and these criteria typically means missing a symptom or two (while still representing all main criteria of PTSD)

Table 4. Conceptual issues regarding the implementation of the new instrument (continued)

Statements	Percentage	Remarks
Severity measurement		
The severity depends on the amount of main criteria someone meets (A-E)	0%	
The severity depends on the amount of sub-criteria someone meets	12%	
The severity is assessed using Likert Scale (frequency, severity, functioning)	12%	-The ability of the patient to answer the questions on Likert Scale is not always clear-cut -Combine the frequency and intensity to get severity scores for each symptom, then the sum of these indicates overall severity
The severity is assessed by the interviewer based on frequency and suffering	35%	-Observe their frequency and impairment in functioning (as in the NPI) -This option describes a kind of 'clinical view' and more objectively than that you will not get the severity 'measured'.
Other:	41%	-Assess, for each main criterion, the extent to which the symptoms impair function on a 0-2 scale (same as CAPS)

Note: consensus; >67%, consensus; 67%, no consensus; <67%, not applicable

Discussion

The main goal of the present study was to reach consensus among international experts about the added value of a new instrument to diagnose PTSD in people with dementia, as well as the form, content, and application of such a measure. This study is the first in addressing the need and requirements for a new instrument aimed at PTSD in those with dementia where the focus was on both diagnosis and severity, used simple language, adhered to DSM-5 criteria, and was not too long. The experts agreed on the need for this new instrument (TRAuma and DEmentia-interview; TRADE-interview) [23, 24, 44].

In three rounds of discussions experts concluded that the 'other symptoms' and several sub-criteria (e.g., flashbacks, irritability, hyper-vigilance) should not be included because these were not specific for PTSD and could also be symptoms of BPSD or related to ageing [22, 23, 45]. However, clinical presentations show that 'other symptoms', such as memory problems, screaming, and wandering are often described in those with dementia and PTSD [26, 27, 30]. Thus, we suggest that the presence of 'other symptoms' can be used as an indicator for conducting the TRADE-interview. This also applies to the 'physiological measurements', for which several studies have shown that increased physiological reactivity related to trauma-related triggers is an excellent indication of a PTSD diagnosis [46, 47]. Much is still unknown about the 'other symptoms' and the 'physiological measurements'. It is possible that in the future, more knowledge about those aspects will become available and could be useful for future practical applications of the TRADE-interview. Further, especially for people with advanced dementia, these data could be valuable because the anamnesis is then even more limited.

At the end of the study, suggestions for application were made. Concerning the scoring of the items it was decided that 'yes' to at least one of the three components should be answered to meet a PTSD sub-criterion for the highest reliability [45, 48]. Regarding the diagnosis of PTSD, it was decided that one sub-criterion for the main criteria A (trauma), B (intrusion), and E (arousal symptoms) must be met to receive a diagnosis. The DSM-5 shows that these were the main essential criteria in cognitively impaired patients [43]. This can be explained by case reports in the literature that indicate that criterion C (avoidance symptoms) were rarely reported [23, 49]. Notably, most sub-criteria of criterion D (negative cognition and mood symptoms) were excluded in the TRADE-interview because they are indistinguishable from BPSD. Most experts indicated that before such cut-offs should and could be considered, actual testing and observation in practice should take place. When validating the instrument, it can be examined whether this is feasible or needs to be adjusted.

Although this study used the DSM-5 criteria to identify PTSD in people with dementia, ICD-11 should also be under consideration. The DSM-5 includes 20 symptoms, while the proposed ICD-11 criteria include only six qualifying symptoms for a more focused approach [50]. The ICD-11 has a unique way to identify PTSD avoiding overshadowing other disorders such as depression [51]. As a result, it could be expected that people with dementia, who are known to show less PTSD symptoms, are more likely to meet the diagnosis according to the ICD-11 compared to the DSM-5. However, a study from Fox et al. [52] found more older adults met the diagnostic criteria of PTSD based on the guidelines of the DSM-5 compared to the ICD-11. A shared limitation in diagnosing PTSD using the ICD-11 and DSM-5 is the required presence of one of the core elements 'avoidance symptoms', which a literature review show are not recognized in people with dementia [23, 49].

The development of the TRADE-interview has added value for both clinical practice and research. The TRADE-interview offers opportunities to conduct methodologically solid and consistent research into this complex target group. Clinically, this instrument can help in evaluating the indication for trauma-focussed therapy, such as EMDR and Prolonged Exposure therapy. Furthermore, the TRADE-interview can possibly differentiate potentially undiscovered PTSD in BPSD. In addition, more insight can be gained into the magnitude of the problem and about the occurrence of the impact of the PTSD symptoms in those with dementia. In future investigations, the TRADE-interview should be tested to assess its psychometric properties using classical test theory (i.e., diagnostic accuracy) [25]. In addition, we hope to be able to investigate for which stages of dementia the instrument is suitable and possibly work towards an instrument that is useful for multiple stages of dementia. But most importantly, the first steps are made to improve diagnosing PTSD in people with dementia.

The primary limitations of this study were on the composition of the expert group which might have affected the finding. That is, the contribution of international experts ($n=4$, 24%) was low compared to the Dutch experts ($n=13$, 76%). However, as the opinions of international experts were overall in agreement with Dutch experts, that information bias is likely low. It is notable that 65% of the experts were psychologists, with the remaining psychiatrists (5%), geriatric physicians (18%) and other (12%). It was also a challenge to include experts who were experienced in the field of both dementia and PTSD. Nevertheless, 60% of the psychologists were experts on working with PTSD in the older population. Thus, the current composition of the expert panel seemed well-suited for the development of the TRADE-interview. It may be that the composition of the expert team was also influenced by the COVID-19 crisis, as the start of the study was scheduled in March 2020, which was in the early stages of the pandemic.

The study had to be postponed to May, though there were a few participants ($n=6$) who had withdrawn before starting due to the crisis. Another limitation of the current study is the use of the DSM-5 rather than looking into both DSM-5 and ICD-11. The ICD-11 has been included in the discussion, but in future it is important that the new instrument will also be translated to the ICD-11 guidelines. In addition, the expert panel decided to exclude some sub-criteria in the new instrument. This ensures that the symptoms are more specific to PTSD rather than explaining the dementia or other psychiatric diagnosis. However, with this we also risk missing symptoms, and this will therefore have to be investigated through the classical test theory (i.e., diagnostic accuracy) in further research.

The study results confirm the need for a diagnostic tool for PTSD in dementia patients for both scientific research and clinical practice. In accordance, with help of an international expert panel, we developed the TRADE-interview, which can be applied by health care professionals, particularly psychologists and doctors in primary care, specialist mental health care, nursing homes, and hospitals. In order to improve care of people with dementia with PTSD there are still multiple challenges beginning with testing its psychometric properties using classical test theory (i.e., diagnostic accuracy). Developing this tool may be the first step in discovering the impact of potentially traumatic life events in people with dementia and may hopefully lead to further initiatives to improve their care, treatment, and research.

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Supplemental material

Appendix 1. International associations for trauma

Organisation	Country
Corengo (BCM TMC)	USA
Cognitive dementia and memory service	Australia
Gloucester hospital NHS trust 2gether	United Kingdom
Lithuanian society for traumatic stress studies	Lithuania
Deutschsprachige gesellschaft für psychotraumatologie	Germany
The Georgian traumatic stress society	Georgia
The Polish traumatic stress society	Poland
The UK psychological trauma society	United Kingdom
The Swiss society of psychotraumatology	Switzerland
The Italian society for the study of traumatic stress	Italy
Centro de Trauma	Portugal
Croatian society of traumatic stress	Croatia
Ukrainian society of overcoming the consequences of traumatic events	Ukraine
Swedish society for psychotrauma	Sweden
Belgian institute for psychotraumatology	Belgian

Appendix 2. Results round 1

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
Screening for traumatic life events				
There is a need for the use of a tool to screen for traumatic life events in patients with dementia in clinical practice.	88%	4%	8%	-
There is a need for the use of a tool for screening traumatic life events in patients with dementia in the area of research.	96%	4%	0%	-
Screening for traumatic life events can provide an improved treatment perspective for dementia patients.	96%	4%	0%	-
Screening for traumatic life events can provide a better understanding of the patient's behavioral and psychological symptoms of dementia (BPSD).	96%	4%	0%	-
With the development of a tool to screen for traumatic life events a diagnosis of PTSD in dementia can be made earlier.	88%	12%	0%	-

Appendix 2. Results round 1 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
Given the aging population and its related increasing problems of dementia, it is essential to develop a tool to screen for traumatic life events.	77%	19%	4%	-Especially, if we want to keep demented persons in their own living environment as long as possible
The Life Events Checklist (LEC-5; Weathers et al., 2013) is suitable for screening for traumatic life events in patients with dementia.	42%	31%	27%	-Too difficult wording -Too detailed → not reliable -Too long -Self-report not optimal in dementia
The Global Psychotrauma Screen (GPS; Olff et al., 2017) is suitable for screening for traumatic life events in patients with dementia.	23%	27%	50%	-Too difficult for self-report -2-alternative answer options more valid than Likert scale -Not specific enough -Too long
The Childhood/Recent Traumatic Events Scale (CTES/RTES; Pennebaker et al., 2013) is suitable for screening for traumatic life events in patients with dementia.	27%	19%	54%	-Too complex questions -Only refers childhood traumas -Likert scale not useful -An interview form is needed for dementia
Are relevant questionnaires missed, if so which ones?				-Harvard Trauma Questionnaire → easier wording -Trauma Screening Questionnaire

Appendix 2. Results round 1 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
Diagnosing PTSD				
PTSD in patients with dementia is often missed without a diagnostic tool.	73%	19%	8%	-
Diagnosing PTSD in patients with dementia is insufficiently reliable based on only clinical research.	58%	34%	8%	-Clinical interview needed -Question is unclear
There is a need to use a tool for diagnosing PTSD in patients with dementia in clinical practice.	81%	19%	0%	-Screen with PCL-5 and with high scores a clinical interview
There is a need to use a tool for diagnosing PTSD in patients with dementia in the area of research.	92%	8%	0%	-
Diagnosing PTSD in dementia can provide a better understanding of the patient's behavior.	96%	0%	4%	-
A diagnosis of PTSD in dementia is needed for treatment.	92%	4%	4%	-Also for dealing with these patients
The diagnosis of PTSD in dementia is of added value for targeted treatment.	92%	8%	0%	-

Appendix 2. Results round 1 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
With the development of a tool to diagnose PTSD in dementia the diagnosis can be made more valid.	85%	15%	0%	-
Diagnosing PTSD in dementia can contribute to the quality of life of the patients.	92%	8%	0%	-Less behavioral symptoms, less institutionalization
Given the aging population and its related increasing problems of dementia, it is essential to develop a tool to diagnose PTSD in dementia.	88%	8%	4%	-Important but not essential
The Clinician-Administered PTSD Scale (CAPS-5; Weathers et al., 2018) is suitable for diagnosing PTSD in patients with dementia.	23%	15%	62%	-Too extensive and long -Too complicated -Not specific enough -Pro: interview more suitable
The Post-Traumatic Stress Disorder Checklist (PCL-5; Weather et al., 2013) is suitable for diagnosing PTSD in patients with dementia.	39%	23%	38%	-Most promising, but needs to be tested -Interview more suitable than self—report -Not suitable advanced dementia

Appendix 2. Results round 1 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
The Post-Traumatic Diagnostic Scale (PDS-5; Foa et al., 2015) is suitable for diagnosing PTSD in patients with dementia.	23%	27%	50%	-Too long -Too complex with Likert scale -Self-report is not optimal in dementia
The Post-Traumatic Stress Screen for the Cognitively Impaired (PTSS-CI; Carlson et al., 2012) is suitable for diagnosing PTSD in patients with dementia.	65%	23%	12%	-Observer version is useful -Brief and simple -Not specific enough for PTSD -Only useful for veterans not sexual assault for example -Assesses last week instead of month -Screener not suitable for diagnosis
Are relevant questionnaires missed, if so which ones?				-ITQ (Cloitre et al., 2018) -IES-R
Severity of PTSD				
There is a need to use a tool for measuring the severity of PTSD symptoms in patients with dementia in clinical practice.	77%	23%	0%	-

Appendix 2. Results round 1 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
There is a need to use a tool for measuring the severity of PTSD symptoms in patients with dementia in the area of research.	88%	12%	0%	-Helpful for analyzing outcome measures
Given the aging population and its related increasing problems of dementia, it is essential to develop a tool to measure the severity of PTSD symptoms in dementia.	73%	23%	4%	-
The Clinician-Administered PTSD Scale (CAPS-5; Weathers et al., 2018) is suitable for measuring severity of PTSD in patients with dementia.	46%	19%	35%	-Self-report not suitable for this population -Too complex in terms of language
The Post-Traumatic Stress Disorder Checklist (PCL-5; Weather et al., 2013) is suitable for measuring severity of PTSD in patients with dementia.	27%	19%	54%	-Too long and complicated -Very experienced interviewer needed

Appendix 2. Results round 1 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remark (text)
The PTSD Symptom Scale Self Report for DSM-5 (PSS-SR-5; Foa et al., 2013) is suitable for measuring the severity of PTSD symptoms in patients with dementia.	27%	23%	50%	-Too long and detailed on frequency -Self-report not suitable -Small range of traumatic events for criterion A
Are relevant questionnaires missed, if so which ones?				-ITQ
	The development of a tool to screen for traumatic life events is relevant for (multiple answers are possible)	The development of a tool to diagnose PTSD in dementia is relevant for (multiple answers are possible)	The development of a tool to measure the severity of PTSD in dementia is relevant for (multiple answers possible)	
Primary care	73%	65%	54%	
Specialist mental health care	96%	92%	96%	
Nursing homes	92%	85%	81%	
Hospital	77%	65%	50%	
Other	Geripsychiatric units = 4% Services for homelessness = 4% Incarceration settings = 4% Guided home care = 4%	Services for homelessness = 4% Incarceration settings = 4% Guided home care = 4%	Services for homelessness = 4% Incarceration settings = 4% Guided home care = 4%	

(continued)

	The development of a tool to screen for traumatic life events is relevant for (multiple answers are possible)	The development of a tool to diagnose PTSD in dementia is relevant for (multiple answers are possible)	The development of a tool to measure the severity of PTSD in dementia is relevant for (multiple answers possible)
Remarks	-Requires some expertise	-People with undiagnosed dementia lose jobs and become homeless and may be arrested for misunderstood behavior	-Not primary care; if PTSD is suspected, a more extensive assessment on severity may follow

	The TRADE-interview should include one or more of the following (more answers possible):	Remarks
The screening for traumatic life events	100%	-Ideally, all of the above. But rating will be difficult
The diagnosis of PTSD in dementia patients	96%	-In the first instance use as a screening instrument and, if there is reason to do so, further interview for diagnosis and severity
The measures of severity of PTSD symptoms	77%	-First two most important

	The following disciplines can conduct the TRADE-interview:	Remarks
Psychologist	100%	-If adequately trained and specifically trained
Doctor	81%	
Nurse	58%	
Other	Family = 4% Team-member = 4% Observers = 4%	

Appendix 3. Results round 2

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remarks (text)
The anamnesis must be part of the TRADE-interview.	76%	10%	14%	-Depends on dementia severity → not valid
The hetero-anamnesis must be part of the TRADE-interview.	86%	0%	14%	-
The TRADE-interview must contain a clinical observation.	81%	14%	5%	-Nurse need to be trained in recognizing the symptoms -Depends on the setting -This should be done at different times and situations related to triggers
The TRADE-interview should include physiological measures to screen for PTSD symptoms in the elderly with dementia.	33%	19%	48%	-Too drastic and too little specific information -It is difficult to distinguish between dementia and trauma/PTSD -Not validated for diagnostics
A file study should be part of the TRADE-interview.	81%	5%	14%	-Information often missed in the file -If necessary (no conclusive information from anamnesis/ hetero-anamnesis)

Appendix 3. Results round 2 (continued)

Question (text)	Agree (percentage)	Neutral (percentage)	Disagree (percentage)	Remarks (text)
The TRADE-interview should have included another element, namely:				-Observed behavior during the interview

Question (text)	Yes	No	Anamnesis	Hetero-anamnesis	Observation	File study
Trauma, actual or threatened violent death, serious injury or accident, or sexual violence						
A1: Directly exposed to trauma	100%	0%	85%	80%	-	80%
A2: Eyewitness (in person) to others directly exposed to trauma	80%	20%	75%	75%	-	75%
A3: Learning of direct exposure to trauma of a close family member or close friend	40%	60%	-	-	-	-
A4: Repeated or extreme exposure to aversive details of traumatic event (eg, trauma workers viewing human remains or repeatedly exposed to details of child abuse), in person or via work-related electronic media	75%	25%	67%	80%	-	73%
Intrusion symptoms						
B1: Recurrent, involuntary, distressing trauma memories	100%	0%	89%	63%	58%	-

(continued)

Question (text)	Yes	No	Anamnesis	Hetero- anamnesis	Observation	File study
B2: Recurrent, distressing trauma related dreams (nightmares)	100%	0%	74%	79%	68%	-
B3: Dissociative reactions/flashbacks related to trauma	95%	5%	83%	83%	67%	-
B4: Intense or prolonged psychological distress to trauma reminders	60%	40%	-	-	-	-
B5: Marked physiological reactions to trauma reminders	55%	45%	-	-	-	-
Avoidance symptoms						
C1: Avoidance/efforts to avoid distressing internal trauma reminders (memories, thoughts, feelings)	60%	40%	-	-	-	-
C2: Avoidance or efforts to avoid distressing external trauma reminders (people, places, activities)	80%	20%	73%	73%	80%	-
Negative cognitions and mood symptoms						
D1: Inability to recall key features of the trauma	40%	60%	-	-	-	-
D2: Overly negative thoughts and assumptions about oneself or the world	80%	20%	80%	67%	60%	-

(continued)

Question (text)	Yes	No	Anamnesis	Hetero- anamnesis	Observation	File study
D3: Exaggerated blame of self or others for causing the trauma	80%	20%	87%	67%	53%	-
D4: Persistent negative emotional state (eg fear, horror, anger, guilt, shame)	90%	10%	76%	88%	82%	-
D5: Decreased interest in activities	55%	45%	-	-	-	-
D6: Feeling isolated	60%	40%	-	-	-	-
D7: Persistent loss of positive emotions (eg happiness, satisfaction, love)	50%	50%	-	-	-	-
Alterations in arousal and reactivity						
E1: Irritability or anger	90%	10%	71%	76%	82%	-
E2: Reckless or self-destructive behavior	70%	30%	54%	69%	92%	-
E3: Hypervigilance	85%	15%	44%	69%	94%	-
E4: Heightened startle reaction	85%	15%	56%	75%	88%	-
E5: Difficulty concentrating	60%	40%	-	-	-	-
E6: Sleep disturbance (eg difficulty falling or staying asleep, restless sleep)	95%	5%	72%	78%	78%	-
Other symptoms						
Resistance against caregivers	40%	60%	-	-	-	-
Inappropriate dressing and undressing	10%	90%	-	-	-	-

(continued)

Question (text)	Yes	No	Anamnesis	Hetero- anamnesis	Observation	File study
Bizarre eating habits	20%	80%	-	-	-	-
Screaming	60%	40%	-	-	-	-
Impaired problem-solving	0%	100%	-	-	-	-
Impaired visuospatial skills	0%	100%	-	-	-	-
Psychomotor retardation	0%	100%	-	-	-	-
Delirium	10%	90%	-	-	-	-
Memory problems	20%	80%	-	-	-	-
Impaired scanning speed	0%	100%	-	-	-	-
Wandering	30%	70%	-	-	-	-
Disorientation	25%	75%	-	-	-	-
Claiming behavior	30%	70%	-	-	-	-
Addiction problems	40%	60%	-	-	-	-
Self-mutilation	40%	60%	-	-	-	-

Appendix 4. Results round 3

Question 1	Are the 'other symptoms' (e.g., screaming, resistance against caregivers, wandering) of value to screen for PTSD?	Remarks
Yes, the criteria are of value to screen for PTSD	12%	-They are of value, but they can be associated with other conditions
No, the criteria are not of value to screen for PTSD	53%	-Too specific; they could have many (other) causal factors -Clinically relevant, but not part of the criteria for PTSD -Similar for BPSD, so not distinctive for PTSD
Other:	35%	-These behaviors can be determined by many factors, so there is the risk of a tube vision and overdiagnosis
Question 2	Sub-Criterion B1	Remarks
Sub-criterion B1 should be included in the hetero-anamnesis	41%	-Essential to the PTSD diagnosis
Sub-criterion B1 should be included in the hetero-anamnesis but should be adjusted	29%	-Many elderly do not talk about their feelings, so the question should be introduced appropriately -Difficult to observe, it is important to be aware of this
Sub-criterion B1 should not be included in the hetero-anamnesis	18%	-Patients often do not speak about their distressing memories -High risk of interpretation by the informant
Other:	12%	-It has to be some kind of observation measure/question

Question 3	How should the items be scored?	Remarks
Someone meets a criterion when answering 'yes' to the anamnesis	0%	
Someone meets a criterion when answering 'yes' to the hetero-anamnesis	0%	
Someone meets a criterion when answering 'yes' on the observation	0%	
Someone meets a criterion when 'yes' is answered based on the anamnesis, hetero-anamnesis and observation	12%	-It depends on the reliability of the patient and the third person
Someone meets a criterion when 'yes' is answered based on the anamnesis and hetero-anamnesis	6%	-Clinicians will not be able to observe most of the items directly
Someone meets a criterion when 'yes' is answered based on the anamnesis and observation	0%	
Someone meets a criterion when 'yes' is answered based on the hetero-anamnesis and observation	6%	-Depends on the stage of dementia. In advances stages you will have to rely on the hetero-anamnesis and observation
Other:	76% -If 'yes' is answered on 2 out of the 3 (38%) -If 'yes' is answered on 1 out of the 3 (31%)	-To be completely sure -All three are equally important

Question 4	How can the TRADE-interview be used to diagnose PTSD?	Remarks
When someone meets the full criteria for DSM-5	18%	-Since in the TRADE-interview the criteria will be measured through anamnesis, hetero-anamnesis and observation, this must be more feasible -Do not give a diagnosis when less than full criteria are met. That is what an anxiety nos/ subthreshold PTSD diagnosis is for
When someone meets 1-3 criteria following DSM-5	24%	-Criteria A,B and E most clear criteria for cognitively impaired patients
When someone meets a number of sub-criteria	29%	-At least 1 sub-criterion of each of the three main criteria (trauma, intrusion and arousal) -1 sub-criterion for each main criteria, because the threshold should be low -3 or more sub-criteria
Other:	29%	-Orient the diagnosis to ICD-11 -Before such cut-offs should/ could be considered, we must await actual testing and observation -Subsyndromal PTSD is clinically significant, and these criteria typically means missing a symptom or two (while still representing all main criteria for PTSD)

Question 5	How should the severity measurement be made in the TRADE-interview?	Remarks
The severity depends on the amount of main criteria someone meets (A-E)	0%	
The severity depends on the amount of sub-criteria someone meets	12%	
The severity is assessed using Likers Scale (frequency, severity, functioning)	12%	-The ability of the patient to answer the questions on Likert Scale is not always clear cut -Combine the frequency and intensity to get severity scores for each symptom, then the sum of these indicates overall severity
The severity is assessed by the interviewer based on frequency and suffering	35%	-Observe their frequency and impairment in functioning (as in the NPI) -This option describes a kind of 'clinical view' and more objectively than you will not get the severity 'measured'
Other:	41%	-Assess, for each main criterion, the extend to which the symptoms impair function on a 0-2 scale (same as CAPS)

Clinical vignette: Jan [part 7]

Treatment

After Jan was diagnosed with PTSD, the care team worked with a psychologist who specializes in trauma therapy for older adults. Due to Jan's state of progression of dementia, traditional trauma-focused cognitive behavioral therapy was estimated not to be feasible. Instead, the psychologist recommended Eye Movement Desensitization and Reprocessing (EMDR), a type of trauma-focused therapy that has proven effective in treating PTSD.

EMDR involves guiding the patient to recall traumatic memories while following a series of bilateral eye movements. This process helps the brain reprocess those memories in a less distressing manner. Although Jan's dementia posed challenges, the therapist adapted the sessions to his cognitive abilities, focusing on alleviating his immediate distress rather than deeply exploring the traumatic memories.

Note: The described case is based on my clinical experience as a psychologist. Multiple cases have been combined and adapted to protect confidentiality and ensure that individuals cannot be identified. All scenarios reflect realistic and representative situations I have encountered in clinical practice.





Chapter 8

Impact and needs in caregiving for individuals with dementia and comorbid Posttraumatic Stress Disorder living in nursing homes

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Exposure to potential traumatic events (PTE) can result in long-lasting psychological disorders, such as Posttraumatic Stress Disorder (PTSD). Most knowledge about PTSD is based on research on adults in specific survivor groups, including veterans and women who were in abusive relationships. In later life, cognitive and functional decline can make it harder to cope with PTE, resulting in delayed-onset PTSD symptoms.

There is limited information about the prevalence of PTSD in individuals with dementia, but recent research suggests it to be between 4.7% and 7.8% [1]. It is difficult to diagnose PTSD in this population due to a lack of appropriate tools [2]. As the global dementia population triples by 2050, there is a critical need to improve the identification and treatment of PTSD in individuals with dementia.

Given that PTEs are usually characterized by a sense of powerlessness, the limited choice and control inherent to dementia care can be distressing. Individuals who have survived PTE may find that common care practices (e.g. washing and dressing), as well as environmental factors (e.g. lighting, smells and uniforms) and interpersonal factors (nursing staff speaking loud, giving commands, appearing angry or impatient) trigger memories of PTE and may experience threatening. This can result in challenging behavior for nursing staff, who might relate the behavior solely to cognitive decline or dementia [3]. However, these symptoms are called 'PTE-related neuropsychiatric symptoms,' which require a calm, controlled approach. Ethical dilemmas, such as "Should an individual with dementia be forced to change dirty clothing if efforts to do so result in very distressed behavior?" may arise and cause moral distress.

Mrs. A is a 77-year-old woman with dementia, married with 2 children. She currently resides in a nursing home and has been exhibiting increased cognitive decline and neuropsychiatric symptoms. These include: physical and verbal aggression toward staff during care moments, screaming, crying, and pinching or hitting. In particular, being woken up in the morning by means of touch and taking a shower seems to increase Mrs. A's agitation. Besides, recently Mrs. A has exhibited increased wandering and shouting. This behavior has led to heightened tension and caregiver burden within the care team.

The clinical manifestation of PTSD in individuals with dementia may differ from those without dementia [4]. PTSD symptoms can be difficult to distinguish from neuropsychiatric symptoms. For example, it is possible that 'screaming' is a fear response to a flashback that the individual is experiencing and, thus, a potential PTSD symptom. Another example is 'resistance against caregivers' due to a history of violence or sexual abuse, and 'wandering' as a form of avoidance behavior. Earlier research showed that the DSM-5 PTSD symptoms

of re-experiencing, anxiety, and sleep disturbances are commonly reported in individuals with dementia, while avoidance behavior was less commonly seen [5, 6]. This difference in clinical manifestation could lead to misinterpretation and misdiagnosis, potentially resulting in ineffective treatment.

In collaboration with nursing homes and a mental health care institute in the Netherlands, our research group recently developed a semi-structured diagnostic tool to diagnose PTSD in individuals with dementia: the TRAuma and DEmentia (TRADE)-interview [2]. The diagnostic accuracy of this interview is currently under investigation [7].

Initially, Mrs. A's symptoms were thought to be due to cognitive decline, but further investigation revealed a history of sexual abuse. Mrs. A has been sexually abused in the bathroom by her uncle several times in the past. The TRADE-interview was indicative for PTSD. Analysis of potential triggers showed that suddenly touching (during daily care moments) was the most relevant trigger.

To our knowledge, there are no guidelines available for treating PTSD in individuals with dementia. While psychotropic drugs are commonly used to manage symptoms in clinical practice, they come with significant risks. Little research has been done on psychological treatments, but some studies show promising effects for Eye Movement Desensitization and Reprocessing (EMDR). A Delphi study from Driessen et al. [8] concluded that there are several treatment options available and appropriate (e.g., EMDR, behavioral counseling and prolonged exposure). More research is needed to determine the most suitable treatment for PTSD in individuals with dementia.

Referral is made to a psychologist, who pursues EMDR-treatment. The EMDR approach was deemed viable with modifications to the protocol, such as the selection of the child and youth protocol, utilization of Visual Analogue Scales (VAS) for the Subjective Units of Disturbance (SUD) scale and the Validity of Cognition (VOC) scale, and active involvement of the psychologist in formulating negative and positive cognitions. After a few sessions, the nursing staff reported improvement in daily care: physical and verbal aggression decreased, there was less wandering and screaming.

In general, nursing staff receives little education on the effects of trauma, and the psychological literacy of dementia care workers is insufficient. Specific education is crucial to know the impact of PTE on individuals with dementia. This emphasizes also the relevance of trauma-informed care (TIC) principles in nursing homes. The TIC model recognizes how PTE affects a person's life and

their experience of care. Implementing TIC principles can promote staff and patient safety, reduce the risk of re-traumatization, and minimize adverse events [9]. Personalized care methods such as the Personalized Integrated Stepped-Care (STIP) method [10], Grip on Challenging Behavior (GRIP) method [11], and the Stepwise, Multidisciplinary Intervention for Pain and Challenging Behavior in Dementia (STA OP!) method [12], should be integrated with TIC principles to address PTE related neuropsychiatric symptoms effectively. This integration should include routine screening for past PTE and triggers, care adaptations, and team review to develop non-triggering care approaches. The ultimate goal is to integrate this knowledge into the policies, procedures, and practices of all nursing homes worldwide.

In addition to EMDR, an approach plan is personalized in consultation with the family and the multidisciplinary team to ensure the emotional and physical safety. This includes waking her by talking and gradually turning on the lights, instead of touching her immediately, and using a washcloth for care instead of daily showers.

According to the TIC model, the care team introduces behavioral rules to make Mrs. A. feel safe. Where possible, a permanent nursing staff member is assigned to Mrs. A. instead of a substitute nursing staff member. This way Mrs. A. hopefully grows accustomed to their presence, so a trustworthy relationship is formed. When assisting Mrs. A., the nursing staff will inform her in a calm way about every following step and demonstrate their action beforehand and ask for her permission. This ensures transparency and shared decision-making. When assisting Mrs. A., the nursing staff make sure that Mrs. A. has several choices in clothes, jewelry, deodorant in order to promote autonomy and a sense of control. The care team evaluates their alternative care actions every two weeks to explore the effects of avoiding triggers.

Let's remember that nursing staff are facing challenges with individuals who suffer from PTE-related neuropsychiatric symptoms. It's time to improve trauma-sensitive care for these individuals. This can be achieved by: recognizing possible PTSD, improving treatment and personalizing an approach. The ultimate goal is to improve quality of life for people who have PTE-related symptoms in dementia. This approach will definitely promote staff and patient safety.

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Clinical vignette: Jan [part 8]

Evaluation

By identifying the role of PTSD in Jan's symptoms, the care team was able to move beyond standard dementia care and create a more personalized approach that addressed both his PTSD symptoms and cognitive decline. Over several sessions of EMDR, Jan's symptoms began to improve; his nightmares became less frequent, and his episodes of agitation significantly decreased. He became calmer, more engaged with the staff, and less prone to wandering. Although his dementia continued to progress, his PTSD symptoms were better managed, resulting in a noticeable improvement in his overall well-being. Caregivers reported feeling more equipped to support him, and his wife felt reassured knowing that his care was tailored to his unique needs.





The background is a textured teal watercolor wash. A thin, white, wavy line starts from the bottom left, curves across the bottom, and ends in a small loop on the right side.

Chapter 9

General Discussion

Introduction

In this dissertation, we present several studies focused on the recognition and diagnosis of PTSD across the adult lifespan, particularly in older adults and those with dementia. PTSD is generally under-researched in older populations, especially among those with clinically relevant comorbidities such as dementia. While the primary aim is to improve recognition and diagnostic practices, this work also offers broader insights into factors that may increase vulnerability to cognitive decline in those with PTSD. By identifying these risk factors, we can better understand the context in which PTSD may go unrecognized and how it may present differently in later life. In this final chapter, we will briefly summarize the main findings of the dissertation, discuss the insights, challenges and areas for future research, and highlight methodological considerations and clinical implications. By integrating insights from each chapter, we aim to provide a comprehensive understanding of the challenges and opportunities in managing PTSD in older adults and those with dementia. Recognition and diagnosis are crucial for the next step, which is establishing treatment indication, enabling targeted interventions and improving care outcomes for these vulnerable populations.

Summary of main findings

Chapter 2 delved into the impact of how the COVID-19 pandemic and other PTEs influence mental health across the lifespan, particularly in older adults. Using the Global Psychotrauma Screen (GPS), the study found that older age was associated with lower GPS total symptom scores. This age-related decrease was less pronounced for self-reported COVID-19-related PTEs than for other PTEs. Older adults particularly reported higher rates of insomnia and substance use symptoms, while younger adults showed greater severity in PTSD, depression, anxiety, and self-harm symptoms. This study highlights the importance of acknowledging the impact of COVID-19-related PTEs and other PTEs in older adults. These findings emphasize the need to carefully assess and recognize PTEs and their consequences in older adult populations to ensure appropriate treatment indications.

Chapter 3, a systematic review, provided a comprehensive summary of the diagnostic accuracy of PTSD assessment instruments designed for older adults. The review summarized the psychometric properties of 24 instruments used to detect PTSD in older adults across 40 research studies of sufficient quality. The study found that only six studies assessed a DSM-5-based instrument, and half of the tools were validated exclusively in veterans or former prisoners of war

(POWs). Validation studies conducted in specific older adult populations are limited, particularly for cognitively impaired individuals (such as in dementia), those nearing the end of life, or non-Western samples. Overall, although there are various diagnostic tools available for assessing PTSD in older adults, many have limited psychometric evaluations, particularly regarding the needs of this population (e.g., multimorbidity and ease of administration). It is crucial to validate a screening and diagnostic instrument for PTSD that is suitable for this often-overlooked population, as it is important for both clinical practice (e.g., treatment indication) and research (e.g., establishing a gold standard).

Chapter 4 examined the link between PTSD and dementia risk in later life. The systematic review and meta-analysis showed that people with PTSD had a 43–56% higher risk of developing dementia. This association held across both veteran and general populations. The study also found that comorbid conditions such as diabetes and hypertension further increased dementia risk, while depression, traumatic brain injury (TBI), and alcohol use appeared to weaken it. These unexpected patterns may reflect overlapping biological mechanisms, sample-specific effects, or measurement limitations and warrant cautious interpretation. Besides, post hoc analyses revealed that these moderation effects were no longer significant after exclusion of one influential study. These findings highlight PTSD as a significant risk factor for dementia and stress the importance of monitoring both psychological and physical health in trauma-exposed older adults.

Chapter 5 described a detailed research protocol to enhance the diagnosis and treatment of PTSD in people with dementia. The TRADE-study consists of two parts: Study A will validate the TRAUma and DEmentia-interview (TRADE-interview) by comparing its results with clinical assessments of PTSD in people with dementia. Study B will assess the feasibility of EMDR therapy through a randomized control design, with participants either receiving EMDR or being placed on a waiting list. The results of this research are expected to improve the diagnostic process of PTSD and open the door to trauma-focused treatment for people dealing with both dementia and PTSD.

Chapter 6, a systematic review of thirty case studies, explored how PTSD manifests in people with dementia. The most common symptoms observed were irritability, anger, persistent negative emotional states, and sleep disturbances. Diagnosing PTSD in dementia patients is challenging due to overlapping symptoms and the lack of structured diagnostic methods. Surprisingly, avoidance, a core symptom of PTSD, was rarely reported. Instead, symptoms such as memory problems, screaming, and wandering were more frequently noted. Out of 30 cases reviewed, only one met the full DSM-5 criteria for PTSD.

These findings suggest that PTSD in dementia may present differently than in those without dementia, indicating a need for tailored diagnostic approaches. The article concludes that further research is essential to understand the relationship between PTSD and dementia and to improve diagnostic and therapeutic practices for affected individuals.

Chapter 7 underscored the importance of developing specialized diagnostic tools to address the unique challenges faced by people with dementia and comorbid PTSD. The 26 experts in the field of PTSD or dementia care agreed on the critical need for a diagnostic tool to ensure accurate PTSD diagnosis. The study emphasizes that existing diagnostic criteria are insufficient for accurately assessing PTSD in people with dementia. Participants in the study identified key features that should be included in a new diagnostic instrument, such as the need for sensitivity to cognitive decline and the consideration of past PTEs. Based on expert feedback, a first version of the TRADE-interview was developed.

Finally, **chapter 8** explored the impact and needs of caregivers for people with dementia who also have comorbid PTSD living in nursing homes. The study emphasizes the importance of recognizing PTSD in people with dementia in nursing home settings and the necessity for personalizing care approaches and tailored interventions to improve their quality of life.

Taken together, the findings of all chapters underscore the necessity of the recognition and diagnostic process of PTSD in older adults, especially in those with dementia.

Insights and challenges in recognizing PTSD in older adults and dementia

As the population of older adults continues to grow, so does the necessity for a deeper understanding of the interactions between PTSD and aging-related cognitive decline. This dissertation can be considered an important step towards improving the recognition of PTSD and validating feasible and effective diagnostic instruments for older adults and people with dementia. The ultimate goal of enhancing assessment and diagnosis is to ensure that these people receive a treatment indication, allowing them access to appropriate interventions and care. This is particularly crucial, as misdiagnosis or underdiagnosis may prevent people from receiving the necessary treatment. The promising results highlight the opportunity to refine diagnostic tools further

and improve the timely and accurate identification of PTSD in older adults and people with dementia.

Validation of screening and diagnostic instruments

A significant barrier to diagnosing PTSD in older adults is the absence of appropriate diagnostic tools. Chapter 3 highlights that, although many PTSD screening and diagnostic instruments have been validated for adults, studies specifically involving older adults are quite limited. Only 40 research studies are available that summarize the psychometric properties of instruments designed to diagnose PTSD in this population. Several studies recommend using a lower cutoff score on the PTSD Checklist (PCL) for older adults compared to younger adults to better identify potential PTSD diagnoses [1-3]. While establishing age-appropriate norms is valuable, many assessment scales either lack these tailored guidelines or have not been updated for DSM-5 [4, 5]. This gap in diagnostic tools hinders clinical practice and discourages researchers from studying older cohorts due to data reliability and validity concerns. Without tools that accurately capture the unique experiences of PTEs in later life, studies risk perpetuating the exclusion of this group.

For people with dementia, the difficulty of diagnosing PTSD is further heightened by the altered clinical manifestations of PTSD, where symptoms may present atypically or overlap with dementia-related behaviors. This is supported in Chapter 6, where it is shown that only 1 out of 30 cases met all the DSM-criteria. While this may raise the question of whether some of these people simply did not have PTSD, qualitative and contextual evidence from their histories and symptomatology suggested otherwise. This discrepancy highlights a potential limitation of using standard diagnostic frameworks in populations with cognitive impairment. The stricter symptom structure of the DSM-5, especially the requirement of clear avoidance behaviors, may not capture how PTSD manifests in people with dementia, who often cannot verbalize their distress or consciously avoid reminders of PTEs. Although ICD-11 requires fewer symptom criteria, it also includes avoidance as a core symptom [6]. Given that avoidance behaviors were frequently absent or difficult to identify in our study population, current frameworks might miss clinically relevant cases of trauma-related distress. This concern is highlighted in Chapter 3 of this dissertation, where we show that nearly all validated PTSD instruments for use in dementia populations are based on DSM criteria, with only one tool reflecting the ICD-11 framework. Additionally, as discussed in Chapter 7 and found in the research of Fox et al. [6], a larger number of adults were found to meet the diagnostic criteria using the DSM-5 compared to the ICD-11, despite its more flexible approach.

Given these limitations, it becomes crucial not to dismiss the possibility of PTSD simply because an individual does not meet every criterion on paper. Especially in dementia care, it may be necessary to adopt a hypothesis-driven approach, where PTSD remains a working diagnosis based on life history, contextual factors, and observable symptoms, even in the absence of full diagnostic confirmation. Maintaining this perspective allows clinicians to consider trauma-informed care or targeted interventions, which may improve quality of life and reduce distress, regardless of formal diagnostic thresholds.

In Chapter 7, The TRADE-interview is a semi-structured diagnostic tool developed to assess PTSD in people with dementia. Unlike general PTSD diagnostic tools, the TRADE-interview is specifically designed to account for the cognitive impairments associated with dementia. This specialization ensures more accurate and relevant assessments. The tool incorporates input from the patient, informal caregivers and formal caregivers, who can provide valuable insights into the patient's history and current behaviors. The TRADE-interview also focuses on observable behaviors and symptoms, which is crucial for patients who may struggle to articulate their experiences due to dementia. This contrasts with other tools that rely heavily on self-reported symptoms.

Future research

Future research should aim to develop universal diagnostic instruments adaptable across age groups, including children, adults, and older people with dementia. Such tools must align with frameworks like the DSM-5 or ICD-11 while being simplified or adjusted to accommodate the specific needs of diverse populations. Future research should also evaluate the feasibility and effectiveness of these tools in diverse clinical settings to ensure they are practical and user-friendly for both clinicians and patients. Special attention is currently being given to validating the TRADE-interview, as discussed in Chapters 5 and 7. This process is already well underway, and I am actively involved in its implementation. The validation focuses on older adults with dementia and the unique care settings in which they reside. Addressing these gaps will improve clinical practice and encourage broader inclusion of older adults in trauma research, ensuring that their unique experiences and needs are adequately represented.

Obstacles and importance of PTE consequences and PTSD research in older adults

Older adults remain underrepresented in studies on PTEs and PTSD, leading to a critical gap in our understanding of how this condition manifests and is experienced in later life [4, 7, 8]. This underrepresentation of older adults in PTEs and PTSD research was also evident in Chapters 2, 3, 4 and 6, reflecting broader

trends in the literature. Several methodological, practical, and systemic factors contribute to the exclusion of older adults from PTEs and PTSD research [9]. One reason older adults are often excluded is the perception that their inclusion complicates study designs [10]. Age-related variables such as comorbid physical conditions, cognitive decline, and polypharmacy introduce complexities that may challenge researchers aiming for streamlined, homogeneous samples. Additionally, ethical concerns around the potential stress of study participation, particularly when revisiting PTEs, may deter researchers from including older participants.

While there are valid reasons to exclude older adults from certain studies, such as their unique clinical manifestations and the complexity they introduce into study designs, this exclusion limits the generalizability of findings and risks perpetuating a cycle of neglect in PTE and PTSD research [11]. This oversight may arise from a lack of awareness or interest in geriatric perspectives within the broader PTE and PTSD research community. Additionally, the challenges mentioned above can make it difficult to achieve sufficient sample sizes, hindering the ability to draw robust conclusions. However, such exclusion also reflects an underlying form of ageism in research design, where the needs of older adults are deprioritized or considered too complex to investigate [5]. As a result, crucial gaps remain in our understanding of how PTEs affect this population, and older people may be denied access to timely and appropriate treatment. Without adequate evidence and tailored interventions, older adults with PTSD, especially those with cognitive impairments, risk being overlooked in both mental health and dementia care, reinforcing disparities in diagnosis, care planning, and recovery outcomes.

On one hand, dedicated studies focusing on older adults are essential. This population often experiences PTSD differently, with PTEs resurfacing and interacting with age-related stressors such as bereavement, social isolation, and physical decline [4]. As Chapter 8 demonstrates, PTSD in people with dementia presents unique caregiving challenges, requiring targeted diagnostic and therapeutic strategies. Developing specialized instruments like the TRADE-interview, as described in Chapters 5 and 7, is necessary to address the specific needs of older adults with dementia. Thus, tailored studies are vital for improving the diagnostic process of PTSD in older adults and people with dementia, as it could enhance the understanding of how PTEs affect this subgroup.

On the other hand, excluding older adults from broader, lifespan-spanning studies poses its own problems. If this demographic is omitted, it becomes difficult to compare PTE responses across age groups and understand how PTSD evolves over time. For example, Chapter 2 revealed that COVID-19-related

PTEs had a relatively more pronounced impact on older adults compared to other PTEs, reflecting the relatively higher impact of the COVID-19 pandemic on older adults and underscoring the importance of their inclusion in studies that examine PTEs across the lifespan. Including older adults in such studies ensures that their experiences are not forgotten and enables researchers to examine the progression of traumatic stress across different life stages.

Future research

The lack of research on older adults in PTE and PTSD studies is a significant oversight that impacts mental health care for this growing population. Future research should focus on their specific needs and incorporate them into both targeted and lifespan studies, for instance, by including older adults in longitudinal cohorts starting earlier in life. This allows tracking PTE and related symptoms over time and helps identify long-term consequences. However, it is crucial to conduct retrospective studies for current older cohorts, as waiting for new cohorts to age may come too late to address the pressing needs of today's older population. By doing so, research can provide more realistic and comparable data, bridging the gap between personalized care for specific subgroups and the broader understanding of PTE and PTSD across the lifespan. Funding agencies and academic journals must also promote inclusion, as neglecting older adults not only underrepresents them but also limits the understanding of PTEs and PTSD. By addressing their unique needs, we can ensure that older adults are no longer forgotten in PTE and PTSD research.

Inclusion of more diverse samples

Research on PTEs and PTSD in older adults often lacks inclusivity, with significant gaps concerning diverse subgroups. Many studies predominantly focus on specific populations, such as veterans [5, 12], while neglecting the general aging population, which includes people exposed to a wide range of PTEs [4]. While veterans represent an important subgroup due to their elevated exposure to combat-related PTEs, this narrow focus overlooks the broader experiences of PTEs among the general aging population. Military-related PTEs often occur within a specific context, with structured support systems such as Veterans Affairs services readily available for many affected individuals. This bias is reflected in abundant studies and diagnostic tools tailored specifically for veterans. As a result, the generalizability of findings is limited, leaving significant gaps in understanding how PTEs and PTSD manifest and are managed in older adults from civilian backgrounds [11]. Chapter 4 of this dissertation provides a compelling case for expanding research beyond veterans. The findings reveal that the relative risk of developing dementia in people with PTSD does not significantly differ in the general population compared to veteran-specific groups. However, the risk factors and trajectories of PTSD in civilian older adults

may differ considerably from those in veterans, necessitating a broader research scope to capture these variations fully.

In addition to the focus on veterans, PTEs and PTSD research in older adults often overlooks other critical subgroups (Chapters 2, 3, 4, 6 & 8). Ethnic and racial minorities, for example, remain underrepresented in studies despite evidence that cultural and systemic factors may influence PTE exposure, symptom expression, and access to care [11]. Besides, Fox et al. [6] found that women over 60 are significantly more likely to meet criteria for PTSD than men, highlighting the need for gender-sensitive approaches, mainly since much of existing PTSD research has been based primarily on male populations [6]. Research has shown that black older adults are more likely to experience cognitive impairment associated with cumulative stress exposures across the life course, yet they are underrepresented in PTSD studies [13]. Furthermore, Chapter 4 reveals that people with PTSD have a 43-56% higher risk of developing dementia compared to those without PTSD. Despite this alarming statistic, there is a surprising lack of focus on this issue within PTE and PTSD studies, particularly considering the growing aging population and the rising prevalence of these conditions. Similarly, the “oldest-old” population, those aged 85 and above, is frequently excluded from research due to perceived challenges in recruitment and data collection, even though this group is growing rapidly and may face unique age-related vulnerabilities [11]. This gap is also evident in the current dissertation, where we could not specifically address this demographic in any chapter due to the limited availability of literature and data on this population. This highlights the critical need for future research to prioritize research of the oldest-old to better understand and address their unique PTE-related challenges. Additionally, Chapters 5, 6, 7 and 8 highlight the significant influence of cognitive decline on PTSD symptoms and their clinical manifestation, complicating diagnosis and treatment.

Future research

To create a more inclusive body of research, future studies should prioritize researching older civilians from diverse backgrounds and explore the broader spectrum of PTE exposures. This would improve the representativeness of findings and enhance the development of interventions tailored to the unique needs of older adults in the general population.

Addressing comorbidity

Older adults often experience a range of co-occurring physical and psychiatric conditions, such as cardiovascular disease, diabetes, chronic pain, depression, and anxiety, which further obscure the clinical picture and overlap symptoms with PTSD [1, 14, 15]. A systematic review by Baltjes et al. [16] highlights that

psychiatric comorbidities, including depression and anxiety, are prevalent in older adults with PTSD and significantly complicate diagnosis and treatment. The overlapping symptoms, such as sleep disturbances, fatigue, and emotional withdrawal, make it challenging to distinguish PTSD from other psychiatric disorders, which can lead to underdiagnosis or misdiagnosis. This difficulty is also evident in Chapter 2, where older adults in the sample reported experiencing insomnia more frequently. This could be linked to hypervigilance and feelings of loneliness commonly observed in older adults with PTSD [17]. However, it may also result from the regular changes in sleep patterns that occur with aging [18]. These overlapping symptoms complicate the identification of PTSD, particularly in people with cognitive impairments such as dementia, as outlined in Chapters 5, 6, 7 and 8. Thus, comorbid disorders must always be considered when diagnosing PTSD in older adults and people with dementia [19].

A complicating factor when recognizing and diagnosing PTSD in older adults with dementia is the overlap with neuropsychiatric symptoms [20-22]. These findings are in line with those presented in Chapter 6, where irritability, anger and sleep disturbances were identified as the most prevalent symptoms among people with both PTSD and dementia. This overlap can complicate the differentiation between PTSD symptoms and neuropsychiatric symptoms. Furthermore, Chapter 6 found that 93% of the case reports noted 'other symptoms', such as memory problems, screaming and wandering. In Chapter 8, we refer to some of these symptoms as 'PTE-related neuropsychiatric symptoms', suggesting that they may be associated with a previous PTE. For instance, 'screaming' could represent a fear response to a flashback the individual is experiencing, potentially indicating a PTSD symptom. Another example discussed in Chapter 8 is 'wandering,' identified in 22.2% of cases in Chapter 6 as a form of avoidance behavior.

Future research

Future research should focus on exploring the relationship between PTSD, dementia, and other chronic conditions to gain a better understanding of how these comorbidities influence the presentation and management of PTSD. Longitudinal studies are especially important in this context, as they can monitor the progression of PTSD and its comorbid conditions over time, offering valuable insights into how these interactions develop and affect patient outcomes. However, such studies are often costly, time-consuming, and may not benefit the current older population. Therefore, integrating practice-based knowledge and employing more pragmatic and feasible methods, such as Single Case Experimental Designs (SCED), can be highly valuable [23]. These approaches allow for detailed monitoring of individual trajectories and intervention effects

in real-world settings, making them particularly suitable for older adults with complex needs [24].

Methodological considerations

Strengths

This dissertation has several notable strengths, one of which is its practice-oriented approach, which emphasizes the clinical applicability of its findings. This focus ensures that the research contributes not only to academic knowledge but also to improvements in mental health care for older adults and people with dementia. In Chapter 3, this strength is evident in the evaluation of existing diagnostic instruments to determine their potential suitability for use in clinical practice. Building on this, Chapter 7 involves collaboration with both research and clinical experts to identify the essential features of a diagnostic tool that would be practical and effective in real-world clinical settings. These efforts demonstrate the dissertation's commitment to bridging the gap between research and practice by addressing the diagnostic challenges faced by underserved populations. The focus on clinical applicability extends further in Chapter 8, which explores the impact of PTSD and dementia on nursing staff and families. This chapter highlights that broadening and improving knowledge about PTEs and PTSD in people with dementia has far-reaching effects in the clinical setting, not only for the individuals themselves but also for the caregivers and family members who support them.

Furthermore, this dissertation, along with the TRADE-study described in Chapter 5, is among the first to comprehensively examine the intersection of PTSD and dementia, a critically understudied field. Before the start of this research, only a handful of peer-reviewed studies, most of them small-scale or case-based, had explored this comorbidity. Since then, the field has slowly grown, and this dissertation has played a significant role in that development.

The dissertation's approach of bridging these two areas, PTSD and dementia, requires not only a deep understanding of both fields but also the willingness to adapt methodologies and theories to the unique needs of this population. This creative aspect of the research contributes to the development of innovative diagnostic tools and potential interventions that can improve care for older adults with dementia who experience PTSD.

Moreover, this research exemplifies the power and necessity of integrative collaboration between the fields of dementia research, long-term care, and mental health (GGZ). These domains have traditionally operated separately,

but this dissertation shows that the difficulties faced by people with dementia and comorbid PTSD demand a more unified and collaborative approach. The connection between these research areas, firmly grounded in practice, is not only innovative, it is essential.

The field requires constant adaptation as new research findings emerge, and the dissertation acknowledges that future work will need to build on this foundation and incorporate new insights. As such, this work represents a critical first step in what is likely to be a long-term process of refining diagnostic criteria and care models for PTSD in older adults and those with dementia. Overall, the dissertation's thorough investigation into the diagnostic accuracy, risk factors, clinical manifestations, and caregiving needs related to PTSD in older adults and dementia offers valuable contributions to the field, paving the way for future research and improved clinical practices.

Limitations

While this dissertation advances our understanding of recognizing PTSD in older adults and people with dementia, as well as improving the diagnostic process, certain limitations have to be considered.

One significant limitation of this dissertation is the limited availability of empirical research on PTSD in older adults and people with dementia, as most existing studies are case reports or small-scale qualitative descriptions, making it difficult to draw robust comparisons and conclusions. This scarcity affects the generalizability and depth of the findings. In Chapter 3, most assessment instruments were only validated in a specific population, often supported by only one or two studies, raising concerns about their reliability. Additionally, Chapter 6 notes that only 30 cases worldwide have been documented with both PTSD and dementia, highlighting the rarity and limited understanding of this comorbidity.

Moreover, while clinical assessment is generally considered the gold standard for diagnosing PTSD, its applicability in people with dementia remains limited. Many clinicians and psychologists report uncertainty and a lack of confidence in conducting such assessments in this population, as highlighted in Chapter 7. As a result, the practical implementation of this gold standard is often inconsistent or avoided altogether, which may lead to underrecognition of PTEs and PTSD and reduced sensitivity in detection. This complicates the assessment and comparison of findings in Chapters 6, 7, and 8, where varying diagnostic criteria and tools were used. Additionally, the absence of a universally trusted and practically feasible standard hampers the validation of new diagnostic

instruments and interventions, potentially slowing the development of effective clinical practices.

Secondly, a significant limitation of this dissertation's chapters 2, 3, 4, 6 & 8 is the potential for selection bias regarding the older adult population. The study may not represent the broader older adult population, as it primarily includes older adults who are more technologically savvy, healthier, and likely more educated than average. Participants needed internet access and cognitive ability to complete surveys, leading to an underrepresentation of people over 80 and those with cognitive impairments or limited internet access. Additionally, the systematic reviews in chapters 3 and 6 mainly included studies based on veteran and prisoner-of-war populations, which limits the generalizability of the results and excludes a significant portion of the older adult population who may experience different levels or types of symptoms and challenges.

Moreover, in chapter 7, a selection bias may have occurred due to the reliance on an online search of peer-reviewed publications and consultations with national associations, which may favor experts who are more visible or active in academic and professional networks, potentially overlooking qualified people who are less published or unaffiliated. Additionally, asking experts to nominate colleagues could lead to a homogenous group, resulting in a disproportionate representation of Dutch experts (76%) compared to international experts (24%), potentially skewing the findings. Most experts were psychologists, limiting the diversity of insights, and the challenge of finding those with dual expertise in PTSD and dementia further compounds this bias, affecting the overall comprehensiveness and applicability of the results.

Thirdly, this dissertation concerns information bias across chapters 2, 3, 4, 6, and 8. The diagnostic instruments used in these chapters rely on recall of PTEs, which older adults might misremember or underreport due to cognitive decline. However, in clinical practice, we experience that many older adults, even those with mild cognitive decline, can recall and discuss PTEs when questions are asked in a sensitive and structured manner. However, shame and stigma associated with PTEs can further inhibit older adults from disclosing their experiences [25]. Furthermore, older adults might struggle to recognize PTSD symptoms in themselves, attributing them to aging or other health issues instead [26, 27]. This complexity underlines the importance of careful clinical interpretation, as misattributions may obscure trauma-related origins of distress.

It is also important to acknowledge that this dissertation focused specifically on PTSD, while the consequences of PTEs can be much broader. PTE consequences may manifest in various other forms that fall outside the scope of the current

work. As a result, the actual impact of PTEs on older adults and people with dementia may be significantly greater than reflected in this dissertation. Moreover, this research focused on people aged 60 and above; people younger than 60 with early-onset dementia were not included, even though they may experience different trauma-related challenges. Therefore, while self-report remains valuable, it must be contextualized within a broader clinical assessment that considers cognitive capacity, communication style, comorbid health conditions, and the broader psychological consequences of PTEs.

Therefore, while the study provides valuable insights, its conclusions should be interpreted cautiously, recognizing that they may not fully capture the complexities of mental health in the older adult population. These limitations highlight areas for future research to enhance the validity and applicability of the study's conclusions.

Clinical implications

The results obtained may have important implications for clinical practice as they provide a first insight into recognizing and diagnosing PTSD in older adults and dementia. To support the translation of these findings into practice, a visual overview of key clinical considerations for recognizing PTSD in people with dementia is included at the end of this paragraph. This tool, designed in the format of a practical flyer, can easily be used in care settings and aims to raise awareness among healthcare professionals. Additionally, this dissertation describes a clinical case based on real-life situations from clinical practice. This case serves as a practical example, illustrating how theoretical insights can be applied in a real-world setting to improve understanding, diagnosis, and care strategies for people with PTSD and dementia.

Recognition & Diagnosis of PTSD



❖ Be aware of PTE history

Usually, nursing home residents' (potentially traumatic) history is unknown. It is important to inquire about the resident's background and history whenever neuropsychiatric symptoms or suspicion of PTEs arise. This ensures that any PTEs can be taken into account in their care.



❖ Recognize atypical PTSD manifestations

In people with dementia, PTSD may present as behaviors like wandering or emotional distress, which deviate from traditional PTSD symptoms.



❖ Acknowledge symptom fluctuations

PTSD symptoms can re-emerge due to stressors or life transitions, even decades after the original PTE.



❖ Use structured tools like the TRADE-interview*

The TRADE-interview helps identify PTSD symptoms in people with dementia, even when they struggle to articulate their experiences. It supports more accurate recognition.



❖ Recognize and minimize PTE-related triggers

Minimizing triggers related to PTEs, such as loud noises, sudden movements, or unfamiliar environments, is essential in reducing distress and agitation in people with PTSD and dementia.



❖ Implement a trauma-sensitive approach

Apply a trauma-sensitive approach to address the specific needs of older adults with PTSD and people with comorbid dementia, reducing (professional) caregiver stress and improving patient outcomes.



❖ Screen and treat beyond diagnosis

Even if someone does not fully meet the DSM-5 criteria for PTSD but exhibit PTSD symptoms or possible PTE-related neuropsychiatric symptoms, a clinician should consider whether psychological treatments, such as EMDR, may still be indicated.

* The TRADE-interview is currently not yet validated.

Conclusions

This dissertation addresses the “Forgotten Wounds”, emphasizing the urgent need for greater recognition and improved diagnostic methods for PTSD in older adults, especially those living with dementia. It highlights the importance of acknowledging these hidden yet significant scars and ensuring they receive proper awareness, care and healing. Through a series of studies, this dissertation provides a foundational understanding of the complexities involved in identifying PTSD within this population, emphasizing the unique challenges posed by cognitive impairments, multimorbidity, and underrepresentation in research.

The findings reveal that PTSD symptoms often manifest differently in older adults and especially those with dementia, requiring tailored diagnostic tools and approaches. The development of the TRADE-interview exemplifies the potential for innovative approaches that account for cognitive decline and incorporate insights from caregivers. Furthermore, this work underscores the broader gaps in PTE and PTSD research, including the need to include diverse populations, such as the oldest-old and ethnic minorities, to ensure findings are comprehensive and representative.

By integrating research findings with practical examples from clinical practice, this dissertation offers actionable insights for healthcare providers. Ultimately, this work serves as a stepping stone for future research and clinical innovation, paving the way for more inclusive and effective mental health interventions for older adults and people with dementia.

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Clinical vignette: Jan [part 9]

Conclusion

Jan's case emphasizes the importance of addressing potentially traumatic events in older adults with dementia. Without the TRADE-interview and input from family members, a potential diagnosis of PTSD might have gone unnoticed, resulting in ongoing distress for both the individual with dementia and their caregivers. The combination of dementia and PTSD necessitated a personalized approach to care. However, by implementing EMDR and a trauma-sensitive approach, individuals with dementia may experience significant relief from PTSD symptoms. This improvement allows them to live with greater peace and comfort, despite the challenges that dementia presents.





Addendum

Abbreviations

CBT = Cognitive Behavioral Therapy

DSM-5 = The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders

EMDR = Eye Movement Desensitization and Reprocessing

GPS = Global Psychotrauma Screen

HPA-axis = Hypothalamic–Pituitary–Adrenal axis

ICD = the International Classification of Diseases

NPS = Neuropsychiatric Symptoms

PCL = PTSD Checklist

POW = Prisoner of War

PTEs = Potentially Traumatic Events

PTSD = Posttraumatic Stress Disorder

SCED = Single Case Experimental Designs

TBI = Traumatic Brain Injury

TRADE-interview = TRAuma and DEmentia-interview

TRADE-study = TRAuma and DEmentia-study

Summary

Most individuals experience potentially traumatic events (PTEs), with many people experiencing such events but only a subset developing Posttraumatic Stress Disorder (PTSD). While often linked to younger individuals, PTSD also affects older adults (>60 years), with prevalence rates between 2.3% to 5.5%. Aging-related changes can trigger or worsen PTSD symptoms. Additionally, people with dementia may face unique challenges, as cognitive decline complicates PTSD diagnosis, often leading to misinterpretation of symptoms. With an increasing older adult population, understanding and accurately diagnosing PTSD in older adults, especially those with dementia, is crucial for improving their treatment and ensuring appropriate care.

Chapter 1 provides a general introduction to the topic and the aim of this dissertation. It emphasizes the importance of research into the recognition and diagnosis of PTSD in older adults and people with dementia. This chapter also outlines the structure of the subsequent chapters and the studies that will be described therein.

As traumatic stress emerges as a global issue, the psychological impact of PTEs across the adult lifespan remains unclear. **Chapter 2** delves into this by investigating how trauma-related symptoms vary from ages 16 to 100, particularly comparing self-reported COVID-19-related PTEs to other PTEs. The findings reveal that overall symptom severity declined with age, yet this decline was less pronounced for self-reported COVID-19-related PTEs than for other PTEs. In addition, older adults reported higher rates of insomnia and substance use, while younger adults showed greater severity in PTSD, depression, anxiety, and self-harm symptoms. The findings suggest that recent and ongoing stressors like the COVID-19 pandemic may have a distinct and more enduring psychological impact on older adults.

Recognizing PTSD in older adults is crucial for ensuring they receive adequate treatment. **Chapter 3** presents a systematic review summarizing the diagnostic accuracy of PTSD screening and diagnostic instruments for older adults. The review identifies fourteen relevant studies from the past decade, with only six studies that assessed a DSM-5-based instrument. It points out the lack of studies assessing the psychometric properties of PTSD instruments for diverse older adult populations, including civilians, females, non-Western individuals, those with cognitive decline, and non-English speakers. This gap hampers the interpretation of epidemiological evidence on PTSD prevalence in older adults and people with dementia.

Given the global burden of dementia and the growing recognition of PTSD as a potential risk factor, **Chapter 4** presents a meta-analysis that examines the association between PTSD and dementia, including potential moderating factors. The analysis shows that PTSD is associated with a significantly increased dementia risk. Diabetes and hypertension appeared to strengthen this link, while depression, TBI, and alcohol use initially seemed to weaken it. However, post hoc analyses indicate that these effects are largely driven by a single study. The findings emphasize the importance of understanding comorbidities in the context of PTSD-related dementia risk.

With the rising number of people with dementia and consequently also comorbid PTSD, **Chapter 5** underscores the importance of enhancing knowledge about this population. It outlines the design of the TRAuma and DEmentia-study (TRADE-study), a multi-center prospective study aimed at improving the diagnostic process of PTSD and assessing the effects of eye movement desensitization and reprocessing (EMDR) treatment in people with dementia living in Dutch care facilities.

To refine the diagnostic process, gaining insight into the clinical manifestation of PTSD in people with dementia is essential. **Chapter 6** describes a systematic literature review that gathers data on these clinical manifestations. The review identifies common symptoms such as agitation, aggression, and flashbacks, but also notes that subjects often do not meet the full DSM-5 criteria for PTSD. It highlights the challenges in distinguishing PTSD symptoms from dementia-related behaviors and suggests that symptoms like screaming and wandering may indicate possible PTSD.

Due to this different clinical manifestation, PTSD may be easily interpreted as neuropsychiatric symptoms of dementia. Besides, a valid diagnostic tool for PTSD in dementia is lacking. **Chapter 7** addresses this by conducting a Delphi study to reach a consensus on the essential features of a diagnostic instrument for PTSD in people with dementia. With the help of an international expert panel, the TRADE-interview was developed to diagnose PTSD in this population.

The first and most crucial step in improving care is the prompt recognition of traumatic stress and PTSD. **Chapter 8** synthesizes information from the previous chapters through introducing a practical case, emphasizing the role of healthcare workers in nursing homes. These workers are essential in recognizing possible PTSD and involving the appropriate disciplines.

Finally, **Chapter 9** discusses the main findings, methodological considerations, implications for clinical practice, and directions for future research, bringing the dissertation to a comprehensive conclusion.

Nederlandse samenvatting

De meeste individuen maken potentieel traumatische gebeurtenissen mee, waarbij veel mensen dergelijke gebeurtenissen meemaken, maar slechts een deel Posttraumatische Stressstoornis (PTSS) ontwikkelt. Hoewel vaak geassocieerd met jongere individuen, treft PTSS ook ouderen (>60 jaar), met prevalentiecijfers tussen 2,3% en 5,5%. Veranderingen gerelateerd aan veroudering kunnen PTSS-symptomen uitlokken of verergeren. Bovendien kunnen mensen met dementie unieke uitdagingen ondervinden, aangezien cognitieve achteruitgang de diagnose van PTSS bemoeilijkt, wat vaak leidt tot misinterpretatie van symptomen. Met een toenemende oudere bevolking is het begrijpen en nauwkeurig diagnosticeren van PTSS bij ouderen, vooral bij degenen met dementie, cruciaal voor het verbeteren van behandeling en het waarborgen van passende zorg.

Hoofdstuk 1 biedt een algemene inleiding tot het onderwerp en het doel van dit proefschrift. Het benadrukt het belang van onderzoek naar de herkenning en diagnose van PTSS bij oudere volwassenen en mensen met dementie. Dit hoofdstuk schetst ook de structuur van de volgende hoofdstukken en de studies die daarin worden beschreven.

Naarmate traumatische stress een wereldwijd probleem wordt, blijft de psychologische impact van potentieel traumatische gebeurtenissen (PTE's) gedurende de volwassen levensloop onduidelijk. **Hoofdstuk 2** gaat hierop in door te onderzoeken hoe trauma-gerelateerde symptomen variëren van 16 tot 100 jaar, met name door zelf gerapporteerde COVID-19-gerelateerde PTE's te vergelijken met andere PTE's. De bevindingen laten zien dat de algehele symptoomernst afnam met de leeftijd, maar deze afname was minder uitgesproken bij zelf gerapporteerde COVID-19-gerelateerde potentieel traumatische gebeurtenissen (PTE's) dan bij andere PTE's. Daarnaast rapporteerden ouderen hogere percentages slapeloosheid en middelengebruik, terwijl jongere volwassenen ernstigere symptomen van PTSS, depressie, angst en zelfbeschadiging vertoonden. De resultaten suggereren dat recente en aanhoudende stressoren, zoals de COVID-19-pandemie, een specifiek en langduriger psychologisch effect kunnen hebben op ouderen.

Het herkennen van PTSS bij oudere volwassenen is cruciaal om ervoor te zorgen dat zij adequate behandeling krijgen. **Hoofdstuk 3** presenteert een systematische review die de diagnostische nauwkeurigheid van PTSS-screening en diagnostische instrumenten voor oudere volwassenen samenvat. De review identificeert veertien relevante studies uit het afgelopen decennium, waarvan slechts zes studies een op de DSM-5 gebaseerd instrument hebben

beoordeeld. Het wijst op het gebrek aan studies die de psychometrische eigenschappen van PTSS-instrumenten voor diverse ouderen populaties beoordelen, waaronder burgers, vrouwen, niet-westerse individuen, mensen met cognitieve achteruitgang en niet-Engelssprekenden. Deze kloof belemmert de interpretatie van epidemiologisch bewijs over de prevalentie van PTSS bij oudere volwassenen en mensen met dementie.

Gezien de wereldwijde ziektelast van dementie en de toenemende erkenning van PTSS als een mogelijke risicofactor, presenteert **Hoofdstuk 4** een meta-analyse die de associatie tussen PTSS en dementie onderzoekt, inclusief mogelijke modererende factoren. De analyse laat zien dat PTSS geassocieerd is met een significant verhoogd risico op het ontwikkelen van dementie. Diabetes en hypertensie lijken deze associatie te versterken, terwijl depressie, hersenletsel en alcoholgebruik deze in eerste instantie lijken te verzwakken. Post-hoc analyses geven echter aan dat deze effecten grotendeels worden aangedreven door één enkele studie. De bevindingen benadrukken het belang van het begrijpen van comorbiditeiten in de context van aan PTSS gerelateerde dementierisico's.

Met het toenemende aantal mensen met dementie en daarmee ook comorbide PTSS, benadrukt **Hoofdstuk 5** het belang van het vergroten van de kennis over deze populatie. Het schetst het ontwerp van de TRAuma en DEmentie-studie (TRADE-studie), een multicenter prospectieve studie die gericht is op het verbeteren van het diagnostische proces van PTSS en het beoordelen van de effecten van Eye Movement Desensitization and Reprocessing (EMDR) behandeling bij mensen met dementie die in Nederlandse zorginstellingen wonen.

Om het diagnostische proces te verfijnen, is het essentieel om inzicht te krijgen in de klinische manifestatie van PTSS bij mensen met dementie. **Hoofdstuk 6** beschrijft een systematische literatuurreview die gegevens verzamelt over deze klinische manifestaties. De review identificeert veelvoorkomende symptomen zoals agitatie, agressie en flashbacks, maar merkt ook op dat proefpersonen vaak niet voldoen aan de volledige DSM-5-criteria voor PTSS. Het benadrukt de uitdagingen bij het onderscheiden van PTSS-symptomen van dementie-gerelateerd gedrag en suggereert dat symptomen zoals schreeuwen en dwalen mogelijk wijzen op PTSS.

Vanwege deze verschillende klinische manifestaties kan PTSS gemakkelijk worden geïnterpreteerd als neuropsychiatrische symptomen van dementie. Bovendien ontbreekt een geldig diagnostisch instrument voor PTSS bij dementie. **Hoofdstuk 7** behandelt dit door een Delphi-studie uit te voeren

om consensus te bereiken over de essentiële kenmerken van een diagnostisch instrument voor PTSS bij mensen met dementie. Met de hulp van een internationaal panel van experts werd het TRADE-interview ontwikkeld om PTSS bij deze populatie te diagnosticeren.

De eerste en belangrijkste stap in het verbeteren van de zorg is de snelle herkenning van traumatische stress en PTSS. **Hoofdstuk 8** synthetiseert informatie uit de voorgaande hoofdstukken door een praktische casus te introduceren, waarbij de rol van zorgverleners in verpleeghuizen wordt benadrukt. Deze zorgverleners zijn essentieel bij het herkennen van mogelijke PTSS en het betrekken van de juiste disciplines.

Tot slot bespreekt **Hoofdstuk 9** de belangrijkste bevindingen, methodologische overwegingen, implicaties voor de klinische praktijk en richtingen voor toekomstig onderzoek, waarmee het proefschrift tot een uitgebreide conclusie wordt gebracht.

Valorization

This dissertation

The primary goal of the research described in this dissertation is to improve the recognition and diagnosis of PTSD in older adults and people with dementia. The main findings include that older adults show lower PTSD symptoms, with COVID-19-related PTEs having a less pronounced effect, suggesting better coping strategies and different clinical presentations in older adults. A comprehensive review of PTSD assessment tools for older adults revealed limited validation, particularly for those with cognitive impairments. A research protocol was crafted to validate the TRADE-interview for PTSD in dementia and to evaluate the feasibility of EMDR therapy. It was observed that PTSD in dementia presents itself differently, with symptoms such as irritability and sleep disturbances being more prevalent than avoidance. The necessity for specialized diagnostic tools for PTSD in dementia prompted the development of the TRADE-interview. Moreover, the significance of recognizing PTSD in dementia patients in nursing homes and the requirement for personalized care were emphasized. The dissertation underscores the complexity of diagnosing PTSD in older adults with dementia and the necessity for tailored diagnostic and therapeutic approaches.

Relevance: what does this dissertation contribute to science and society?

The current dissertation on PTSD in older adults and people with dementia significantly contributes to both science and society by bridging the fields of mental health (GGZ), nursing homes and dementia research, domains that have traditionally remained separate. This work demonstrates that integrating these disciplines is possible and essential for improving care for older adults and people with dementia. Importantly, this integration does not need to rely solely on a medical model. A broader, person-centered approach, focusing on emotional needs, life history, and meaningful engagement, can be equally or even more valuable in understanding and supporting individuals with trauma and dementia.

Scientifically, the dissertation deepens our understanding of how PTSD manifests in older individuals, particularly those with cognitive impairments. It highlights the need for more sensitive and tailored diagnostic tools, such as the TRADE-interview, and lays the groundwork for making psychological treatment more accessible to this group. Notably, this research has helped pave the way for the recent inclusion of dementia in the Dutch PTSD treatment guideline, an important milestone driven mainly by the insights gained from this work.

Societally, the findings emphasize the necessity of recognizing and accurately diagnosing PTSD in older adults, particularly in nursing home settings, to improve their quality of life. By drawing attention to the potential for targeted psychological interventions, even when full diagnostic criteria are not met, this dissertation helps create a foundation for more compassionate, personalized care. In doing so, it contributes to a healthcare system that better serves the emotional and psychological needs of people with dementia.

Target group: who could benefit from this dissertation?

The findings of this dissertation could be valuable for researchers, clinicians, and policy-makers working in the field of older adults, particularly in the area of PTSD in older adults and individuals with dementia. Healthcare professionals, such as doctors, nurses, and mental health specialists, would gain valuable insights for better recognizing and diagnosing PTSD in these populations. Caregivers and family members of older adults and people with dementia could also benefit from understanding the unique challenges and symptoms associated with PTSD, leading to more compassionate and effective care. Furthermore, policymakers and researchers could utilize the findings to develop targeted interventions and support systems, ultimately improving the quality of life for affected individuals.

Activities: how to inform and involve the target group?

We have published all our scientific work in open-access journals that are available free of charge. Additionally, our findings were disseminated to the scientific community and clinicians through presentations at various international conferences, including the 17th biennial Conference of the European Society for Traumatic Stress Studies in Belfast, the 39th Annual Meeting of the International Society for Traumatic Stress Studies in Los Angeles and the ARQ 50 year conference in the Netherlands. We also presented our findings at several Dutch conferences, including the Conference of Psychiatry and Dementia in 2021 and 2024, the NVvP spring conference and the conference for practitioners D-ZEP.

We also shared our findings through presentations and workshops to healthcare professionals working with older adults, for instance, at symposia hosted by the Center of Consultation and Expertise (CCE), the Dutch Institute of Psychologists (NIP), and the Professional Association of Care Providers and Nurses (V&VN). Additionally, we gave lectures and seminars to healthcare organizations participating in the TRADE-study. Moreover, we used social media platforms to disseminate our findings and participated in several interviews for Dutch magazines (VGCT magazine, ONS magazine and EMDR Magazine) to help raise awareness, provide personal insights, and offer practical guidance.

In addition to these efforts, we actively participated in the Global Collaboration on Traumatic Stress, specifically through involvement in the ON TRACK group (Older adults, Traumatic stress, and Resilience – A Collaborative Knowledge network). Together with international colleagues, we co-authored the paper “Posttraumatic Stress Disorder in Older Adults: A Global Collaboration on Setting the Future Research Agenda” (Sobczak et al. 2025), which outlines priorities for future research and highlights the importance of international cooperation in understanding PTSD in later life.

We worked closely with Alzheimer Nederland and a broad network of long-term care and mental health institutions. Through this, we ensured that our research is directly informed and translated into clinical practice. As a practicing psychologist in the field of geriatric mental health and dementia care, I was able to apply insights from this research directly into clinical settings, helping to close the gap between science and practice.”

Looking ahead, it will be crucial to more actively involve people with dementia and/or a history of PTEs or their relatives in future research. Their lived experiences can provide valuable perspectives on how PTE-related symptoms manifest and are managed in daily life. This involvement can enhance the development of more personalized, relevant diagnostic tools and interventions. Including their voices, not just as participants, but as contributors, will help ensure that future research and care approaches are better tailored to their needs and realities.

Taken together, our dissemination strategy contributed to advancing knowledge about PTSD in older adults and people with dementia while fostering interdisciplinary collaboration among individuals with lived experience, caregivers, clinicians, researchers, and policymakers.

Dankwoord

Hoewel mijn naam op de kaft staat, was dit proefschrift allesbehalve een soloproject. Tijd dus om de mensen te bedanken zonder wie dit er nooit was gekomen.

Prof. Dr. Olff, beste Miranda, ons contact begon tijdens mijn onderzoeksstage, toen Sjacko en ik werkten aan de ontwikkeling van het TRADE-interview. Op haar advies namen we contact met jou op vanwege jouw expertise in trauma en je ervaring met het ontwikkelen en valideren van meetinstrumenten. Toen later de vraag kwam wie mijn promotor zou kunnen worden, hoefden we daar dan ook niet lang over na te denken, en gelukkig was jij ook enthousiast. Je was altijd bereikbaar, dacht snel en helder mee, en wist op het juiste moment ook te bewaken dat het onderzoek wetenschappelijk onderbouwd bleef; iets wat ik, met mijn sterke klinische blik, af en toe dreigde los te laten. Bedankt voor je betrokkenheid, inhoudelijke scherpste en de prettige begeleiding in de afgelopen jaren.

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Dr. Hoeboer, Chris, via Miranda kwamen we met elkaar in contact en sindsdien heb je me enorm geholpen. Vooral op het gebied van statistiek, want laten we zeggen: niet mijn grootste kracht. Ik kon altijd rekenen op jouw snelle reacties, heldere uitleg en uitgebreide feedback, hoe ingewikkeld mijn vragen soms ook waren (vooral omdat ik niet wist wat ik niet snapte). Daarnaast waardeerde ik je

tips over beter mijn grenzen bewaken, af en toe wat vaker 'nee' zeggen en het stellen van prioriteiten, al vergat ik dat soms helaas weer net zo snel als ik het had beloofd. Dank voor je betrokkenheid, geduld en expertise in de afgelopen jaren!

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Daarnaast wil ik alle co-auteurs bedanken voor de feedback. Mede door jullie heb ik dit mooie proefschrift mogen neerzetten.

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Mijn collega psychologen van TanteLouise, tijdens mijn promotietraject werkte ik parttime als psycholoog bij jullie, een combinatie die niet altijd vanzelfsprekend was en regelmatig vroeg om flexibiliteit vanuit mijn werk. Wat ben ik dankbaar dat ik in zo'n warm team terechtkwam. Jullie waren vanaf het begin oprecht geïnteresseerd in mijn onderzoek en de voortgang daarvan. De motiverende berichtjes, jullie luisterend oor en de ruimte om telkens weer iets te delen hebben me enorm geholpen. Daarnaast wil ik Marcha, Rianne en Debbie in het bijzonder bedanken voor het meedenken en meebewegen wanneer de onderzoeksdrukke weer toenam. Jullie begrip en vertrouwen hebben het mogelijk gemaakt om beide rollen (onderzoeker én psycholoog) goed te kunnen combineren. Ook de Raad van Bestuur wil ik graag bedanken voor de ruimte die ik heb gekregen om op een cruciaal moment drie weken fulltime aan mijn onderzoek te werken. Die extra tijd was van onschatbare waarde en heeft me geholpen om belangrijke stappen te zetten richting de afronding van dit traject.

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Curriculum Vitae

Demi Constantia Dimphna Havermans was born on April 27, 1997, in Breda, the Netherlands. She spent her childhood in Moerdijk with her two sisters (Joyce and Sabine), brother (Stephan) and parents (Marc and Ingrid). She completed secondary school at Graaf Engelbrecht in 2016. After that, she moved to Maastricht to pursue her Bachelor's degree in Health Sciences (2016 - 2019) and a Master's degree in Mental Health (2019 - 2020).



During her master's degree, she gained experience with the older adult population through clinical and research internships at Mondriaan Ouderen in Heerlen. This experience sparked her passion for this population and her interest in enhancing practice through scientific research. Throughout her research internship, she was mentored by Dr. Sjacko Sobczak and contributed to the TRADE-study, which led to the development of the TRADE-interview.

Upon completing her master's degree, she began working in the SGGZ for adults (18+) at Caleidozorg. However, due to her interest in PTEs and PTSD in people with dementia, she opted to continue part-time research as a research assistant. Her continued involvement with the older adult population through research reinforced her appreciation for working with this population. After two years, she decided to pursue her part-time clinical work as a psychologist in nursing homes with TanteLouise. After working as a research assistant for 2 years, it was decided in consultation to officially start a PhD program at the TRADE-study in October 2022.

She is currently still working part-time as a psychologist at TanteLouise and started her 2-year training as a healthcare psychologist in April 2025. In addition, she has started as a postdoctoral researcher at TanteLouise in collaboration with Rotterdam University of Applied Sciences.

List of publications

- 2025 Gielkens, E., Havermans, D.C.D. & Lely, J. (2025). Leef tijd – doet die ertoe bij de behandeling van psychotrauma. *Tijdschrift voor Ouderensychologie*.
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- 2021 Havermans DCD, Sobczak S & Van der Velden M (2021). Impact van post-traumatische stress stoornis bij mensen met dementie. *Tijdschrift voor Ouderengeneeskunde*, 4.

Conference contributions

- 2025 **'EMDR on the spot bij dementie'**
Workshop – congres voor Behandelaren D-ZEP
- 'Feasibility of Eye Movement Desensitization and Reprocessing in a person with dementia and post-traumatic stress disorder: a case report'**
Symposium – Voorjaarscongres NVvP
- 2024 **'Traumabehandeling bij (vergevoerde) dementie: EMDR-on-the-spot'**
Online lezing – Psychologen regio-overleg Limburg
- 'Assessment van PTSS bij ouderen met dementie'**
Symposium - Congres SCEM Psychiatrie en Dementie
- 'Posttraumatische stress stoornis (PTSS) bij mensen met dementie'**
Lezing en workshop - CCE Middagsymposia
- 'Assessment van PTSS bij ouderen met dementie'**
Online symposium – NIP voorjaarssymposium
- 'TRAuma and Dementia - TRADE-study'**
Online lezing – Overleg Mondriaan Ouderen en Open Universiteit
- 2023 **'Gedrag als signaal – Traumasensitief werken in de VVT'**
Online webinar – CCE
- 'Posttraumatische stress stoornis (PTSS) bij mensen met dementie- casuïstiek'**
Lezing en workshop - CCE middagsymposia
- 'Impact of (childhood) trauma in older adults'**
Symposium - Congres ESTSS in Belfast
- 'Diagnosing Posttraumatic Stress Disorder (PTSD) in people with dementia'**
Poster – Congres EPA

'Clinical manifestation and assessment of PTSD in people with dementia'

Symposium - ARQ Congres

'The diagnostic process of PTSD and the association with neuropsychiatric symptoms in individuals with dementia'

Symposium - Congres ISTSS in Los Angeles

'Trauma bij ouderen'

Lezing - tanteLouise paramedische dienst & medische staf

'Trauma bij ouderen'

(online) Webinar - tanteLouise zorgmedewerkers

2022 **'Posttraumatische Stress Stoornis (PTSS) bij mensen met dementie'**

Online masterclass – V&VN

'From diagnosis to intervention: PTSD in people with dementia'

Pitch – NP&PP Research day

2021 **'PTSS en dementie: lessen voor de praktijk'**

Online informatieve lezing - crowdfunding TRADE-study

'Van diagnose naar interventie: PTSS bij mensen met dementie'

Symposium - congres SCEM Psychiatrie en Dementie

