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Review

The Impact of Climate Change on Older Adults' Mental Health: A Primer for Clinicians

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Abstract

Climate change is a major public health emergency. Natural disasters (earthquakes, floods, hurricanes, tornadoes, tsunamis, landslides, wildfires, and volcanic eruptions) have been increasing in frequency and severity and can cause lasting psychological sequelae. Older adults are highly vulnerable to the physical and mental health impacts of extreme weather and natural disasters. A narrative review was conducted to identify and summarize English-language articles focusing on the impact of climate change on older adults' mental health. Sixty sources were identified. This review summarizes age-specific risk factors, clinical presentations (including anxiety, depressive, posttraumatic stress symptoms, and sleep disturbances), and management of psychiatric symptoms linked to climate change in the geriatric population. Older adults are highly vulnerable and can experience multiple mental health symptoms as a result of climate change. Clinicians should be aware and educated regarding the mental health impacts of climate change on older adults, so they can best support their patients.

Keywords

Older adults; climate change; mental health; natural disasters; posttraumatic stress

1. Introduction

Climate change is a major public health emergency, and health professionals are becoming more and more aware of its varied impacts on human health. The United Nations define climate change as "the long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. But since the 1800's, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil, and gas." [1] Natural disasters (earthquakes, floods, hurricanes, tornadoes, tsunamis, landslides, wildfires, and volcanic eruptions) are severe life-threatening stressors [2, 3]. In large part as a result of climate change, the number of weather-related disasters has increased fivefold in the past 50 years, with droughts, storms, floods, and extreme temperatures causing the largest human losses [2, 4]. Extreme weather events can be associated with posttraumatic sequelae similar to human-caused disasters (e.g., mass shootings, terrorist attacks, wars) but may also have additional downstream effects: property destruction (homes, businesses - leading to income loss, and other infrastructure), population displacement, loss of community support, and disruption of health care services [5, 6]. Additionally, extreme temperatures and slow-moving disasters, such as droughts, sea level rise, increases in water and soil salinity, and crop losses result in significant physical and mental health impacts [4]. Children, pregnant women, older adults, Indigenous populations, land workers, marginalized communities, economically vulnerable families, first responders, people living on low-lying territories, immigrants, and refugees are more likely to be exposed and vulnerable to the health impacts of climate change [4-9]. Moreover, uninsured and underinsured people have limited access to health care services at baseline. Lack of access to medical services is amplified in the aftermath of disasters, exacerbating health inequities [5, 6, 9-11]. In turn, health inequities amplify the impact of natural disasters on communities [5, 6, 9, 12].

The pathophysiological mechanisms through which climate change affects mental health are not yet fully understood, although there has been growing interest in this research area in the past two decades, particularly the last five years, as the national and global dialogue has intensified. This paper will focus on the mental health impacts of climate change (specifically, climate anxiety and symptoms associated with weather-related disasters) in older adults. Although highly vulnerable to the health impacts of climate change, the geriatric population is often overlooked. The purpose of this review is to increase clinician awareness regarding the age-specific risk factors, clinical presentations, and management of symptoms and syndromes linked to climate change in older adults and to provide suggestions for future work. Our aim was to provide practical information that clinicians can readily use when they are called upon to manage patients affected by these scenarios (in many cases, urgently) and to help improve their level of comfort and confidence, so patients have faster access to much needed mental health care. To our knowledge, no papers focusing on clinical presentations and management of climate-related mental health symptoms in older adults have been published to date.

2. Materials and Methods

A literature search was performed to identify studies focusing on the impact of climate change on older adults' mental health. The database PubMed was searched for articles published in English. Search terms included *older adult*, *aging adult*, *elderly*, *climate*, *climate anxiety*, *air pollution, natural disaster*, *wildfire*, *flooding*, *hurricane*, *mental health, anxiety*, *dementia, depression*, *posttraumatic stress*, and *sleep*. For the treatment section, the search included the terms *posttraumatic stress* and *psychotherapy* as well as specific medications that have shown efficacy in late-life posttraumatic stress disorder (PTSD) in general, e.g., *citalopram*, *mirtazapine*, and *prazosin* [13]. Case reports, case series, review articles, and grey papers presenting organizational position statements were included. There were also several randomized controlled trials (RCT) regarding management strategies. Additional articles were identified by examining the reference lists of the papers identified through the above search. Studies presenting adults of all ages were included, after reviewing the full text and/or tables and confirming that they included older individuals. Studies not listing participant ages or focusing on younger adults only were excluded, as were studies related to extreme temperatures, slow-moving disasters, and man-made disasters. Articles on these topics were retained if they illustrated broader points, such as vulnerability or resilience. Most sources defined older adults as people aged 60 or 65 and older. Several articles focusing on individuals aged 50 or older were included if they were particularly relevant or if they had been included in prior meta-analyses and it was not possible to disaggregate the data. Throughout this paper, the terms *older adults*, *aging adults*, *elderly*, *late-life*, and *geriatric population* were used interchangeably, as were *weather-related disasters* and *climate disasters*.

A narrative review was conducted, summarizing findings. Figure 1 depicts the PRISMA flow diagram for literature search and article selection [14].

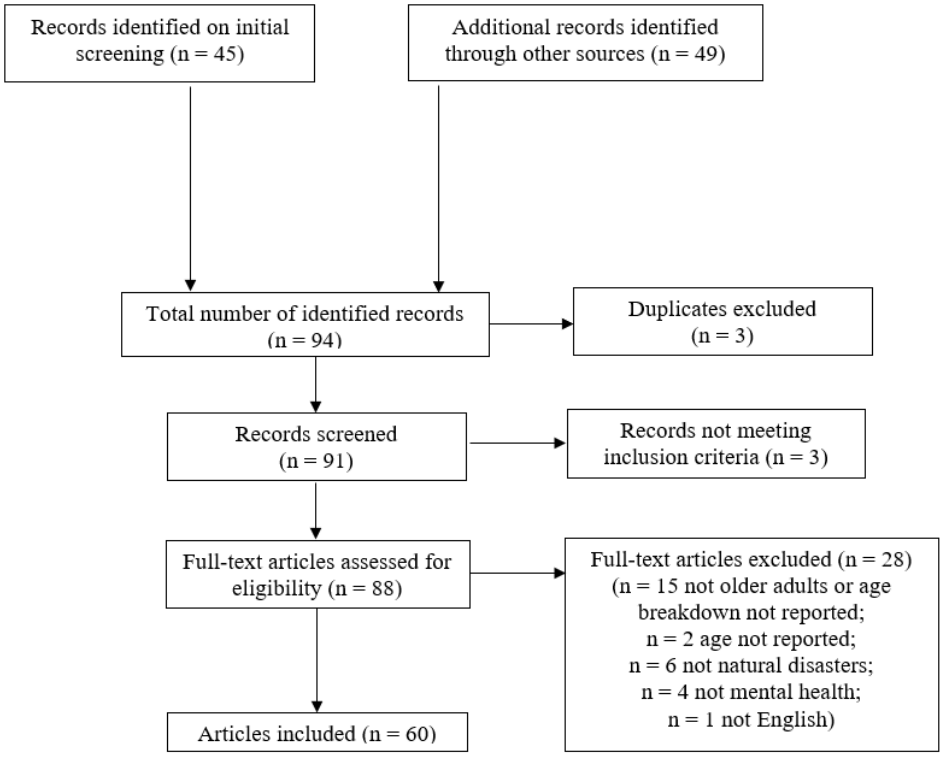

Figure 1 PRISMA flow chart of literature search and article selection.

3. Results

We identified 60 sources through the search strategy described above. All were published in the last twenty years, reflecting the growing interest in this topic, as well as the higher number and impact of natural disasters. The results of the narrative review are presented below.

3.1 Older Adults' Vulnerability to the Health Impacts of Climate Change

Older adults are more likely to be exposed to and highly vulnerable to the physical and mental health impacts of heat waves, extreme weather events, and air pollution [15-17]. A number of physiological and psychosocial factors contribute to this heightened vulnerability, namely chronic medical or neurological conditions (e.g., cardiac disease, respiratory problems, cerebrovascular accidents, Parkinson's disease), sensory (e.g., vision, hearing) impairments, cognitive deficits, polypharmacy, and psychiatric illness. Additionally, linguistic isolation, living alone, having limited social support, and not having access to reliable transportation can all limit mobility and affect older people's ability to receive or understand evacuation orders and get to safety during natural disasters.

In a U.K. registry-based study of 22,562 deaths, individuals with dementia, psychosis, and substance misuse (particularly alcohol) had a 4.9% higher risk of death for each additional 1°C above the 93rd percentile of the annual temperature average [18]. Additionally, short-term exposure to air pollution and to higher ambient temperature has been linked to an increased number of psychiatric hospitalizations among older adults [19].

3.2 Mental Health Impacts of Climate Change in Older Adults

Older adults can experience multiple mental health difficulties in response to fast- and slow-moving climate disasters. For purposes of this review, the search was narrowed to air pollution and natural disasters. Posttraumatic stress and depressive symptoms or disorders have been best studied. The sources reviewed also highlighted anxiety symptoms or disorders, adjustment disorders, cognitive deficits, and sleep disturbances. These mental health aspects will be detailed below, classified by climate-related variables.

3.2.1 Air Pollution

Accumulation of greenhouse (heat-trapping) gases in the atmosphere contributes to air pollution, as well as further global warming [4]. Poor air quality can exacerbate or cause cognitive deficits, and social determinants of health intersect with and amplify this age-related susceptibility. A study of approximately 12,000 adults aged 50 years or older living in Metro Atlanta area revealed that low socioeconomic status neighborhoods were most vulnerable to air pollution [20]. This finding has been replicated in many places, in the U.S. and abroad [9].

The French Tri-City cohort prospectively followed approximately 6,000 adults aged 65 or older (median age, 73.4 years) for up to 12 years. Exposure to particulate matter with diameter smaller than 2.5 μm ($PM_{2.5}$) was significantly associated with global cognitive decline over time [21]. Another French team conducted a cross-sectional examination of cognitive functioning in a large cohort of approximately 220,000 adults aged 18-69 [22]. This study also revealed a significant association of exposure to black carbon, nitrogen dioxide (NO_2), and $PM_{2.5}$ with cognitive deficits among those aged 45 years or older [22]. The evidence linking ambient air pollution to cognitive

impairment has been so convincing that the Lancet Commission has recently included it among the modifiable risk factors for dementia [23]. Neuroimaging studies have also revealed an association of long-term exposure to $PM_{2.5}$, NO_2, and ozone with increased risk for late-life depression [24, 25], as well as a potential correlation of $PM_{2.5}$ exposure with burden of amyloid-beta plaques in the brain [26].

3.2.2 Natural Disasters

A systematic review and meta-analysis found that aging adults were 2.11 times more likely to develop PTSD and 1.73 times more likely to experience adjustment disorders after being exposed to natural disasters compared to younger individuals, although this review included only six older studies, focused on earthquakes and tsunamis in Asia and Australia [27]. Other studies found age to be protective against developing post-disaster PTSD [28, 29]. About 6% of older individuals may experience delayed onset of posttraumatic symptoms and a slower recovery following natural disasters; this has been associated with a greater number of post-disaster stressors and traumas [30].

Aging individuals who escaped wildfires reported a high prevalence of anxiety, depression, insomnia, nightmares, and PTSD [31-34]. Older age, female sex, and having an imminent fear of death were independently associated with insomnia among survivors of wildfires in Greece [33]. Proximity to and experience with the fires can mediate PTSD symptom severity, although this association has not been specifically found among older survivors [35].

Older adults affected by hurricanes and floods may experience clinically significant anxiety, depressive, and PTSD symptoms, as well as suicidal ideation or plans [11, 12, 36-42]. A rich body of research regarding the mental health impact of floods and hurricanes, including in aging adults, has emerged after Hurricane Katrina, which brought catastrophic floods to Louisiana, Mississippi, and Alabama in 2005, Hurricane Sandy, which struck the Eastern U.S. in 2012, causing widespread damage and human loss, and Hurricane Maria, which left behind widespread devastation in Puerto Rico in 2017. The relevant studies are summarized in Table 1. Several notable health inequities emerged in this regard. Hispanic ethnicity was significantly associated with higher PTSD symptom levels among survivors of 2004 Florida hurricanes, but only in younger, not older adults [29]. Older adults with PTSD symptoms and hypertension had a higher risk of developing new cardiovascular events (cerebrovascular accidents, myocardial infarction, congestive heart failure exacerbation, or cardiovascular death) 1-2 years after Hurricane Katrina [43]. This association was found among Blacks, but not Whites.

Table 1 summarizes details of the 21 primary sources identified on air pollution and climate disasters. Grey papers, review articles, perspectives, and other sources were discussed in text only.

Table 1 Summary of primary sources describing the impact of air pollution and natural disasters on older adults' mental health.

Author, year	Location, context	Study type, population	N	Age (years) Mean ± SD[a]	Psychiatric symptoms/diagnoses	Findings
Air pollution						
Duchesne et al., 2022 [21]	France	Longitudinal prospective (up to 12 years)	6,380	>65 Median (IQR), 73.4 (8.0)	Cognitive deficits	Exposure to $PM_{2.5}$ significantly associated with MMSE score decline over time
Zare Sakhvidi et al., 2022 [22]	France	Cross-sectional population-based cohort	61,462	>45 57.79 ± 7.13	Cognitive deficits	Higher exposure to black carbon, NO_2, and $PM_{2.5}$ significantly associated with deficits in semantic fluency and executive function
Petkus et al., 2022 [24]	USA	Cross-sectional WHIMS cohort	764 women	81.6 ± 3.6	Depressive symptoms	Higher exposure to $PM_{2.5,}$ NO_2, and ozone in the prior 3 years significantly associated with depressive symptoms
Qiu et al., 2023 [25]	USA	Longitudinal cohort	1,526,690	73.7 ± 4.8	Late-onset depression	Long-term exposure to $PM_{2.5,}$ NO_2, and ozone significantly increased depression risk
Wildfires						
Binet et al., 2021 [31]	Fort McMurray, Alberta, Canada Wildfires	Cross-sectional (12-14 months post-disaster)	356	Range, 55-87	PTSD and depressive symptoms, insomnia	Overall: 50% PTSD symptoms, 58.5% depressive symptoms, 57.4% insomnia (age-disaggregated data not reported) Older participants less likely to receive psychological care than younger ones

Halcomb et al., 2023 [34]	Australia Bushfires	Cross-sectional (28-31 months post-disaster)	155	Range, 65-90+	Anxiety symptoms; self-rated health status; resilience	86.2% respondents felt anxious about the fires; 57.2% reported the fires negatively affected their mental health
North et al., 2008 [32]	Oakland/ Berkeley, California, USA Wildfires	Longitudinal (4, 16, and 39 months post-disaster)	62	56.6 ± 12.8 Range, 34-82	GAD, panic disorder, MDD, PTSD, alcohol and drug use disorders[b] Temperament traits[c]	Overall: PTSD intrusion symptoms (59%) and hyperarousal symptoms (60%) associated with low self-directedness and high harm avoidance TCI scores (age-disaggregated data not reported)
Psarros et al., 2017 [33]	Greece Wildfires	Cross-sectional (1 month post-disaster)	92	58.1 ± 15.8	Depressive and PTSD symptoms, insomnia	98% had depressive symptoms; no MDD Older age associated with insomnia
Hurricanes & floods						
Acierno et al., 2006 [29]	Florida Hurricanes (multiple)	Cross-sectional (8-10 months post-disaster)	1,130 vs. 413	71.0 ± 7.9 42.9 ± 10.5	GAD, depression, and PTSD symptoms[d]	Older adults reported lower rates of PTSD, depression, and GAD symptoms than younger adults
Corley et al., 2022 [11]	New York City area, New York, USA Hurricane	Cross-sectional (1-4 years post-disaster)	411	71.7 ± 9.3	PTSD symptoms, probable anxiety and depressive symptoms[e]	Lack of access to medical care strongly associated (ORadj = 4.11) with PTSD symptoms, but not with other mental health symptoms
Heid et al., 2016 [42]	New Jersey, New Jersey, USA Hurricane	Cross-sectional (8-27 months post-disaster)	88 (44 with PTSD vs. 44 without PTSD)	Range, 56-80	Depressive symptoms 4-6 years pre-disaster; PTSD symptoms post-disaster	Participants with PTSD reported more depressive symptoms, chronic health problems, functional disability, and pain 4-6 years prior to hurricane exposure compared to those without PTSD
Heid et al., 2017 [39]	New Jersey, New Jersey,	Longitudinal prospective (up to 33 months)	2,205	59.86 ± 6.83	PTSD symptoms Social cohesion, social control	Greater storm exposure linked to higher levels of PTSD symptoms

	USA Hurricane			Range, 54-80		Social cohesion, but not social control, was protective against PTSD symptoms
Kessler et al., 2008 [36]	New Orleans, Louisiana, USA Hurricane	Longitudinal (5-8 months and 1 year post-disaster)	815 total[f]	≥60	Anxiety and mood disorders, suicidality	Prevalence of PTSD (20.9 vs 14.9%), suicidal ideation (6.4 vs 2.8%), suicide plans (2.5 vs 1%) increased over time (age-disaggregated data not reported)
Pietrzak et al., 2012 [37]	Galveston Bay area, Texas, USA Hurricane	Cross-sectional (2-5 months post-disaster)	193	69.2 ± 7.6 Range, 60-100	PTSD and depressive symptoms; perceived needs for psychological care	Past-month prevalence of PTSD symptoms 7.6% and of depressive symptoms 8.6%; 27.2% endorsed at least one perceived need for psychological care
Pietrzak et al., 2012 [38]	Galveston Bay area, Texas, USA Hurricane	Longitudinal (2-5, 5-9, 14-18 months post-disaster)	151	≥65	PTSD, GAD, MDD, panic disorder, suicidality, alcohol use disorders	Past-month PTSD prevalence declined over time (6.9% vs 2.5%); past-month prevalence of GAD, panic disorder, depression, and suicidality remained relatively stable over time
Pietrzak et al., 2013 [30]	Galveston Bay area, Texas, USA Hurricane	Longitudinal prospective (up to 15 months)	206	69.2 ± 0.5 Range, 60-92	PTSD symptoms	78.7% no PTSD symptoms; 16% chronic, clinically significant symptoms; 6.3% delayed onset of clinically significant symptoms
Sirey et al., 2017 [12]	New York City, New York, USA Hurricane	Cross-sectional (24 months post-disaster)	1,512	75.1 ± 8.3 Range, 60-100	PTSD and depressive symptoms	14% clinically significant depressive symptoms; 5% suicidal ideation; 24% hurricane-related flashbacks Depressive symptom rates varied with age: - Younger-old (60-74 years): 17.5% - Older-old (≥75): 11.3%

Stukova et al., 2023 [40]	Puerto Rico, Hurricane	Cross-sectional (3-12 months post-disaster)	212	60+	Anxiety, depressive, and PTSD symptoms	Older adults had lower anxiety, but higher depressive and PTSD symptom rates than younger adults
Swiatek et al., 2022 [41]	Puerto Rico, Hurricane	Cross-sectional (6 months post-disaster)	523	60.2 ± 14.8	Depressive symptoms, suicide risk, perceived lack of safety	20.6% depressive symptoms, 9.9% suicidality, 14.5% feeling unsafe (as proxy for anxiety)

[a] Unless otherwise specified.
[b] Diagnoses established using the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition revised (DSM-III-R).
[c] Measured using the Temperament and Character Inventory.
[d] Diagnoses established using the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV).
[e] Measured using the Patient Health Questionnaire-4 (PHQ-4).
[f] Age breakdown not reported.
GAD = generalized anxiety disorder; IQR = interquartile range; MDD = major depressive disorder; MMSE = Mini-Mental State Examination; NO_2 = nitrogen dioxide; ORadj = adjusted odds ratio; $PM_{2.5}$ = particulate matter with diameter smaller than 2.5 µm; PTSD = posttraumatic stress disorder; SD = standard deviation; TCI = Temperament and Character Inventory; WHIMS = Women's Health Initiative Memory Study.

There are few studies regarding the mental health impact of post-disaster relocation on aging adults, and even fewer focused on older climate refugees (people forced to leave their homes due to climate change). Post-disaster displacement has been associated with high rates of PTSD, anxiety, and depressive symptoms [29, 44]. Forced relocation can also compound feelings of loss and grief, particularly among those with a strong sense of place attachment [7, 45]. Moreover, patients with dementia relocated to unfamiliar environments can experience confusion and exacerbation of underlying cognitive deficits. A prospective study of elderly individuals temporarily relocated after the Great East Japan Earthquake and Tsunami of 2011 who were followed for up to 42 months found that the percentage of cognitively impaired people significantly increased over time [46]. Aging adults who became socially isolated also had a significantly higher rate of depressive symptoms 6-8 years after the earthquake, compared to those who were not isolated [47].

3.3 Psychotropic Medication Effects with Extreme Temperatures

Older individuals are more susceptible to dehydration which, in turn, can lead to renal injury, hypovolemic shock, and seizures. Dehydration can also increase circulating levels of medications resulting in toxicity (for example, with lithium). Even though people of all ages can easily become dehydrated during heat waves, older adults are at higher risk, due to several physiological factors: decreased sweating, diminished thirst sensation, lower total body water and plasma volume, reduced glomerular filtration rate, and lower cardiac output, resulting in less blood flow to the skin and extremities [48]. Additionally, older adults may restrict fluids to avoid frequent urination when taking diuretics. Chronic medical conditions and polypharmacy also play a role.

Many psychotropic medications can increase the risk of heat stroke, as follows [48, 49]:

- Anticholinergics, antihistamines, tricyclic antidepressants and other agents with anticholinergic properties reduce sweating;
- Antipsychotics reduce sweating and affect thermoregulation;
- Amphetamines raise the base body temperature;
- Beta-blockers and sympathomimetic agents affect vasodilation of skin capillaries, not allowing heat to be released;
- Diuretics cause dehydration;
- Nonsteroidal antiinflamatory agents and angiotensin converting enzyme inhibitors can impair renal function;
- Laxatives may cause electrolyte imbalances;
- Thyroid hormones increase metabolic heat production.

These aspects should be kept in mind, and older adults counseled on the increased risk of heat stroke when prescribing the above agents.

3.4 Climate Anxiety in Older Adults

Even people who have not experienced natural disasters may develop anxiety when witnessing the ecological devastation and anticipated threats posed by climate change (eco-anxiety) [8, 10]. Climate anxiety is a facet of the wider phenomenon of eco-anxiety and refers to anxiety specifically linked to anthropogenic (human-caused) climate change and its impact on the environment [10, 50, 51]. The American Psychological Association defines climate anxiety as “the chronic fear of environmental cataclysm that comes from observing the seemingly irrevocable impact of climate

change and the associated concern for one's future and that of next generations" [10]. Although more prevalent among youth, climate anxiety can also occur in older individuals [10, 52]. It is important to note that climate anxiety and eco-anxiety are not considered psychiatric disorders and are therefore not included in current diagnostic classifications, although symptoms can become severe enough as to cause functional impairment [8, 51].

3.5 Older Adults' Resilience Regarding Climate Change

Despite all the challenges outlined, aging adults are quite resilient. They help maintain a coherent sense of identity for their families and are often leaders in rebuilding destroyed communities. Their psychological strength and resourcefulness can help guide younger generations. Research exploring older adults' post-traumatic growth and resilience in the aftermath of natural disasters is scarce. Many studies have focused on risk factors for post-disaster PTSD instead, defining resilience as the absence of PTSD symptoms [38, 42, 53, 54]. These risk factors were reviewed in detail by Kellis et al. [55]. Moreover, although measures of older adult resilience when facing health challenges and life stressors have been developed [56-58], evidence-based indicators for post-disaster resilience have not yet been clearly established [59]. Approaches to quantifying potential contributory factors such as social capital and social cohesion also vary. These research gaps make it difficult to characterize the climate disaster-related resilience construct [54].

Individual and community factors that contribute to older adult post-disaster resilience include:

- life experience (including prior exposure to natural or human-caused disasters, such as the World Trade Center attacks preceding Hurricane Sandy; this has been termed "inoculation hypothesis") [29, 60, 61]; more specifically, prior disaster exposure was protective against PTSD, but increased risk for depression following climate disasters [37]
- social cohesion and social capital [29, 34, 39, 53, 60, 62-64]
- positive emotion and optimism [60, 65]
- history of mastering challenges [65]
- positive religious coping skills [66]
- perceived quality of the neighborhood green space [67].

Social cohesion (reflecting the trust and connections among community members) mediated the association between disaster exposure and PTSD symptom severity among New Jersey residents exposed to Hurricane Sandy [39]. Social capital (the ability to mobilize resources based on one's relationships and position within the social group) was cited as an important resilience contributor by ten older adults (age range 67-83) displaced by two successive floods in Brisbane, Australia [60]. Having a high structural social capital (participation in organized activities) reduced the odds of developing PTSD after flooding in a Japanese sample of older women, although the opposite was true for older men [62]. In a survey of 272 adults aged 18-98 who were living in Houston in areas affected by Hurricane Harvey, a greater perceived quality of the neighborhood green space was significantly associated with lower risk of developing PTSD and hurricane-related distress 2 years later [67]. Higher emotional resilience levels mediated the effects of perceived green space quality on hurricane-related distress measures.

3.6 Management of Climate Change-Related Psychiatric Symptoms in Older Adults

There are no studies specifically focusing on the management of climate anxiety or natural disaster-related symptoms in older adults, although several reports have included adults of all ages. This section draws on the general adult literature, extrapolating recommendations. There is limited evidence for the effectiveness of specific therapeutic approaches for eco-anxiety. Hasbach [68] recommended expanding the initial therapeutic interview to include the patient's relationship with nature and incorporating strategies to reconnect with nature, such as assigning between-session nature-based homework or holding therapy sessions outdoors. Feder and colleagues [69] suggested a four-step approach: *normalizing* climate-related feelings and providing a safe space to process these; *cognitive restructuring* (trying to shift away from catastrophic thinking) and understanding that, although the future is uncertain, small actions taken in the present can have profound effects in complex systems ("the butterfly effect"); *building or enhancing emotional resilience*; and taking individual or collective *purposeful action* to mitigate and adapt to climate change. The ability to live with ambivalence and accept one's ethical responsibility, while keeping things in perspective, is an important psychological task when dealing with climate change [8]. Baudon and Jachens [70] conducted a scoping review of treatment interventions for eco-anxiety. Cognitive-behavioral therapy, mindfulness-based cognitive therapy, psychodynamic psychotherapy, and motivational interviewing were among the approaches studied, although the strength of the evidence varied [70]. As mentioned above, climate anxiety may be less prevalent in older adults; as such, this area requires further exploration.

With regard to the management of post-climate disaster symptoms, appropriate triage of older adult survivors and prompt linkage to resources and services are crucial [12, 71, 72]. Screening for psychiatric symptoms, including for the survivors who were exposed, but not directly affected by the disaster, is recommended, coupled with a risk stratification approach that can guide prioritization and resource utilization. Psychological first aid has been shown to be beneficial and well-received by disaster survivors and to increase provider confidence, although it has not been specifically studied in connection to older adults [73]. In the study conducted by Sirey et al. [12], Hurricane Sandy survivors were offered up to 6 free sessions of Engage, a supportive therapy modality coupled with behavioral activation. The intervention effectiveness was not reported.

Cognitive-behavioral therapy (CBT) has best evidence in the treatment of mental health symptoms following natural disasters, including for aging adults [74-77]. A modified intervention called CBT for post-disaster distress (CBT-PD) was effective for individuals with moderate-to-severe PTSD symptoms in the aftermath of Hurricane Sandy, and benefits were maintained at 2 years [77].

Based on the evidence available to date, pharmacological management of late-life climate-related PTSD does not appear to differ from that of other posttraumatic stress syndromes. First-line agents are selective serotonin reuptake inhibitors or serotonin–norepinephrine reuptake inhibitors [78]. Mirtazapine as monotherapy, titrated up to 45 mg/day, was not significantly better than placebo in a 16-week (8-week double blind phase, followed by 8-week open label) randomized trial of veterans with PTSD [79]. Prazosin, an α_1-adrenergic blocker, is used for patients with PTSD-associated nightmares, although evidence has been mixed and is not age-specific [80, 81].

4. Discussion

There is a paucity of research addressing the specific mental health needs of older adults in the context of climate change, although the number of published studies has increased in recent years. Studies performed in the wake of natural disasters predominate, with very few explorations of climate anxiety in aging individuals. There is also insufficient evidence regarding management strategies for post-disaster mental health symptoms. This narrative review summarized age-specific risk factors, clinical presentations (including anxiety, cognitive, depressive, and posttraumatic stress symptoms, and sleep disturbances), and management of psychiatric symptoms linked to climate change in the geriatric population, based on the evidence available to date.

The strength of the evidence and study designs varied widely. The study design was most often cross-sectional, performed at different intervals after the traumatic event, ranging from one month [33] to 16 years [63]. There were only five longitudinal prospective studies [30, 32, 36, 38, 39]. Sample sizes varied widely as well, ranging from ten to hundreds or thousands of individuals. Several epidemiological studies were included [18-22]. In particular, the two French investigations linking air pollution to cognitive impairment drew their findings from large population-based cohorts [21, 22], and one followed participants for up to 12 years [21]. The sources reviewed were international, originating from the U.S. [4, 11, 12, 19, 20, 25, 29, 30, 32, 35-39, 42, 44, 53, 61, 64-67, 71, 73], Puerto Rico [5, 40, 41, 72], Canada [7, 31], Australia [16, 34, 45, 60], Europe [8, 18, 21, 22, 33], and Asia [46, 47, 62, 63, 75]. Several articles were specifically focused on older adults, including the oldest-old [11, 12, 29-34, 36-39, 41, 42], four of which also surveyed people over 90 years of age [12, 30, 34, 37]. The majority recruited adults of all ages, with a smaller representation of the higher age segments, while some did not present the age breakdown, so it was difficult to draw age-specific conclusions. Most studies did not have control groups. Several authors stratified participant samples by age (although subgroup sizes were not always comparable, which limited statistical power for comparing mental health outcomes), and one study compared 44 older adults with PTSD to 44 without [42].

This review focused on air pollution and its impact on cognitive functioning, given the emerging research and relevance of this association, and post-disaster psychopathology, due to its salience and prevalence. PTSD and depression have been best studied among post-disaster mental health syndromes. One advantage of PTSD research is that most authors used the standardized, validated Posttraumatic Stress Disorder Checklist (PCL) [82] or Diagnostic and Statistical Manual of Mental Disorders (DSM), although PTSD criteria were revised in the latest DSM edition [83]. Twelve-month PTSD prevalence for adults 60 years of age and older in the general population is 1%, and it tends to decrease over time [84, 85]. There is no clear estimate of late-life post-disaster PTSD rates, although a recent systematic review indicated an all-age prevalence of up to 52% of survivors [86]. In this review, past-month PTSD prevalence was 7.6% [37], while point prevalence shortly after hurricane exposure was 20.9% (age-aggregated data) [36]. In contrast, anxiety and depressive symptoms were measured with various instruments, so results were more heterogenous and difficult to summarize.

As Table 1 shows, investigations of hurricane survivors from the U.S. mainland (Katrina and Sandy) were better represented, whereas the literature on Hurricane Maria in Puerto Rico and disasters in other parts of the world was less robust. The 2022 devastating floods in Pakistan, which affected an estimated 33 million people, left 89,000 displaced, and led to an increase in suicides [87] were a

tremendous tragedy. Yet, few related reports were identified in PubMed, and none regarding older adults specifically. This may reflect more limited research resources, the broad infrastructure destruction, hindering access to affected communities, or publishing in non-English language journals. Another observation about the Katrina-focused studies is that multiple teams used the same dataset, reporting various aspects of the data collected.

Half of the primary sources reviewed reported the participant race/ethnicity breakdown [11, 12, 29-31, 36-41, 53], of which three only showed the White/Caucasian and non-White/Caucasian subsamples. Minoritized populations are more vulnerable to the mental health impacts of climate change [4-10] as well as other types of disasters [28] and more likely to live in areas with the highest projected levels of climate change impacts with 2°C of global warming or 50 cm of global sea level rise [88]. Only three of the studies we reviewed identified racial differences, which is an extremely low number, considering the widespread societal and health inequities present in the U.S. Other authors found higher rates of depressive [89] and PTSD [90] symptoms in Blacks compared to Whites following Hurricane Katrina. However, the racial difference in depressive symptoms was no longer significant after controlling for other socio-demographic factors [89]. The association of race with post-disaster mental health outcomes has not yet been fully elucidated; structural racism is most likely an important mediator [59, 90, 91]. Moreover, only three of the studies explored the Indigenous perspectives: one focused on the Inuit in Nunantsiavut, Canada [7], another included First Nations members [31], and the third surveyed members of Aboriginal communities in New South Wales, Australia [45]. Several additional studies included Native American/Alaskan people, but no specific results were shown, most likely due to small sample sizes. An extensive exploration of the intersection of social determinants of health with age-related climate change impacts was beyond the scope of this paper, although this area clearly deserves attention and has been the focus of recent research and presentations at professional meetings [9, 91, 92]. Given the health inequities discussed above, having a cadre of culturally proficient trauma recovery providers would be ideal [75, 93]. However, there are few climate-aware clinicians available currently, let alone culturally proficient, trauma-informed ones. As such, it is imperative to develop international curricula and training programs for mental health professionals interested in supporting climate disaster survivors from all backgrounds and countries [94].

Most of the primary sources were quantitative (typically surveys), although several teams conducted qualitative, in-depth interviews with individuals affected by climate anxiety or weather-related disasters [7, 45, 60]. High-quality qualitative studies exist, but only a few met criteria for inclusion, since these typically refer to individual or group perspectives regarding climate change, not so much to mental health presentations. Qualitative studies, which often require a great deal of effort, planning, and community involvement, are important contributions and should be targeted for inclusion in future reviews. This approach could also bring to light the minoritized groups' perspectives, which may be diluted in larger samples.

While the impact of natural disasters on older adults' health has been relatively well studied, there is a dearth of research regarding the management of associated psychiatric symptoms, as well as explorations of climate anxiety in aging individuals. In particular, pharmacological management of late-life post-disaster psychiatric symptoms is woefully under-researched. There are complex pharmacokinetic and pharmacodynamic considerations with the geriatric population, and additional aspects (such as dehydration, electrolyte imbalances, or displacement leading to partial medication adherence) need to be considered in the aftermath of natural disasters. There are also

insufficient attempts to characterize climate and health-related inequities; these aspects are very important and should be prioritized on future research agendas.

This study has several limitations. First, we conducted a narrative review. While systematic reviews provide a higher level of evidence, they are not always the best approach for multifaceted, clinically oriented questions. Recent approaches have suggested using systematic reviews as lenses through which evidence is appraised and summarized to use in clinical practice [95]. The field of climate psychiatry, and climate health in general, is just emerging, and the literature focused on older adults is limited and heterogenous. Table 1 shows there were only 15 non-duplicate primary sources focusing on mental health clinical presentations related to natural disasters in older adults. The remainder were studies pertaining to vulnerability, resilience or management strategies, gray papers, reviews, perspectives, or duplicates investigating the same samples which did not bring any additional information. Of note, several excellent scoping or systematic reviews on mental health aspects related to climate disasters exist [54, 86, 96], although no recent ones focusing on older adults and all the clinical aspects we sought to cover here. The extant reviews informed the outline of this paper, which was followed by branching literature searches for each sub question identified. Second, we excluded most studies that pertained to slow-moving disasters (extreme temperatures, drought). These phenomena cause food insecurity and economic downstream effects, which tend to affect women, children, and older adults disproportionately [4, 10, 91]. Future reviews can shed light on mental health aspects related to slow-moving disasters, as well as earthquakes, which were only briefly covered here. Another limitation is that only English-language publications were included; this is a common weakness of similar reviews [96]. Climate change has global impacts; hence, non-English language literature provides important perspectives and should be included in future work. Lastly, this is a single-author paper, which could have led to bias in source selection.

5. Conclusions

In summary, older adults are highly vulnerable and can experience multiple psychiatric symptoms as a result (or in anticipation) of climate change. As extreme weather events become more frequent and severe, we can expect that every healthcare professional who cares for older adults will encounter such clinical scenarios. All clinicians should be aware and educated regarding these mental health presentations, so they can best support their patients. Here we aimed to provide a primer for clinicians who need to care for such patients immediately. This review can also serve as a starting point for future research, which will in turn inform best practices.

Author Contributions

The first author designed the study, conducted the literature review, and wrote the manuscript.

Competing Interests

The author has declared that no competing interests exist.

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